NIGHTHAWK F-117A™

STEALTH FIGHTER 2.0

INSTRUCTION MANUAL

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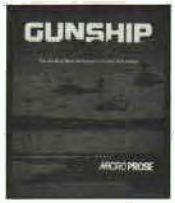

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F-117A
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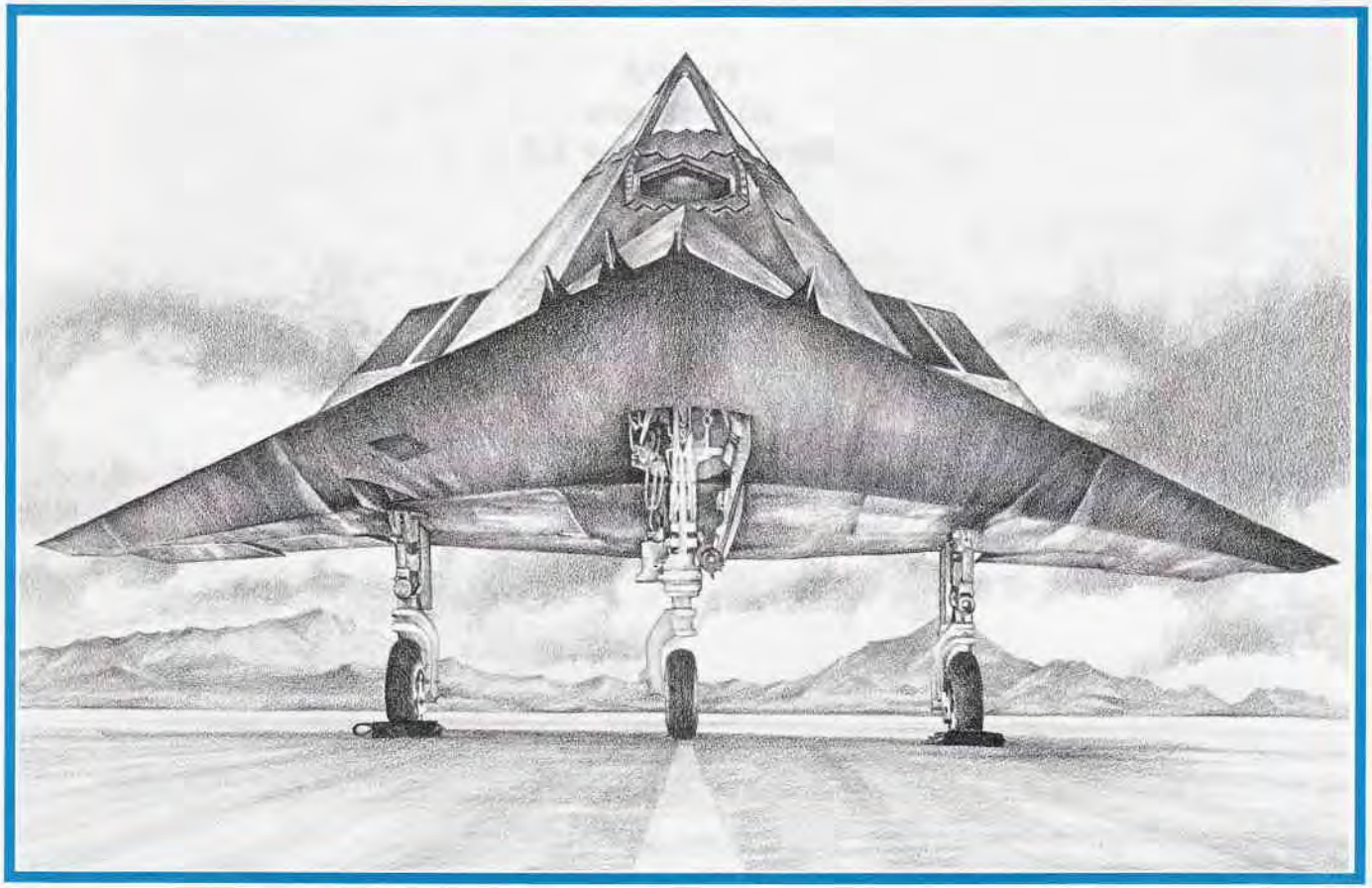

MICROPROSE™
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MicroProse Entertainment Software, Inc.

F-117A
Nighthawk
Stealth Fighter 2.0

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A NOTE TO PLAYERS OF F-19 STEALTH FIGHTER

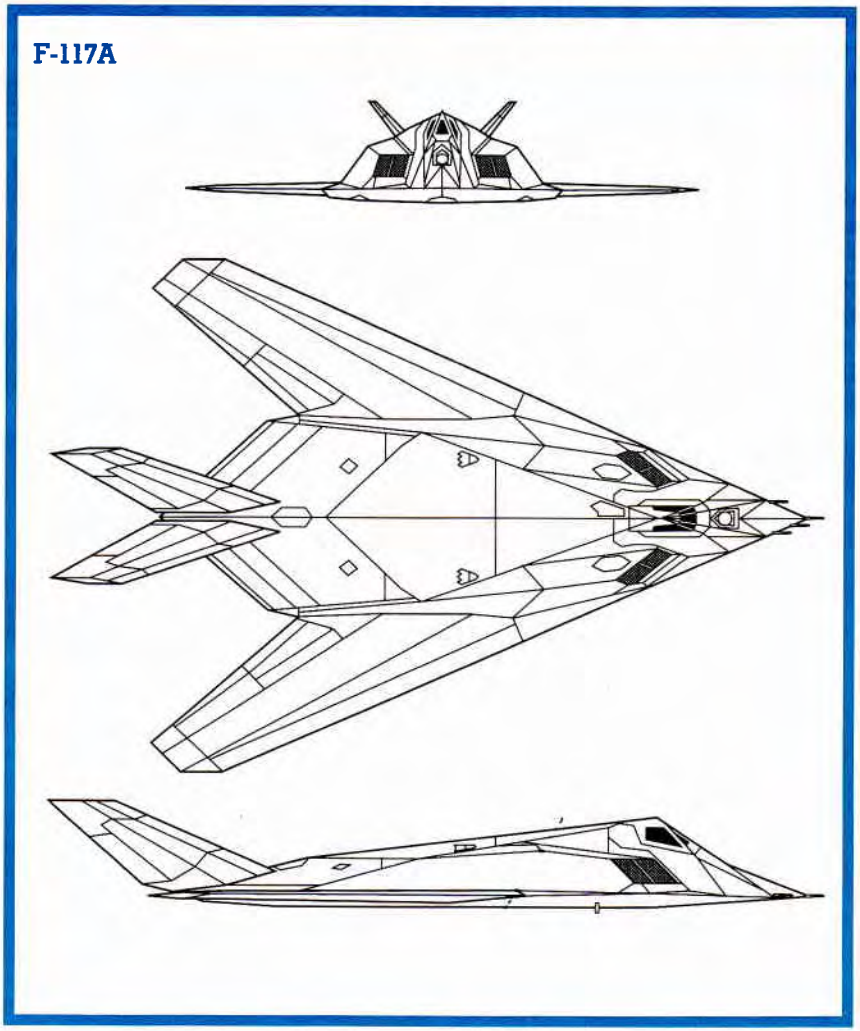
Congratulations on purchasing *F-117A Stealth Fighter 2.0* from MicroProse. We are proud to bring you this upgrade of our classic game *F-19 Stealth Fighter*. That game has been one of the most successful combat flight simulators ever developed. It has won just about every award that is given for entertainment software, and we think we know why: *F-19* had excellent game-play — it was FUN!

Because of this, *F-117A* keeps that same great game-play and brings you the very latest in flight simulation technology and graphics. We've upgraded the entire package from head to toe, but we've kept the basic features of *F-19* intact.

So if you're already familiar with F-19 Stealth Fighter, you should be able to jump right into the cockpit and start flying stealthy sorties right away.

But be careful, the enemy is smarter, your plane is a little more responsive, you fly almost all your sorties at night, and there are more new missions than you can hope to complete in a lifetime of flying.

We hope you enjoy it!



F-117A DATA

Dimensions

Wingspan	43 ft 4 in	(13.21 m)
Length overall	65 ft 11 in	(20.09 m)
Body length	55 ft 1 in	(16.78 m)
Height	12 ft 5 in	(3.78 m)
Wing/body area	1070 sq ft	(100 sq m)

Powerplant

Two General Electric F404-F1D2 nonafterburning engines

Thrust	10,600 lb	(47.1 kN)
Bypass ratio	0.34:1	
Weight	1,820 lb	(825 kg)

Weights

Max take off	52,500 lb	(23,810 kg)
Internal fuel	13,000 lb	(5,895 kg)
Weapon load	4,000 lb	(1,815 kg)
Operating empty	35,000 lb	(15,875 kg)

Estimated Performance

Max Mach number	0.95	
Max speed at sea level	560 kt	(1,040 km/h)
Max speed at 35,000 ft	545 kt	(1,010 km/h)
Cruising speed	460 kt	(850 km/h)
Combat radius*	500 nm	(930 km)

**"Unlimited" with inflight refueling*

INTRODUCTION: F-117A NIGHTHAWK

TARGET IRAQ

BAGHDAD, January 17, 1991 –The still darkness of early morning suddenly gave way to the flash and roar of exploding bombs. Iraqi anti-aircraft artillery (AAA) batteries began firing wildly into the sky, not knowing what or where their targets were. Operation Desert Storm had begun.

Within a few short moments, key Iraqi early warning radar sites, control centers, and communication links were destroyed by unseen attackers. The attackers – US F-117A "stealth" fighters – had flown through hundreds of miles of heavily defended Iraqi airspace undetected, and hit their targets with precise timing and pinpoint accuracy. Almost instantly, the Iraqi air defense command found itself deaf, dumb, and blind.

The performance of "stealth" fighters during the first day of the war alone was enough to vindicate the "black" (secret) programs that had led to their development and construction. On the first day, the F-117As – which comprised only two and a half percent of the coalition's combat air forces – accounted for 31 percent of the Iraqi targets hit. The impact of these raids assured the air supremacy of the allied air forces, and allowed them to strike with impunity anywhere within Iraq and Kuwait.

That a single type of aircraft, unremarkable in its speed and maneuverability, and built almost in direct conflict with the long-held conventions of aircraft design, could have such a decisive effect on the outcome of a war is almost unbelievable. Other technological breakthroughs have proven decisive in war: the machine gun, the tank, and the airplane are all examples. But advantages gained by these advances were so quickly cancelled by other breakthroughs that they had little time to make any significant impact. The Norden bombsight, for example, was an impressive technological achievement that was quickly made obsolete by other technology – like the atom bomb.

RADAR WARS

In the 1920s and early 1930s, the bomber was believed by many to be the ultimate weapon. Theorists like Italy's General Guilio Douhet believed that massed bomber raids would be unstoppable – bombers would be overhead and dropping their bombs before they were sighted, and well on their way home before fighters could be scrambled to intercept them.

But in the late 1930s, the work of Sir Robert Watson-Watt and other researchers resulted in a practical method of detecting aircraft well in advance of their arrival – radio detection and ranging, or "radar." Radar allowed defenders to not only detect enemy aircraft, but to obtain information on the strength of a raid, its speed, and its course.

Radar detects objects by transmitting a high-energy radio pulse. The signal bounces off the object, and the reflected signal is detected by the radar's antenna. The direction from which the reflected signal comes and the time difference between when the pulse was transmitted and the return of the reflected signal are used to determine the bearing and range of the object.

Early ground radar installations proved to be a decisive factor in World War II, notably during the Battle of Britain (1940-1941). The Royal Air Force was able to effectively scramble interceptor fighters to meet Nazi bombing raids and turn the tide of the air war because of the information provided by early warning radar sites. Soon, radar systems became accurate enough to be used to control ground-based anti-aircraft artillery (AAA), and compact enough to be used aboard aircraft. Within a few years, night fighters were able to engage and shoot down enemy aircraft that they never saw.

Targeting radar systems used a constant wave rather than a pulse to track the target, and used two antennas – a transmitter and a receiver. The targeting radar tracked its quarry by centering the signal reflected by the target in its beam, and "locked on" to it, constantly correcting its beam to follow the target's movement. Since the wave was constant, shifts in the signal's frequency caused by the movement of the target – the "Doppler effect" – could be detected by the receiver antenna. The wavelength of the radio wave is compressed by an object moving toward the radar, and stretched out by an object moving away – like the sound waves from the whistle of a passing train. A "Doppler shift" of the returning radar, therefore, could be used for moving target indication (MTI). Modern search radar systems also have this capability.

Surface-to-air missiles were quickly developed that could follow the targeting radar beam to their intended target. These "beam riders" sensed the reflection of the targeting radar off the enemy aircraft, and homed in like bloodhounds. The sky was quickly becoming an increasingly dangerous place.

STEALTHY PLANES

Since the Second World War, evading or negating radar has been a top priority of aircraft designers and air forces. Most efforts relied on active countermeasures – jamming of radar signals, use of "chaff" (strips of aluminum or fiberglass) to create false radar returns, and the use of anti-radar weapons – to eliminate the threat of enemy air defense radar. In addition to these active methods, many aircraft (like the FB-111, B-1, and the British Tornado) were designed specifically to fly close to the ground, using terrain features and the curvature of the earth to avoid detection by radar.

Still, the increasing sophistication and sensitivity of radar systems, radar-guided missiles and air defense systems continued to complicate the lives of pilots. The development of digitally controlled radar systems, like the "phased-array" radar systems used in the Navy's Aegis system, the Patriot missile system and many other modern air defense systems, has made it difficult to jam or otherwise neutralize the effectiveness of such systems. These radars can increase signal strength to "burn through" jamming, change the frequency of their pulses randomly to counteract chaff and other electronic countermeasures, and digitally enhance returned signals.

Evasion of radar by flying close to the terrain was made more difficult by the development of airborne early warning systems (AEWS) like the US Air Force's AWACS system, and by the development of "look-down" radar for fighter-interceptors. These airborne radar platforms can detect aircraft flying at very low altitudes, and have a much longer detection range than ground-based systems simply because they are in the air.

In addition to the improvements in radar technology, the introduction of computers into air defense systems made the latter more efficient and effective. Computers and information technology have increased the flow of information through command structures and have decreased the reaction time of defensive systems to incoming attacks.

Today, "electronic warfare" has become as important as the delivery of weapons. Electronic countermeasures are pitted against counter-countermeasures, as both defender and attacker attempt to render each other's electronic systems impotent. Attack aircraft must be escorted by specialized electronic warfare aircraft and must carry their own countermeasures as well.

"Stealth" technology takes another approach to reducing the threat posed by enemy radar. Rather than depending on electronics, the physical design of the "stealth" aircraft is its main radar countermeasure. Two factors in the design of an aircraft play a part in how well it can be detected by a radar – the amount of surface area it presents to the radar, and the reflectivity of that surface. The range at which an aircraft (or any object) can be detected is in part determined by the amount of reflective surface it presents to the radar, or its "radar cross-section" (RCS). As the radar cross-section of an object is decreased, the range at which it can be detected is decreased. By decreasing the RCS of an aircraft, it is made less vulnerable to detection by enemy radar. The main design barrier to reducing the RCS of aircraft has been the difficulty in modeling the design to predict it.

In addition to decreasing the cross-section of an aircraft design, designers can decrease the aircraft's probability of detection by making it less reflective of radar. By using special materials that absorb radio waves, an aircraft can reduce its radar reflection. In this way, radar-absorbent materials (RAMs) effectively reduce the aircraft's RCS, making it less detectable.

RAMs were developed during the Second World War on both sides – the Germans used one type of RAM on the snorkel tubes of their U-Boats to prevent them from being detected by airborne radars. Still, RAMs alone are only partially effective in reducing reflected radar signals, and may not appreciably change the RCS of an object by themselves.

"Stealth" technology relies on a combination of these two methods – reducing RCS by design and reducing reflectivity by RAMs. The first marriage of the two came in the form of an experimental aircraft produced by Lockheed's top-secret "Skunk Works" in the early 1960s. That aircraft, the A-12, became the prototype for the premier reconnaissance aircraft of the 20th Century – the SR-71 Blackbird.

The A-12 came in response to a call from the CIA for a replacement for the U-2 spy plane. To reduce its radar cross-section, the A-12 featured a slender profile, the elimination of vertical flat surfaces, and flared sides. Saw-toothed indentations in the leading edge of the A-12's wings were designed to deflect radar waves away from the transmitter. In addition, the entire aircraft was painted with a radar-absorbent paint called "iron ball."

The radar cross-section of the A-12 was only 0.015 square meters – about one-thirtieth the RCS of a conventional fighter. Still, the A-12 was far from being invisible to radar. While the A-12 had a fairly small radar cross-section head on, it presented a huge radar and infrared target from behind. It had large, open titanium and steel jet exhaust nozzles and afterburning engines. This did not pose much of a problem, though, since the A-12 could outrun anything fired at it from behind – it flew at Mach 3.5 at an altitude of 95,000 feet. By the time it could be detected by radar, there was little time left for any reaction, and by the time air defenses could be brought to bear, the A-12 would be long gone.

F-117A NIGHTHAWK

Lockheed built upon its experience with the A-12 and its offspring, the SR-71, in the development of the F-117. In the mid-1970s, the "stealth" concept was revived in reaction to the world political climate and the need for a "special operations" aircraft. Key to the success of the design was the concept of a "faceted" surface, with no curved surfaces anywhere on the aircraft.

The reason for the faceted design of the F-117 lies in the equations of James Clerk Maxwell, a Scottish physicist. Maxwell's equations can predict how a body of a given shape will scatter or reflect electromagnetic radiation (such as radio waves). With relatively simple shapes, the results are relatively easy to calculate.

In an aircraft with an "aerodynamic," curved surface, the complex shape and gradual curves of the aircraft make applying Maxwell's equations a feat at which even the most powerful supercomputer may balk. However, if all the curves are removed from the design and replaced with geometric facets, the reflection pattern becomes

much easier to predict. Using computer modeling, aircraft designers were able to create a design with practically no radar cross-section. The combination of its shape and RAM give the F-117 an RCS of between 0.01 square meters and 0.001 square meters, depending on the radar. (This is roughly the same RCS as a small bird or insect.)

With the flat surfaces of a faceted design, radar pulses are only reflected back to the radar when they strike the surfaces dead-on (at 90° angles). All of the F-117's surfaces are tilted at least 30° away from vertical, so almost all radar signals will be bounced upward or downward. While a look-down radar may detect the aircraft if it is 30° above it, the radar would have to be at extremely close range at that angle.

While the faceted surface of the F-117 makes it nearly invisible to radar, it also makes the aircraft extremely difficult to fly. In fact, without the aircraft's computerized control system, it would be impossible to fly at all. Rather than being directly connected to the control surfaces of the aircraft, the pilot's controls are connected to four computers, which in turn move the control surfaces. This type of control system is commonly referred to as a "fly-by-wire" system.

The design of the F-117 not only minimizes the aircraft's detectability by radar, but by all other means as well – infrared, optical, and electronic surveillance. The aircraft is painted flat black – it is designed specifically for night operations – and its engine exhausts are shielded to minimize their heat signature. And the aircraft has no radar of its own, so it cannot be detected by electromagnetic sensors.

Since it has no radar, the F-117 relies heavily upon its inertial navigation system and its infrared sensing equipment to get it over the target and deliver its weapons on target. The F-117 uses a laser designator, its forward-looking and downward-looking infrared (FLIR and DLIR) to guide its "smart bombs" to their targets. With the assistance of AWACS aircraft, the F-117 can use its FLIR to target hostile aircraft as well, though its anti-air capability is somewhat limited without radar-guided air-to-air missiles.

All of the F-117's weapons are carried internally, in twin bays along its center line. This is necessary to maintain the constant RCS of the aircraft. While this limits the weapons load of the F-117, it makes up for it in accuracy and surprise.

The Air Force already is planning significant upgrades to the F-117. If the budget allows, 40 new aircraft may be added to the existing 56 planes in service. One of the possible additions to the new F-117 is a stealthy radar system, which may give the F-117 similar radar capabilities to the F-15. Another possible sensor for the upgraded F-117 is an Infrared Search and Track (IRST) system – a wide-scanning infrared sensor that can track targets much like radar, but without any emissions to detect.

WHAT NEXT?

There are no clear answers to the "stealth" problem for air defense system designers. If there are any solutions already tested, they are highly classified. While highly speculative, these are some of the possible "next steps" for air defense systems in reaction to stealth technology: within the limits of present technology, the best way to detect aircraft like the F-117 is from above. Look-down radar systems have a much higher likelihood of detecting stealth aircraft than ground-based radar, simply because of their angle of attack.

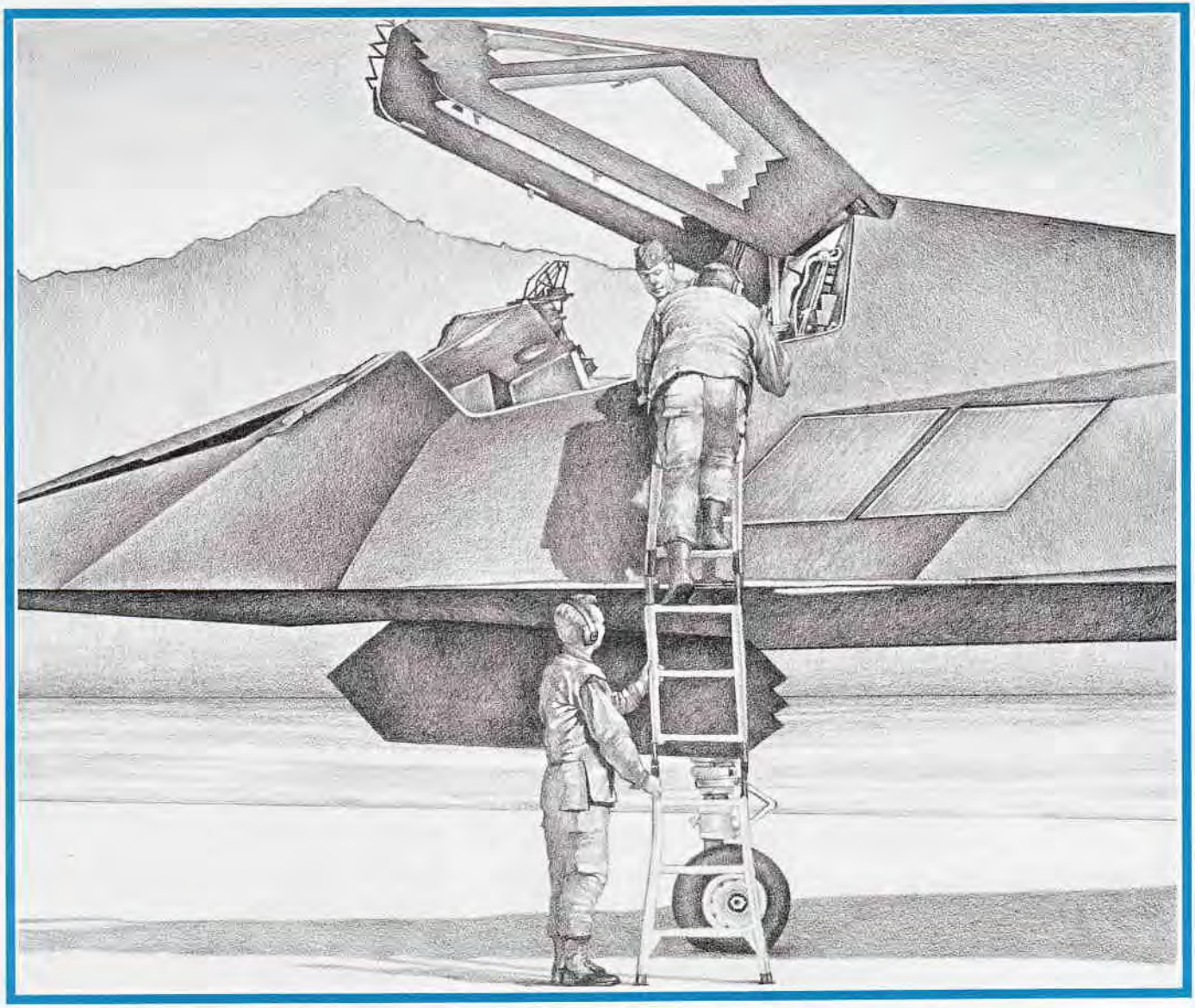
Still, stealth aircraft are high-altitude flyers by nature, and a counter-stealth look-down system would have to be at a fairly high altitude to have much of a chance at long-range detection of them.

One possibility is an airborne early warning system based on aerostats, or blimps. Aerostat radar systems are already used by the US as regional AEW platforms for drug interdiction in the Gulf of Mexico and Caribbean; while these systems operate at comparatively low altitudes, the technology might be adapted to the high altitude AEW role.

Another possibility is a sort of radar "trip wire" system. While ground-based radar signals may be bounced away from their origin by the angled surfaces of the F-117, a ring of secondary radar receivers at long range from the main radar might be able to pick up such deflected signals. Such a receiver would not be able to give altitude or course information about an aircraft, but it might give air defense commanders a fair approximation of bearing and range from the main radar and some warning of an impending "stealth" attack. Other sensors could then be brought to bear on the suspected aircraft and, in the worst case, backup systems could be prepared to come on line.

While stealth aircraft are designed to deflect or absorb radio waves, they are not designed to do the same to laser beams. There has been much discussion of possible LADAR (laser detection and ranging) systems that operate in a fashion similar to search radars, scanning the sky with laser energy and looking for laser light bouncing off of objects to determine their direction, range and speed. Such a system in an air early warning role would require a huge amount of energy and would probably incinerate anything that got too close to it (though that may be a positive effect, too).

Clearly, though, stealth technology will force air defense planners to seriously rethink their strategies. It has already made nearly every air early warning system in the world obsolete, and has permanently changed the complexion of air strike doctrine. Already, designers are struggling with this new problem. Who knows what will come next? Perhaps the people at Lockheed's "Skunk Works" do.



1 F-117A TUTORIAL

YOUR FIRST MISSION

FLYING TO THE TARGETS AND BACK

This tutorial guides you through your first stealth mission. You'll fly from an aircraft carrier in the Mediterranean Sea into Libyan airspace. There you'll destroy a surface-to-air missile (SAM) radar installation. This mission is a practice run, and flying it is not required; it's purely a convenient way to help you learn to use your F-117A. If you prefer to study the aircraft before you fly, go directly to Chapter 2, page 27.

Before you start, install the game onto either floppy disks or a hard disk (see "Installation" in the Technical Supplement for details). You can run the game without installation, but no information is saved. Now load the installed game into your computer (see "Loading" in the Technical Supplement for details).

Terminology

Each key control has a name in *italics*, and is followed by a parenthesized label, indicating which key is referred to by the name. The italicized names used in this manual also appear on the keyboard overlay.

Controller refers to the pointing device you use. This may be a joystick, mouse, or cursor keys. We strongly recommend you use a joystick to fly the aircraft, and a mouse to make selections on the starting screens. Only a joystick or the keyboard may be used to fly the airplane; however, any of the above may be used to make selections from the starting screens.

Selector refers to the Left Mouse Button, Joystick Trigger, Return key, or Enter key, depending on your hardware setup. When the manual says to press the *Selector*, this means to press the button (or Return key) of whatever hardware you're using.

Preflight Briefing Options

Answer the Aircraft Identification Quiz: Check pages 164-172 of this manual to see which aircraft is illustrated.

Pilot Roster: After answering the quiz, you are shown the Pilot Roster, where you must enter a name. Use the *Controller* to move the arrow cursor over the name you want to erase (note that the names highlight as the cursor moves over them). Press the *Backspace* key to erase the highlighted name, type your own name, and press the *Selector*.

A form now appears to the right of the screen, on which you can set some difficulty level options. Since this is your first mission, accept the default options, by selecting "Form Complete" at the bottom. Then select "Exit" from the lower right of the screen.

Ready Room: You now find yourself in the pilots' Ready Room, where pilots wait to be given orders. Notice that there are several doors which you can enter. But for now, simply move the arrow to the Briefing Room door and tap the *Selector*.

Intelligence Briefing: When you enter the Briefing Room, you are automatically assigned a mission. The briefing map shows the general topography of the area, your takeoff point (T), your primary (P) and secondary (S) targets, and your landing point (L). To the right is a menu of options. Select "Mission Brief" to read a detailed description of what you are expected to accomplish. Then press the *Selector* again to see the remainder of the summary, which describes your flight plan and the rules of engagement under which you are operating. Now press the *Selector* again to return to the briefing map.

You may wish to investigate the other options on this map. If so, see "Briefing Room" on page 33 for details. When you are finished studying your mission assignment, choose "Select Weapons" from the menu.

Arming Room: Next you are shown the weapons your crew chief suggests you use for this mission. You could override his decisions and take different weapons, but for this training exercise, take his advice and choose "Go To Hangar" from the menu at lower right.

Hangar: You're now in the Hangar, where your F-117A is being fueled and loaded for the mission. Select "Yes" from the requestor that asks if you're ready.

The Cockpit Console and HUD

Place the appropriate overlay on your computer keyboard. It shows all the controls for your F-117A.

The Cockpit Console: The lower half of your screen represents the cockpit console of the F-117A. The various elements are described on pages 40-54. We suggest you toggle through the various displays on the Multi-Function Displays (MFDs) to get familiar with them.

The left MFD has two map displays. Tap *Maps* (F3) to toggle between them. The right MFD displays either a camera view of the outside world or a data screen. The data displays include:

Weapons (F5): The weapons currently in your weapons bays.

Select Way Pt (F7): A list of the current INS waypoints, including the one you're currently being steered toward.

Change Way Pt (F8): A list of the four INS waypoints, which you can change on the satellite/radar map (on the Left MFD).

Reset Way Pt (Shift F8): resets waypoints to the initial defaults.

Mission (F10): A brief summary of your mission orders.

The Tracking Camera views also appear in the right MFD and show a zoom TV image of a target, with its name, range, and bearing superimposed. The camera is limited to a range of 80-100 kilometers (km). You have these viewing options:

Cam Ahead (/): Aims the camera at the nearest standard target ahead.
Cam Rear (>): Aims the camera at the nearest standard target behind.
Cam Left (<): Aims the camera at the nearest standard target to your left.
Cam Right (M): Aims the camera at the nearest standard target to your right.
Select Target (B): Cycles through all standard targets in the current direction.
Designate New Targ (N): Aims forward camera at nearest target (any type) ahead.

For more information on the target tracking-camera system, see page 45.

The HUD: The upper half of your screen represents the transparent HUD (heads-up display), through which you can see the world beyond. The various symbols and numbers are described in Chapter 2, on pages 40-44.

The HUD has three operating modes: NAV for navigation, AIR for aerial combat, and GND for ground attacks. Tap *HUD Modes* (F2) to cycle through the three settings. Note that in AIR and GND modes the symbols that appear depend on the currently selected weapon. Tap *Select Weapon* (Space Bar) to cycle through your weapons. If you're unsure of what weapons you have on board, tap *Weapons* (F5) to see a display of your four weapons bays, and what they contain.

Hints

To get the most out of this tutorial, remember three things:

There is no danger: Since this is a training mission, enemy weapons are harmless. You've chosen the "No Crash" option, so you can't crash into the ground. Further, you have an automatic radar altimeter that keeps you above 200'. However, it only makes mild corrections, and is helpless against truly wild maneuvers.

Use the "Pause" Key: To best use this tutorial, pause the game – tap *Pause,* (Alt/P) – and read the next few paragraphs, then "un-pause" (tap any key) and resume the action. Whenever you're confused, pause and consult the manual for help.

Resupply if you need it: In training missions, you can get an infinite supply of fuel and ammunition. Each time you tap *Resupply* (Alt/R), your fuel tank is filled and your ammunition is increased to the maximum possible level.

Preflight Checklist

Check the Inertial Navigation System (INS). Tap *Maps* (F3) until the satellite/radar map is displayed on your left MFD. Next tap *Select Way Pt* (F7) to display the INS waypoints list on the right MFD. Look up on the HUD and note on the horizontal heading scale (along the top of the HUD) the location of the INS cursor (blue triangle). You must fly in this direction to reach the first waypoint (see page 53 for details).

Check Armament: Tap *Weapons* (F5) to display the weapons in your bays on the right MFD. As you use *Select Weapons* (Space Bar) to cycle through the weapons, note the active weapon message in the lower left corner of the HUD.

Extend the Flaps: Tap *Flaps* (9). Note the "FLAPS" indicator light in the upper right section of the console. Flaps give you more lift during takeoff.

Check the Catapult: When launching from an aircraft carrier, as you are now, the brakes must be set. This represents the aircraft's attachment to the carrier's catapult system. If the "BRAKE" light is not illuminated on the console, tap *Brake* (0) to set the brakes and engage the catapult.

Start the Engines: Turn on your engines by tapping *Max Pwr* (Shift +). Notice the digital throttle power readout increase to 100 in the lower right of the console (this represents 100% power).

Activate Catapult: When the throttle readout shows 100% power, tap *Brake* (0) to release the brakes and catapult your F-117A off the deck.

Accelerate Past Stall Speed: As you zoom down the deck, watch the speed scale (left side of the HUD) carefully. A bar on that scale will gradually drop down. This is the Stall Speed Indicator. When the Stall Speed Indicator bar drops below the center tick on the scale your plane is past stall speed and you're travelling fast enough to climb into the sky.

Climb: Once you're flying more than 10 knots (kts) faster than stall speed, pull back on the stick to point your nose skyward, then release the stick. Watch the altitude scale on the right side of the HUD; you'll start climbing. Don't climb so steeply you lose sight of the horizon because you may stall. You must start climbing by the time you reach the end of the carrier deck, or you may get wet.

Retract Landing Gear: Once airborne, immediately tap *Gear* (6) to retract your landing gear. Don't leave the gear down – high speeds can rip it off.

Retract Flaps: Tap *Flaps* (9) to retract your flaps. You no longer need extra lift.

Flight to the Primary Target

A Light Touch: Use a light touch on the *Control Stick*. The most common pilot error is a "ham fist" on the stick, throwing the plane wildly around the sky. Use small motions on the stick; the F-117A is very responsive.

Chasing the Gauges: When you roll an aircraft left or right, pitch it up or down, change the throttle, the flaps, or the brakes, it takes a moment for the plane's new situation to be reflected by the gauges. Good pilots fly by making a change, then wait a few seconds to see the results. If you don't, you'll just "chase gauges" that are still changing.

Level Flight: Once airborne, try to achieve level flight. Push the control stick forward or back until the horizon is level across the middle of the HUD and the Flight Path Indicator (see page 42) rests on the horizon. Then make fine adjustments until you're neither gaining nor losing altitude.

Since this is a stealth mission, you want to fly between 500' and 1,000'. Look at the altimeter (vertical scale on the right side of the HUD). If you're above the "1k" mark (1,000') you're too high. Push the nose down into a gentle dive until you reach the desired altitude. Then level out and again place the Flight Path Indicator on the horizon.

Flying on Course: Look at the heading scale across the top of your HUD, find the INS cursor (the small, bright triangle above the top), and turn toward it. As you turn the triangle will move toward the center of the heading scale; when the triangle is in the center of the scale you're "on course" to the first waypoint.

To turn, gently pull the stick left or right. The plane will bank. Release (center) the stick when the bank angle is about 45°. To increase the rate of turn you can pull back on the stick a little. As you do this, watch your speed (on the left of the HUD) and altitude (on the right). A turn with back pressure can slow your plane and cause it to lose altitude, so don't pull back too much. *Minimum safe altitude* is about 200'. However, in this training mission stay at 500'.

Minimum safe speed varies with the current status of your aircraft. The Stall Speed Indicator bar rises from the bottom of the speed scale when you travel too slowly. If this bar reaches the center tick-mark of the scale, your plane is stalling (the "STALL" light will flash and you'll hear an alarm). A stall causes the plane to fall out of control, so try not to stall the plane. If you do, lower your nose to regain airspeed, then pull out into level flight.

Autopilot: If you're confused about which direction to fly, and how to do it, tap *Autopilot* (7). It takes over immediately, turning you onto the correct course. If you're below 500' the autopilot will climb to that altitude. If you touch the control stick the autopilot automatically turns off.

Enjoy Yourself: Once on course, enjoy yourself by trying out all the views.

You can see out the front, rear, and sides of the cockpit canopy using *View Ahead* (Shift /) *View Rear* (Shift >), *View Left* (Shift <), and *View Right* (Shift M). These views assume you are inside the cockpit looking out.

You can also "step outside" your aircraft and watch it using *Slot View* (shift F1), *Chase Plane* (shift F2), and *Side View* (shift F3). Bank the plane left and right to observe the difference between the chase plane and slot views. *Missile View* (Shift F4), *Tacti View* (Shift F5), and *Invrs Tacti View* (Shift F6) are used in combat situations. See page 36 for more detailed description of these options.

You can return to the cockpit at any time; just tap *Cockpit* (F1).

Passing the First Waypoint: When you reach the first waypoint a message appears on the HUD: "Waypoint 1 Reached." Your INS system immediately switches to the next waypoint (the INS cursor jumps to the new heading), which is your primary target. If you have changed the waypoints, tap *Reset Way Pt* (Shift F8) to reset the waypoints to the default settings.

Extra Fuel: You'll notice that one of the four items in your weapons bay is an extra fuel tank. This is because the mission from CV *America*, to Tripoli, and then to Sigonella in Sicily, is a very long trip.

To see your fuel status, tap *Select Way Pt* (F7). The bar gauge across the bottom shows the fuel on hand. The black area at right represents fuel already consumed. The four color-coded bands in the middle represent the amount of fuel needed to reach each of the four waypoints (fuel calculation is based on your current altitude and speed). The final band to the left represents the amount of reserve fuel available.

Your engines cannot draw fuel directly from the extra tank in your bay, so you must pump it from the extra tank into the main tank. To accomplish this, tap *Select Weapons* (Space Bar) until extra fuel is the current "weapon" ("EXTRA FUEL" appears in the lower left corner of the HUD). Now tap *Fire Weapons* (Return key) to "fire" the fuel from the spare into the main tank. If you tap *Select Way Pt* (F7) again, you'll see the fuel status has changed.

Accelerated Time: You can speed the passing of time by tapping *Accel Time* (Shift Z). This doubles the rate at which time passes. To return to normal time, tap *Norm Time* (Shift X). If you forget to return to normal time, don't worry; combat activity or lowering your gear returns you to normal time automatically.

Attacking the Target

Once you're well past the first waypoint and the coast of Libya is on the horizon, it's time to start thinking about hitting your primary target.

Check the Tactical Situation: Switch your left MFD to the gridded tactical map by tapping *Maps* (F3). Your target is a radar site, so look for a radar symbol on this map.

Acquire the Target: Switch your HUD to GND (Air-Ground) mode by tapping *HUD Modes* (F2) until the GND light below the HUD illuminates, then tap *Cam Ahead* (/). If your target does not appear in the right MFD, tap *Select Target* (B) until it does. If you cycle through all possible targets and still don't see the primary target, you're either too far away for your targeting system to see it, or you're somehow flying in the wrong direction.

Select your Weapon: Tap *Select Weapons* (Space Bar) until the message "2 Maverick" appears in the lower left of the HUD.

Wait for Missile Lock: When you've acquired the target, you'll see a box on the HUD. This is the "Tracking Box;" the radar site that appears on the right MFD is in the center of this box.

Missile Lock: When you get within missile launch range, this box changes to an oval; in addition, the red "LOCK" light on your console begins flashing, and a box (the "Lock Box") appears in the middle of the right MFD.

Optimal Missile Lock: If you wait longer, the Tracking Oval turns red and the "LOCK" light ceases flashing and becomes solid; the Lock Box in the right MFD will begin to collapse repeatedly. These indicators signal that "Optimal Launch Range" has been reached and that the missile should be launched immediately.

Launch Altitude: If you launch a weapon while flying too low, you may be caught in the blast area, or a missile may hit the ground before its motor can power it up and away. A simple rule to get you started is that missiles and retarded bombs require at least 500' altitude, free-fall and laser bombs 3,000'.

Launch: When you reach "Optimal Launch Range," open the weapons bay by tapping *Bay Doors* (8), then launch the missile by tapping *Fire Weapon* (Return). After launching, turn away slightly, since flying through an exploding target could damage your aircraft.

Shortly thereafter the missile should hit the target. A successful hit causes a fire and sends a cloud of smoke up into the sky. You get a report on your HUD (sent from an observing AWACS) about the success of the attack.

The Secondary Target: You can now fly to the secondary target (use the INS cursor as a guide) and attack it as well, using the same procedure. Or, if you wish, call it quits and head for home.

The Return Trip

Setting the INS to the Landing Point: Tap *Reset Way Pt* (Shift F8) to insure the default waypoints are loaded in your INS (inertial navigation system), then tap *Select Way Pt* (F7). Now examine the list of waypoints on the right MFD. There are four waypoints listed. If the fourth one is not highlighted, tap *Next Point* (Keypad Shift 3) until it is highlighted. This switches the INS to that point. The last point on the default list is always your return base.

Flying Home: You can either use the autopilot or manually fly home. As before, guide yourself using the INS cursor. When the INS cursor is lined up on the center of the heading scale, you're on course.

If you look at the map (Tap *Maps* (F3)) until the Satellite map appears on the left MFD), you'll notice there's a small island (Malta) just south of Sicily. You should steer just east (to the right) of Malta. As you near Malta, tap *HUD Modes* (F2) to change your HUD to NAV mode, then tap *Cam Ahead* (/). If the Sigonella airbase comes up on the right MFD, fine; this is your destination! However, it's likely that Halfar airfield on Malta will appear instead (it's closer). Tap *Select Target* (B) until Sigonella appears.

Landing at Sigonella Airbase

Level Flight: About 50 km from Sigonella, start lining up your landing approach by achieving level flight at 500' to 1,000' altitude.

ILS: Turn on the Instrument Landing System (ILS) by tapping *ILS* (F9). A horizontal and vertical bar appear on your HUD, representing your position relative to the "glide slope." The glide slope is an imaginary line extending out and up from the runway. First you'll line up beneath this glide slope then follow it down onto the airbase. For more details, see page 54.

Line Up Your Approach: If the vertical bar is left or right of your Nose Indicator, turn in that direction until the bar starts moving toward the center. You want to get back onto a heading of 000° just as the bar centers on the Nose Indicator. Don't worry if the bar is a little off center; as long as Sigonella is dead ahead the vertical bar will gradually creep toward the center. If the bar moves away from center, however, you're travelling away from the glide slope – turn the other way to correct your course.

Reduce Speed: Now cut your throttle back to about 50% by tapping *Decr Pwr* (-) a few times. To maintain level flight while your speed decreases, pitch your nose up slightly (but watch the altimeter on the right side of the HUD, you don't want to gain altitude).

Extend Flaps: When your speed reaches about 300 kts, extend your flaps by tapping *Flaps* (9). This slows you further by giving you more lift. You'll have to readjust the nose a little to maintain level flight.

Lower Gear & Reduce Speed Again: Tap *Gear* (8) to lower your landing gear, and cut the throttle to about 40% power. As your speed gradually decreases you'll have to raise the nose to maintain level flight. By this time you should be close to the glide slope, and travelling about 200 to 250 kts with your speed still decreasing.

If you're moving too fast, tap *Brakes* (0) to extend your airbrakes, then a few seconds later, tap it again to close them. Do not leave the airbrakes open, as this may cause you to stall and crash.

Intercept the Glide Slope: As you get near the airfield, the horizontal ILS bar on the HUD begins to move downward. When the bar approaches the Nose Indicator, pitch your nose down a little. Your objective is to go into a gradual descent that keeps the bar aligned with the Nose Indicator. Watch the Angle of Attack Approach Indexer to determine how much to raise or lower your nose: if the up-arrow is illuminated, pitch up a little; if the down-arrow is lit pitch down (the goal is to have the green cicle in the center lit). To avoid gaining speed in the descent, tap *Decr Pwr*(-) again to reduce your power.

If your speed is too slow, look at the Stall Speed Indicator (the colored bar rising from the bottom of the airspeed scale). If the stall bar is close to the middle of the scale, you're getting into trouble. Tap *Incr Pwr* (+) key once or twice.

As the airstrip comes up, check your speed. You should be travelling between 150 and 200 kts, or decreasing from 250 kts toward 200 kts. If your speed is above 250 kts, you're coming in too fast. Tap *Max Pwr* (Shift +), raise your landing gear, and retract flaps; you try again. Fly to Malta, turn around, and start over.

Touchdown: If your speed is correct (150-200 kts), start watching the altimeter. It should be at 100' to 300' and decreasing. Make small adjustments with the control stick to keep the descent rate steady, but not too fast. The runway is at 0' altitude. When you hear the squeal of your wheels on the pavement, tap *Brakes* (0) instantly, then shut off the engines by tapping *No Pwr* (Shift -). You've made a safe landing.

YOUR SECOND MISSION

DEALING WITH THE ENEMY

On your second practice mission you'll learn about enemy radar, aircraft, and missiles. When you get back to the Ready Room, go straight back into the Briefing Room. You'll be assigned the identical strike against a Tripoli radar station, but this time you're going to worry about the enemy too.

Mission Planning: Before takeoff, check out the intelligence briefing in more detail. Highlight the *Radar Sites* option on the menu and select it. Now use your controller to move the arrow around the map. As it passes over radar site icons, information about missile defenses at the site appears. If you select one of the icons, the effective range of the search radar at that site appears as a circle. You can select any or all of the sites at will and turn the range of each site on and off individually. Each solid circle is a Doppler radar, each dotted circle a pulse radar.

This screen helps you plan a route to Tripoli and back. Remember, the waypoints set in your F-117A's INS outline the default route shown on the map. You may wish to fly a better route, to evade enemy detection as much as possible.

Basically, you avoid detection by Doppler radars if you arc around them, keeping a constant range to the radar. You avoid detection by pulse radars if you fly directly toward or away from them. For more information about radar, see page 74.

When you're finished, you should have a mental "map" of where enemy radars are, how you'll fly through them to avoid detection, and what weapons you'll use to achieve your objectives.

Adjusting Waypoints: When you are on the carrier deck awaiting takeoff, you may wish to adjust the waypoints to fit your own mission plan. The first waypoint, by default, is half-way between your takeoff point and the primary target. Most pilots adjust this point.

To make adjustments, tap *Maps* (F2) until the satellite map appears on the left MFD. Then tap *Change Way Pt* (F8) to display the waypoints list on the right MFD and the plotted flight plan on the left MFD. Use the *Adjust Waypoints* keys (Keypad/Shift 2, 4, 6, and 8) to move Waypoint 1 around the satellite map. Notice the course line automatically "snaps" to the new waypoint as you move it. If you don't like your adjustments, tap *Reset Way Pt* (Shift F8) to reset all the waypoints to the initial default.

Flying to the Target: After takeoff, as you fly to the target, watch the radar patterns on the left MFD satellite map.

Enemy radar signals are displayed as arcs on this map. Dotted arcs represent pulse radar; solid arcs, Doppler. Ground search and AWACS radars are expanding circles, while all aircraft radars and ground tracking radars are short arcs.

Missiles and aircraft appear on the Left MFD satellite map as color-coded dots: red dots represent aircraft, black dots are ground radar sites, yellow dots are enemy missiles.

You'll notice that enemy aircraft with their forward-facing radars may complicate your original plan for penetrating enemy air defenses. You'll have to sneak behind or beneath them.

Flying Stealthy: Now that you understand the situation, watch the Electromagnetic Visibility (EMV) scale (below the Left MFD). The "visibility" of your plane to enemy radar appears as a thick, red bar extending from the right of the scale. Your visibility increases with altitude, higher speed, open bay doors, lower gear, or use of jammers. To keep your EMV small, you should fly low (about 200'), keep your gear up, bays closed, and jammers off; you should also fly toward or away from pulse radars, and at a constant distance (arcing around) from Doppler radars.

The thinner bars extending from the left of the scale represent incoming enemy radar signals. Enemy ground-based radar (EGR) signals appear on the top, enemy aircraft radars (EAR) on the bottom. The color of a particular bar signifies whether that radar signal has detected you or not. Basically, yellow, pink, or white bars indicate you've been detected (see page 48, for a complete explanation). Bar colors match radar arc colors on the satellite map. In addition, whenever you're detected by a signal, the EMV light illuminates briefly, and you hear a warning beep.

Warnings

Eventually, you'll make a mistake, or a previously silent enemy radar may suddenly turn on, and you'll be detected. Even if you are never detected by radar on your approach to a target, when you destroy the target, the enemy will certainly be alerted.

Search Warning: Enemy search radar detects your plane when the enemy radar strength bar overlaps your EMV bar. Search detection means that enemy fighters may be vectored toward your location, and that surface-to-air missile (SAM) batteries in the area may start tracking you.

Tracking Warning: Long- and medium-range SAMs must track a target with radar before firing. Tracking radar appears as a short, narrow arc on the Left MFD Satellite map. When the enemy tracks you, the "TRAK" warning light on your console begins flashing.

Missile Warning Lights: If a radar-homing missile is launched toward you, the "RAD" missile warning light flashes; If an IR (infrared) homing missile is launched, the "IR" missile warning light flashes.

The warning light continues flashing as long as any missile of the appropriate type homes on your plane. Missile warning lights are very important, because they're the only indication of what kind of missile is attacking, and therefore, of what defensive measures should be taken.

Missile Proximity Klaxon: When a missile approaches within a few seconds of your plane, the Missile Proximity Klaxon sounds. This very loud, repeating tone means you must do something immediately, or be hit. Typically you'll drop a chaff or flare cartridge, depending on the type of threat (chaff for radar missiles, flares for IR missiles). However, you can also attempt some last-second maneuvering.

Missile Defenses

When the "TRAK" or a missile warning light begins flashing, get ready to use your defenses – an attack is coming.

Understand the Attack: The first step is to check out the attack. Tap *Maps* (F3) to switch the left MFD to the tactical display. Use *Zoom* (Z) and *UnZoom* (X) to find a useful scale. Missiles are small color-coded lines – IR missiles are red and radar missiles are yellow.

Disappearing: If you're attacked by a radar missile (the "TRAK" or "RAD" light – or both – is flashing), you can evade the attack by reducing your EMV. If the enemy radar loses sight of you, the missile loses guidance and flies on blindly.

Jammers: You can use the ECM jammer against radar missiles (missiles that light the "RAD" warning). Tap *ECM* (4) to toggle the ECM jammer on and off. Use the IR jammer against IR-guided missiles (those which light the "IR" warning). Tap *IR Jammer* (3) to toggle it on and off.

After you turn on the jammer, change course and get away from the missile. If you don't, when you turn off the jammer (or when an advanced missile gets close enough), the missile starts homing on you again! Advanced missiles that "burn through" jamming include semi-active radar missiles, command guidance radar missiles, and second generation IR missiles.

Don't leave your jammers running. The ECM jammer increases your EMV; the IR jammer reduces your speed and can overheat (see page 80 for details).

Chaff and Flares: A chaff or flare cartridge lures a missile for two or more seconds, causing it to fly toward the chaff (radar missile) or the flare (IR missile).

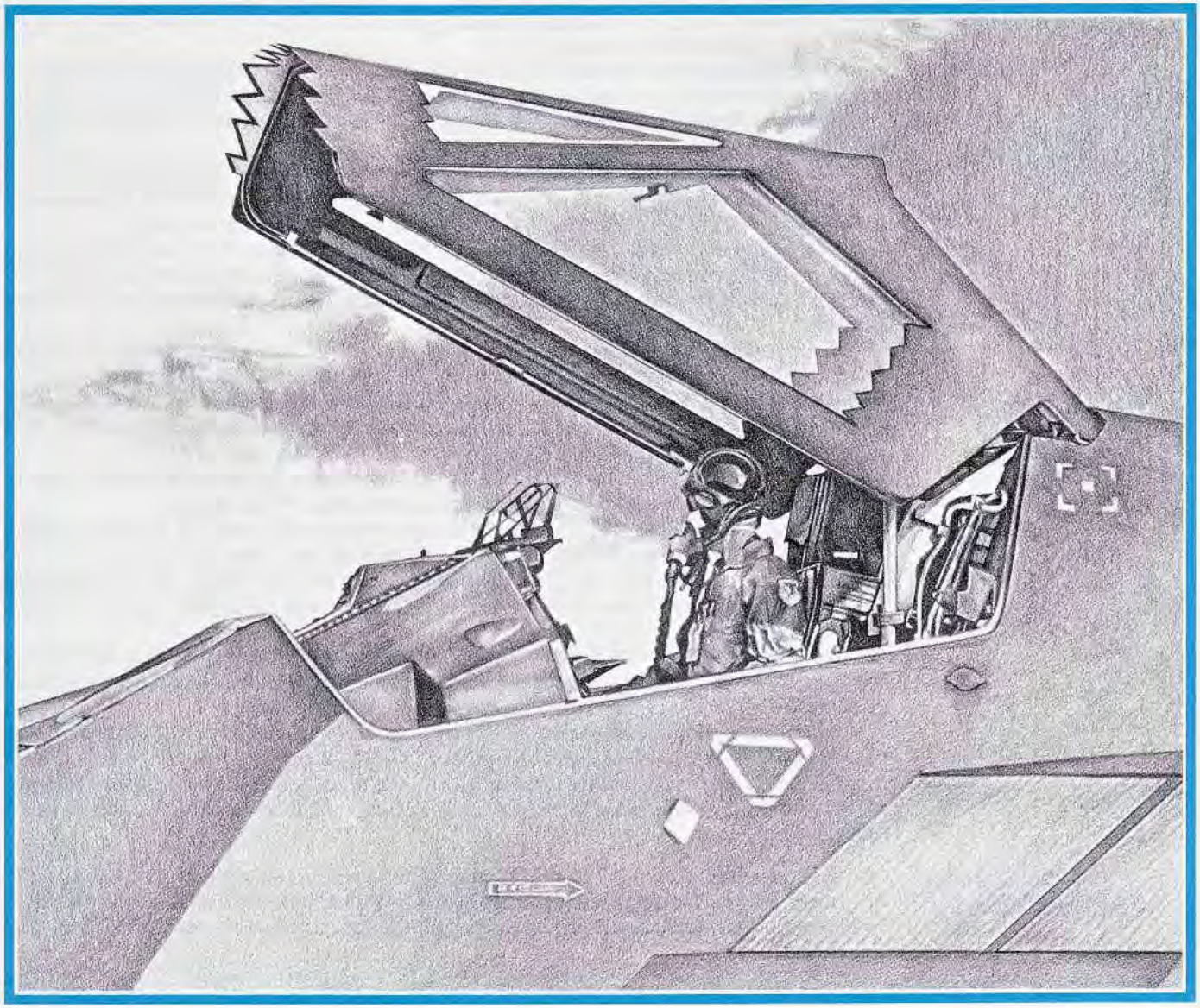
Fire a chaff cartridge, tap *Chaff* (2), when a radar missile ("RAD" light) causes the klaxon to sound. Fire a flare cartridge, tap *Flare* (1), when an infrared missile ("IR" light) sets off the klaxon.

Decoys: Your F-117A carries three decoys that will lure everything for several seconds. To launch a decoy, tap *Decoy* (5). The Decoy light in the cockpit turns on, and remains lit while the decoy is running (see page 80 for more).

Maneuvering: Missiles have only a 45° forward "view." If you're outside of this arc, the missile cannot track you. Therefore, if you "blind" the missile with a decoy, jammer, chaff, or flare, then fly outside its arc, the missile may lose you and fly away. Missiles also have very wide turning circles. You can out-turn a missile (see page 83 for more details).

Ending the Second Mission

Use the instructions in the first mission to aid you in destroying your targets and returning to base. But this time practice evading radar and missiles. You may want to fly this same mission a few more times for more practice before trying a "real" mission. Good luck!



2 OPERATING INSTRUCTIONS

PREFLIGHT BRIEFING

F-117A Stealth Fighter 2.0 has many options. To make a choice, move the *Controller* (joystick, mouse, or keyboard) to position the arrow cursor over the option you want, then press the *Selector* (Button 1, Left Mouse Button, or Return/Enter). Note that pressing Button 2, the Right Mouse Button, or the Escape key, always returns you to the Ready Room (see page 30).

HARDWARE OPTIONS

You may be asked questions about your equipment. See the Technical Supplement for details, including advantageous trade-offs.

AIRCRAFT IDENTIFICATION

To be allowed to choose your own mission assignment, you must correctly identify an aircraft. Flip to the Warplanes section of this manual (pages 164-172) and find the drawing which matches the screen illustration. Observe carefully the shape of the wings, fuselage, nose and cockpit for accurate identification. Then select the correct name.

If your identification is wrong, you are automatically assigned to training. If the identification is correct, you have your choice of assignments.

PILOT ROSTER

Here you can start a new career or continue an existing one. Note that if you erase a pilot's name here the results are permanent. Do not erase pilot names unless you're sure! You will not be able to save pilot records unless you are playing from a copy of the game.

Selecting an Existing Pilot

You can highlight any one of the various names on the roster by moving the arrow cursor (with your *Controller*) over the name you want. Select the name by tapping *Selector*.

Creating a New Pilot

To create a new pilot, you must highlight an existing one and tap the Backspace or Delete key. You may then type in a new name for the pilot. When you've completed the new name tap the return key to enter the new name into the roster. You may then select that pilot as usual by highlighting his name then pressing the *Selector*.

When you've selected a pilot from the Roster a form appears that allows you to indicate some levels of skill for that pilot.

Opponent Quality

The quality of your opponents controls the difficulty of the simulation. The better your opponents, the more difficult your job, but the greater your rewards. Your score is significantly affected by this option. Selecting regular or green opponents reduces your score, making promotions slower and putting the highest medals out of your reach. Selecting veteran or elite opponents increases your score, speeding up promotions and making medals easier to obtain.

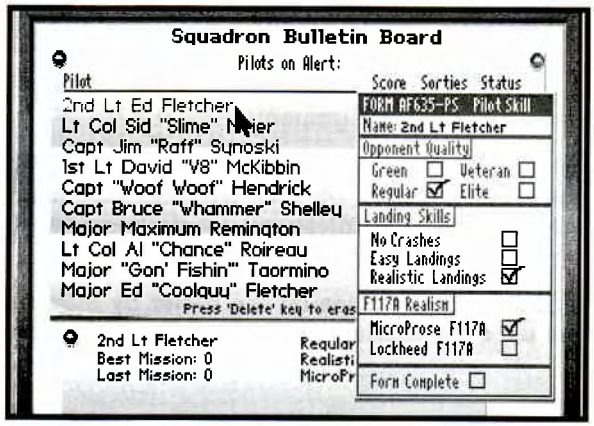
Green Opponents: Here the enemy has older aircraft and SAMs. His radar sets are poorly maintained and frequently out of order. Radar operators only understand the rudiments, and therefore are very bad at reading the sometimes-strange signals given off by your plane. Enemy pilots have virtually no skill in aerobatics and dogfighting.

Regular Opponents: Here the enemy has aircraft and SAMs appropriate to the region: older equipment for Third World and client states, more modern equipment when you face a superpower directly. Radar operators are trained and drilled, but lack experience. Enemy pilots have practiced mock dogfights and aerobatics, but lack the quick perception and aggressive maneuvering of a combat veteran.

Veteran Opponents: Here the enemy has aircraft and SAMs appropriate to the region, like regulars, but tend to use only the better equipment in combat. Radar operators are experienced and have a good sense of judgement. Enemy pilots have dogfighting experience and perhaps a few kills to their credit.

Elite Opponents: Here you face the enemy's best. Elite troops always get the best available equipment. Radar operators know their equipment inside out and can interpret your faint, confusing returns only too well. Enemy pilots are often aces who know every trick in the book and aren't above inventing new ones.

Roster



Landing Skills

This option determines how difficult and dangerous it is to fly your F-117A. Your choice here also affects scoring; the more difficult the flight, the higher your scores will be and the easier to obtain medals and promotions.

No Crashes: This is the ideal choice when learning to fly. In a crash situation your F-117A rights itself and keeps going. When landing you can safely hit the ground as hard as you like. Unless you have your landing gear down, an automatic barometric altimeter keeps your plane above 200', simplifying low-level flying. However, enemy weapons are *not* affected and are still deadly. Your score is significantly reduced if you select this option, making promotions and medals hard to get.

Easy Landings: This choice is preferred by casual, weekend flyers. Safe landing parameters are relaxed considerably, which makes one of the toughest jobs much easier. To avoid a crash you must touch down on a runway, aircraft carrier, or prepared landing strip. Hitting the ground or water anywhere else destroys the plane. As in "No Crashes," an automatic barometric altimeter keeps your plane above 200' unless your landing gear is down. Your score is only slightly reduced if you select this option. Promotions are not materially affected, and you qualify for all but the highest medals.

Realistic Landings: You must be skilled to be successful with realistic landings. Coming down too fast can mean instant death. Your score is full value if you select this option. If all other selections are of similar difficulty, you can be promoted quickly and have a fair shot at every medal.

F-117A Realism

This determines whether you'll be flying a "real" Lockheed F-117A or the MicroProse enhanced version. The Lockheed F-117A is more restricted in what it can do than the MicroProse F-117A.

Lockheed F-117A: If you choose the Lockheed F-117A you'll have 2 weapons bays instead of 4, not be able to carry air-to-air weapons (including the cannon) nor fly air-to-air missions, you will fly only at night, never launch from carriers, and you'll be much less visible to enemy radar.

MicroProse F-117A: The MicroProse F-117A sacrifices a little of the stealthiness of the Lockheed model for more weapons, more mission types, and day and night-time flying (though day missions are still very rare). It's your choice!

Form Complete: When you're finished making selections on the form, select form complete. If you're finished with the Roster, select Exit from the lower right corner.

READY ROOM

This is the pilot's Ready Room, where pilots await orders. From this room you can go to any other room to choose various game options. You can also see a summary of all options currently selected, or return to the Pilot Roster.

To enter another room, move the arrow cursor to the door of the room you want to enter and press the *Selector*.

To return to the Pilot Roster, select the bulletin board on the far wall of the Ready Room.

COMMANDING OFFICER'S OFFICE

You go into the CO's office to request transfer to a different theater or a different duty assignment. Here you select the region of the world for your new assignment, the level of political and military tension in that region, and the types of missions you'll be flying there.

Regions of the World

There are nine different areas of the world in which to operate. Each one takes you to a different time period of contemporary history, and each has its own set of unique challenges and missions. Some areas are much more dangerous than others and you are rewarded more lavishly for operating in these areas.

Ready Room

Persian Gulf, 1984: This a complex and moderately dangerous situation. Iran is a radical, revolutionary state involved in a long war with Iraq, as well as numerous shooting incidents with the US Navy.

North Cape, 1985: You face the full strength and power of the Soviet Union during the height of the Cold War. This region contains many large USSR military complexes and naval bases. This is a dangerous area.

Libya, 1986: A client state of the Soviet Union, Libya is one of the prime supporters of international terrorism, and on the receiving end of American air and naval air attacks. This a relatively easy situation.

Training missions in Libya are fixed. Strike training is always a mission from the USS *America* to Tripoli; air-to-air training is always an interception of fighters patrolling the skies over Benghazi.

Central Europe, 1986: As in the North Cape, you face first-line forces of the Soviet Union and the Warsaw Pact. Numerically inferior but qualitatively superior NATO forces (including your F-117A) meet this huge military power. Should superpower skirmishing or a full-blown World War III occur, victory and defeat would hinge on events in this region. This is one of the most dangerous areas.

Middle East, 1989: The Middle East is a complex web of confusing alliances and rivalries. You'll face both Soviet and Western equipment as you fly missions against Syria, Iraq, and other terrorist-support states. This a dangerous area.

Desert Storm – Iraq, 1991: The vast military might of the US, Great Britain, France, and their Arab allies oppose the Baathist dictatorship of Saddam Hussein and the Iraqi military, in the Kuwait and Iraqi Theaters of Operations. This is a moderately challenging situation.

Vietnam, 1994: The US military has sent air units back into southeast Asia to oppose Vietnamese expansionism and to settle an old score. This is a very dangerous arena.

Cuba, 1995: Cuba is determined to expand the communist revolution into Central America and the eastern Caribbean. Washington has decided to stop it before it spreads. This is a dangerous situation.

Korea, 1997: The Chinese and North Koreans have finally had enough of US-dominated democracy in Asia. They are planning to carry out attacks against US and South Korean installations. Washington, of course, will defend its foothold in the Far East. This is one of the most dangerous situations.

Commanding Officer's Office

Level of Conflict

The level of conflict in the region has a dramatic effect on how you must fly your missions. Each type of conflict has its own challenges. No choice is easier than another. In general, the hotter the war situation, the more violent and dangerous the mission, while Cold War demands careful planning and good judgement – different skills, but no less important ones!

Cold War means clandestine missions. Flying without being detected is key. (Fortunately, enemy radars and SAMs aren't expecting trouble. They often confirm a contact many times before attacking.) If you are detected, you must destroy the plane or radar which saw you. However, the more you use weapons, especially against any other targets, the greater the scandal, and the less successful your mission. In fact, many missions in the Cold War involve photo reconnaissance, flying secret materials in or out of enemy territory, or surgically "removing" a single, specific target.

Limited War missions are also clandestine. It is still important to fly without being seen, but since warfare is ongoing, military targets are fair game now. However, be careful to avoid hitting civilians. Attack and strike missions are common, but so are photo reconnaissance and clandestine spy missions. In limited war enemy radar operators expect some trouble. Their reactions are slightly faster.

Conventional War is all-out conflict. Inflicting the maximum destruction upon the enemy is the main objective here. Avoiding detection has no political importance, but is useful if you want to survive the mission! Any target in enemy territory is fair game, military or civilian. However, enemy air defense operators rarely confirm their targets – in wartime everybody shoots first and asks questions afterward!

Mission Type

You may select from two types of "real" missions and two types of "training" missions. Training missions represent flying a flight simulator instead of flying a real aircraft.

Air-to-Air Missions have an enemy aircraft as your primary objective. If you're a hotshot with air-to-air missiles (AAMs) and dogfighting, this is your cup of tea. However, the secondary objective is often a ground target.

Strike Missions assign ground targets as both objectives.

Training Missions generate normal air-to-air or strike missions, as appropriate, with three exceptions: you cannot be hurt by enemy fire; you are not scored for the mission – you receive no rating points, no decorations, no promotions (after all, the mission wasn't real!); you receive fixed mission orders. For example, if you selected Libya (as in the tutorial), strike missions are always against a ground target in Tripoli, air-to-air missions are always against fighters over Benghazi. If you're just learning to fly and fight the F-117A, this feature allows you to try the same mission over and over, until you understand fully what's happening.

BRIEFING ROOM

This screen shows a detailed map of the region of the world you chose in the CO's Office. On this map is the flight plan for your proposed mission. Your takeoff point (T), primary target (P), secondary target (S), and landing point (L) are always visible on the briefing map, as reference points.

Also shown on this map are important sites such as airfields and radar and SAM sites. You can learn important information about these sites by moving the cursor over them and reading the text that appears. In addition, you can see the range of various enemy radars and missiles. This screen, with its great variety of information, is the perfect place to plan your mission. You may wish to take notes about particularly dangerous enemies, or the route you have in mind.

Mission Brief

This presents a detailed description of your operational orders, with specific information about the primary and secondary objectives. After you've read this, and you tap the Return key, you'll read about your flight plan, describing your takeoff and landing sites, estimated fuel required, and a summary of the Rules of Engagement (ROE).

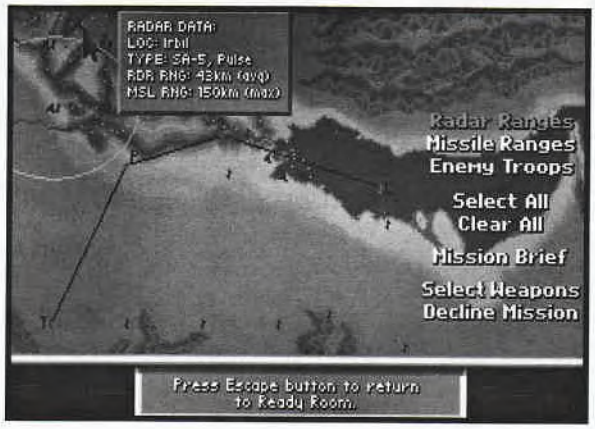
Radar and Missile Ranges

If you move the arrow around the briefing map, information boxes appear that tell you important facts about the various sites on the map. If you select one of the site icons, a circle appears that indicates either the radar range of that site or the missile range, depending upon which of the menu items is selected. You can select any or all of the sites at will and turn the range of each site on and off individually. If you choose "Select All" from the menu, all ranges are shown, if you select "Clear All" all ranges currently shown are erased.

Radar Ranges: If you select *Radar Ranges* from the menu at right, you are shown radar ranges when you select a site. The initial range shown is the site's effective radar range; if you then tap the Space Bar, the display switches to maximum radar ranges.

Missile Ranges: If you select *Missile Ranges* from the menu at right, you are shown missile ranges when you select a site. The range shown is always the SAM's maximum range.

Briefing Room



Enemy Troops Selecting this option shows you the location of known enemy ground force concentrations. These locations are boxed on the map and indicate areas where there are likely to be large numbers of shoulder-launched SAMs.

Decline Mission If you select this option, the current mission is cancelled and you are given a new one immediately. This may be handy if you want to be selective in the missions you fly.

Select Weapons This option places you in the Maintenance Room where you can examine the weapons your crew chief has deemed appropriate for your assigned mission and change them if you desire.

Maintenance Room

MAINTENANCE ROOM

Here you select the weaponry and equipment you desire for your mission.

To place a weapon into a bay, use the *Controller* to move the the arrow to the bay you want to affect, then select the bay using the *Selector*. Now use the *Controller* to highlight the weapon you wish to place into the selected bay, and the *Selector* to place it there.

Note that your estimated fuel required, and current fuel carried, appear; make sure you have enough fuel to complete the mission!

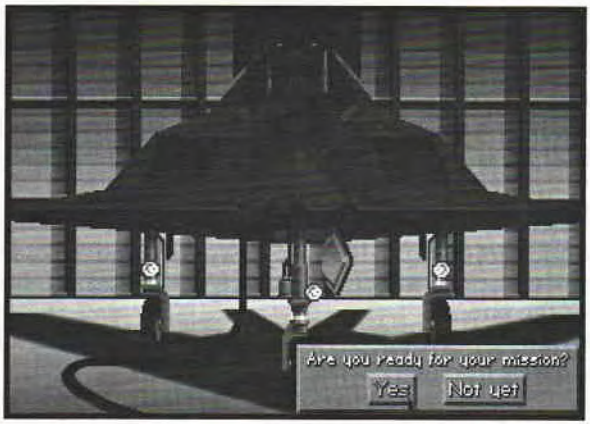
Default Armaments: The initial weapons loaded in Bays 1 and 2 represent your crew chief's choice of weapons for your mission. The weapon in Bay 1 (upper left) is for the primary target, the weapon in Bay 2 (upper right) is for the secondary. If extra fuel appears in one of your bays it's because the crew chief has determined you'll need it.

Choosing Armaments: See pages 139-141, for details about each weapon. The "Weapon Effectiveness" chart, page 139, rates all weapons against common targets. It's wise to carry at least one "7" or "6" rated weapon for the primary and secondary objectives.

THE HANGAR

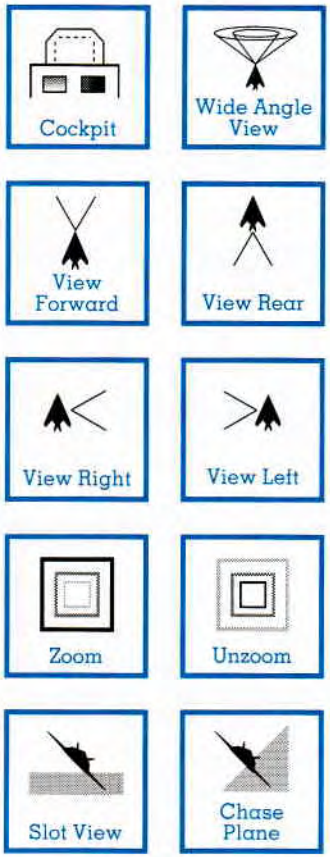
Here you see your F-117A being topped off with fuel for the mission. You are given the choice to go ahead and fly the mission or return to the Ready Room. Of course if you go ahead and fly, there's no turning back; but if you return to the Ready Room, you can go to any of the above rooms and change your assignments at will.

Hangar



SIMULATION CONTROLS

VIEWING CONTROLS



The following views are from inside the cockpit of the F-117A. They allow you to look in four different directions and change the cone of view out the front of the cockpit.

From-the-Cockpit Views

Cockpit: Tap *Cockpit* (F1) for the standard view, looking out of your cockpit through the HUD.

Wide Angle View: The *Wide Angle* key (C) toggles between a standard viewing arc (about 60°) and a wide-angle viewing arc (about 120°). This view places your point of view farther back in the cockpit, showing more of the cockpit structure and a wider angle view of the world outside. This is excellent for spotting and tracking enemies in a fast-moving dogfight.

View Forward: Tap *View Ahead* (Shift /) to turn off the HUD and look over the cockpit control panel, giving you maximum visibility forward.

View Rear: Tap *View Rear* (Shift >) to look through the back of your cockpit.

View Right: Tap *View Right* (Shift <) to look out the right side of your aircraft.

View Left: Tap *View Left* (Shift M) to look out the left side of your aircraft.

Out-of-Plane Views

As an aid to learning flight maneuvers and providing some very dramatic cinematography, a variety of out-of-plane views are available. In these views you're outside of your aircraft, looking at it and/or the enemy.

In all but the Chase Plane view, *Zoom* and *UnZoom* (Z and X) are operable, moving your viewpoint closer to or farther away from the F-117A.

Slot View: Press *Slot View* (Shift F1). This view is named after the famous "in the slot" position used by aerial acrobatic teams. You're positioned directly behind the F-117A. The viewpoint remains level with the ground, to clearly show the degree of pitch and roll of the F-117A as you maneuver it. This view is excellent for learning efficient flight.

Chase Plane View: Press *Chase Plane* (Shift F2). You're in a "chase aircraft," following a short distance behind the F-117A. As the F-117A accelerates, it will tend to "run away" from you, while when it slows down it tends to "fall back" toward you. *Zoom* and *UnZoom* dsoes *not* work with this view.

Side View: Press *Side View* (Shift F3). You're to the right side of the F-117A. This view can provide a useful reference point. It's also an excellent way to check the state of your landing gear. Missile launches are most dramatic when seen from this viewpoint.

Missile View: Press *Missile View* (Shift F4). Here you're positioned directly behind the F-117A's active weapon. If ordnance is in flight, you're positioned behind the weapon launched most recently. If no ordnance is in flight, you're positioned behind the plane, and will follow the first item launched. This view lets you follow the weapon directly to the target. If you're having trouble understanding why your weapons miss, switching to this view after launch may be educational.

Tactical View: Press *Tacti View* (Shift F5). You're directly behind the F-117A, looking past it at whatever target you're currently tracking. This view automatically rotates and pans to keep both the F-117A and its target in view. This view is invaluable in combat situations; it helps you outmaneuver and line up on an opponent or return for a second or third attack run on a ground target.

Inverse Tactical View: Press *Invrs Tacti* (Shift F6). You're directly behind the F-117A's current target, looking past it toward the F-117A. You see the target in the foreground, and the F-117A (which often is no more than a dot in the sky) far away. The view automatically rotates and pans to keep both the target and the F-117A in view. This a very dramatic view when making attack runs on ground targets.

The Movie Director: An experienced pilot, flying in training mode, can use these views to good effect. By switching between the cockpit and various views, you can illustrate what's happening and impress casual bystanders.

For example, you can use the Chase Plane view and autopilot to watch your plane launching from the carrier and turning onto course. Then switch to Slot View and show off loops, rolls, split-S turns and Immelmans (see pages 89-92). Find an enemy aircraft and use the *Tacti View* to show your plane maneuvering against his. Then switch to *Invrs Tacti* to watch his responses. Before launching a missile go to the *Side View*, to watch the weapon dropping away. Then jump to the *Missile View* to follow it into the target. The possibilities are as endless as your imagination.

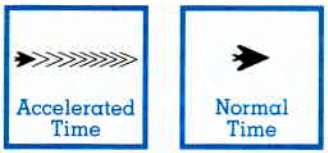
OTHER CONTROLS

Pause

Pause (Alt/P) immediately freezes the action. To resume, press any key.

Some computers have a special key labeled "pause" or "hold." Depending on the internal design of your machine, this key may also work. Pause may be very useful when you are first learning to fly.

Accelerate Time



Accel Time (Shift Z) doubles the rate at which time passes, and is useful when flying long distances without encountering significant threats. When in accelerated time mode, "ACCEL" appears on the HUD.

Norm Time (Shift X) returns the simulation to normal time. Since it's almost impossible to control and fight your craft in accelerated time, in combat and landing situations you're automatically returned to normal time. Accelerated time automatically stops if you're detected by enemy radar, you open the weapons bay, or lower the landing gear.

Detail Adjust

Detail Adjust (Alt/D) allows you to change the amount and depth of ground detail visible through the cockpit, speeding computer execution; the slower your computer, the lower the level of detail you should use.

Volume Adjust

Volume Adjust (Alt/V) allows you to change the type and variety of sounds used in the simulation. When you press the key, the new sound setting appears briefly on the HUD.

Training

Training (Alt/T) allows you switch into training mode at any time during play. This may be useful if things get particularly confusing, or if you decide to just go sightseeing. Remember though, you don't get rewards for training missions.

Resupply

Resupply (Alt/R) is available *only* in training missions. It fills the plane's fuel tanks and gives it extra weapons. Resupply is designed for sightseeing and target practice. Needless to say, those who prefer realism in simulations should never touch this option.

"Boss" Hide Game

"Boss" Hide Game (Alt/B) immediately pauses the simulation and clears the screen, effectively making the computer appear to be idle. To resume the simulation, you press *"Boss" Hide Game* again. This key is not only useful at the office, but also to forestall irate parents, children, spouses, and relatives who complain about the time you spend at the computer!

Quit

Quit (Alt/Q) immediately ends the simulation and returns the computer to DOS. It does not save information to disk, so any accomplishments since the last pilot roster will be lost.

Save

There is no "save" key in *F-117A Stealth Fighter 2.0*. Instead the simulation automatically saves your pilot record whenever your leave the pilot roster during the preflight briefing.

This "automatic save" feature requires you to be using a copy of the program (a copy on either a floppy or hard disk), rather than the original MicroProse disk from the box. If you're using the original disk, you cannot save data, although you can otherwise run the simulation normally.

Main Cockpit

DISPLAYS AND AIRCRAFT CONTROLS

TERMINOLOGY

Each control has a name in *italics*, which is used on the keyboard overlay; in addition, the actual key used in the IBM version of the game appear in parentheses. A master list of all names and keys also appears in the Appendix.

Controller refers to the pointing device used by your computer. This may be a mouse, joystick, or cursor keys, depending on your hardware. See the Technical Supplement for details.

HEADS-UP DISPLAY (HUD)

The HUD is designed to provide all the crucial flying and weapon information in a graphic format. HUD data is projected onto a wide-angle clear pane in the front of the cockpit. You look "through" the HUD to the situation outside. As a result, valuable information is right in front of your eyes, where it is most useful.

Because the F-117A is a night fighter, the text displayed on your HUD can be switched from white to green for ease of reading. At night it is green automatically; if you are assigned a rare daytime mission, the text appears white on your HUD. If for some reason you are forced to stay in the air past daylight, you may wish to switch the text color back to daytime colors. To do so tap *day/Night HUD* (F4).

In addition, you can customize your HUD to some extent using the *De-clutter* key (V). These modes condense some of the information to single digital readouts; experiment to find the setting you like best.

HUD Modes

Your HUD has three modes: Navigation (NAV), Air-to-Air (AIR), and Air-to-Ground (GND). You switch between modes using *HUD Modes* (F2). The HUD Mode Indicator Lights, directly below the HUD, indicate the HUD's current mode. Each mode has specific uses and affects not only the types of information displayed on the HUD, but also what types of information are available on your right-side Multi-Function Display (MFD).

NAV mode helps you navigate between airbases by restricting your tracking system to friendly and neutral airbases and aircraft carriers. AIR mode is for attacking aircraft, so your tracking system is restricted to flying targets. GND mode is for attacking ground targets. Your tracking system is restricted to these targets.

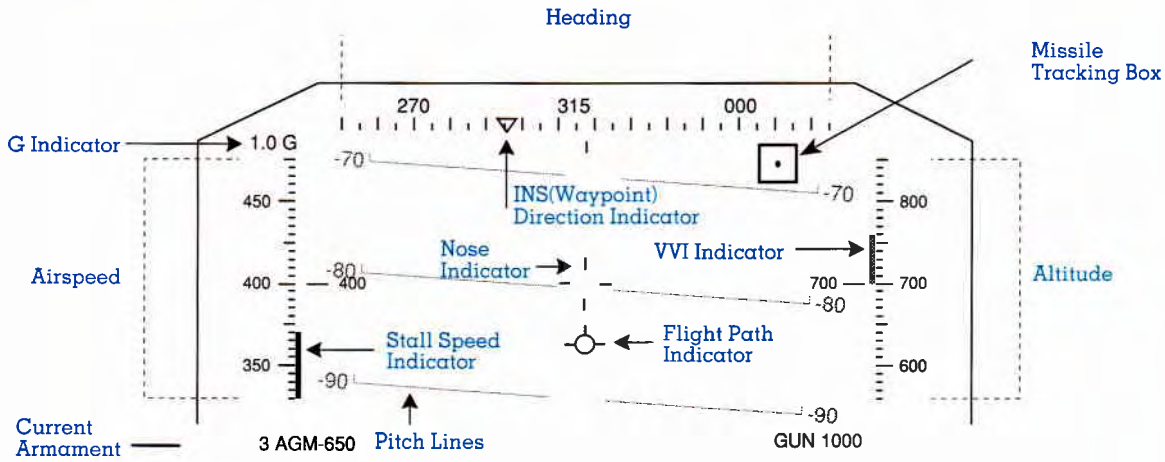
Universal HUD Information and Symbology

Some HUD information is universal across all modes. This information is displayed, or available, regardless of your HUD's current mode.

Airspeed: Your airspeed (in knots) is indicated on the left side of your HUD on a vertical scale; a digital readout of your current speed appears beside the center tick-mark.

Stall Speed Indicator: The Stall Speed Indicator is a colored bar which rises from the bottom of the airspeed scale. If it extends beyond the center tick-mark, your plane has stalled, and falls out of control briefly until the automated recovery system takes over. A low-altitude stall can be fatal.

Standard HUD Symbology



Altitude: Your altitude (in feet) is indicated on the right-side vertical scale; a digital readout of your current altitude appears next to the scale's center tick-mark. At 1,000' the scale changes to thousand-foot increments (2K is 2,000', etc).

Vertical Velocity Indicator (VVI): The small, colored bar extending upward or downward from the altitude scale's center tick-mark is the VVI. If the bar extends upward, you're gaining altitude; If it extends down, you're losing altitude. Each tick-mark represents 100 feet per minute, so the longer the bar, the faster you're gaining or losing altitude.

Landing Speed Indicator: This colored arrow appears only when your landing gear is down and marks the safe maximum VVI for landing. If the VVI extends below this mark, landing is unsafe.

Angle of Attack (AOA) Approach Indexer: The AOA Approach Indexer becomes operational when your landing gear is down. It assists you in obtaining optimal pitch of the plane's nose as you approach a landing. If the green circle in the center of the display is lit, your angle of attack is OK; if the yellow up arrow is lit, you need to pitch your nose up; if the red down arrow is lit, pitch your nose down slightly.

Heading: The horizontal scale across the top is your heading in degrees. North is 000°, East is 090°, South is 180°, and West is 270°.

INS (Waypoint) Cursor: The colored triangle above the heading scale shows the direction to the currently selected INS "waypoint." To get "on course," turn until the marker is above the middle tick-mark on the heading scale.

Nose Indicator: Fixed in the middle of the HUD, this cross-hair indicates the direction your plane's nose is currently pointing.

Flight Path Indicator: This indicator shows the direction you are flying (which may be different from the Nose Indicator). It is available only in NAV and GND modes.

The plane is geometrically level when the nose and Flight Path Indicators overlap (rare in an aircraft). Further, level flight (constant altitude) often requires the nose to be pitched slightly above the flight path (see Techniques and Tactics, 59).

G-Indicator: This readout in the upper left corner of the HUD indicates the current G-forces on your plane's airframe. The plane can withstand more G stress than the pilot, whose limits are between -3 and +9, depending on training and experience.

Pitch Lines: These lines appear on the HUD if you're in NAV mode or pitched so far up or down that the horizon is invisible. Each line represents 10° of pitch up or down. If you're perfectly level, pitch is 0°; when climbing straight up or diving straight down, pitch is 90°.

Current Armament: In the lower left the HUD indicates what weapon is currently selected, and the number currently available, such as "3 Sidewinders," or "2 Slicks," etc.

On the lower right is the word "Gun" followed by the number of rounds currently available. This refers to your 20mm cannon and its remaining ammunition.

Radio Messages: You are sent coded burst transmissions periodically, which are decoded by your onboard computers and displayed as text across the top of the HUD.

Tracking Box: The Tracking Box appears on your HUD whenever your F-117A's tracking system is locked onto a target and the target is visible through the HUD; the Tracking Box frames the target. In addition, the target appears in your right-side MFD. The current HUD mode determines what targets can be tracked.

The *Cam Ahead* (/), *Cam Rear* (>), *Cam Left* (<)and *Cam Right* (M) keys set the tracking camera to "look" in the direction indicated. Once locked onto a target, it follows that target, even if the target moves from one quadrant to another.

Missile Tracking Boxes: A Missile Tracking Box appears on your HUD whenever a missile is visible through your HUD. If the box is green, the missile it frames is one that you launched. If it is yellow, the missile is an enemy missile. There may be several Missile Tracking Boxes visible in your HUD simultaneously.

Air-to-Air Mode Indicators

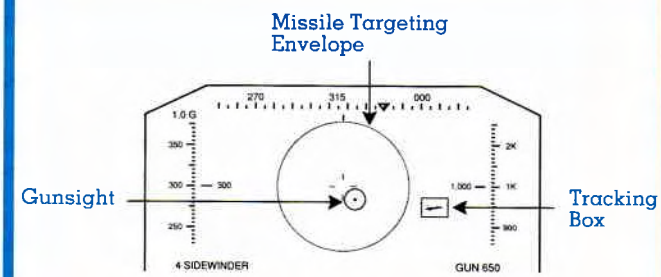
To set the HUD to AIR mode, tap *HUD Modes* (F2).

Gunsight: The Gunsight circle replaces the Flight Path Indicator and shows where your shells would hit if you'd fired six seconds earlier (the time it takes them to travel the 6 kilometer maximum range). If you're tracking a target, it shows where the shells would land if you'd fired the proper time in the past for them to travel that range. See page 68, for details.

Missile Targeting Envelope: This large, faint circle represents the area in which an air-to-air missile can be aimed and "locked onto" a target.

Tracking Box and Oval: The Tracking Box appears on your HUD whenever your F-117A's optical tracking/targeting system is locked onto a target which is in front of the plane and visible through the HUD; the Tracking Box frames the target. In addition, the target appears in your right-side MFD if the tracking camera is activated. In AIR mode, the tracking system locks onto airborne targets.

HUD in AIR-to-AIR mode



The Tracking Box is color-coded to inform you if your currently armed weapon is appropriate for use against the current target. If the Tracking Box is white, the weapon is appropriate for the current target. The size of the Tracking Box indicates how effective the current weapon is against the current target — the larger the box the more effective the weapon. Tap *Select Weapon* (space bar), to arm a different weapon.

When using self-guided weapons, the box turns into an Oval when the target is within firing range and the missile is "locked on." When the Tracking Oval turns red, the shot is a "sure thing," with nearly no chance of missing.

Air-to-Ground Mode Indicators

To set the HUD to GND mode, tap *HUD Modes* (F2).

Tracking Box and Oval: The Tracking Box appears on your HUD whenever your F-117A's optical tracking system is locked onto a target which is in front of the plane; the Tracking Box frames the target. In addition, the target appears in your right-side MFD. In GND mode, the tracking system locks onto ground targets only.

The Tracking Box is color-coded to indicate if your currently armed weapon is appropriate for use against the current target. If the Tracking Box is white, the weapon is appropriate for the current target. The size of the Tracking Box indicates how effective the current weapon is against the current target — the larger the box the more effective the weapon. Tap *Select Weapon* (space bar), to arm a different weapon.

When using self-guided weapons, the box turns into an Oval when the target is within firing range and the missile is "locked on." When the Tracking Oval turns red, the shot is a "sure thing," with nearly no chance of missing.

Bombsights: When free-fall and/or retarded bombs are armed, a special set of bombsight aids appears on the HUD. If your current course, speed and altitude will place you within a bomb blast, the HUD bombsight symbology (described below) flashes. You can still drop a bomb in this situation, but you should take appropriate action to escape the resulting blast.

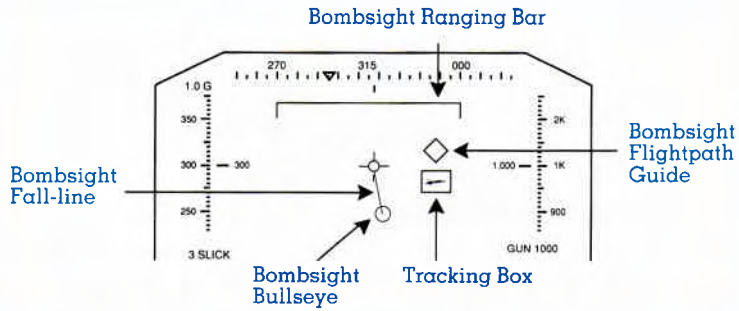
Bombsight Flightpath Guide: This indicates the "path in the sky" you should fly for a perfect bombing run. Keeping your Flight Path Indicator centered within this symbol means you're "on course."

Bombsight Ranging Bar: This indicates when to release a bomb based upon range to the target. As you get closer to the drop point, the bar compresses. When it becomes a single vertical line (or dot) drop the bomb.

Bombsight Fall-line and Bullseye: This appears only if free-fall bombs are armed. A line extends from your flight path toward the ground. At the end of this line is a circle ('bullseye'). Your bomb will land in the middle of this circle.

Camera Lens Sight: If your current armament is the 135mm/IR camera, the camera lens sight (a small "+") appears on the HUD. It indicates the direction your camera lens aims.

HUD in AIR-to-GROUND mode



MULTI-FUNCTION DISPLAYS (MFDS)

Left-Side Multi-Function Display (MFD)

This MFD appears on the left side of the cockpit and displays two different types of map: the Satellite/Radar Map and the Tactical Display Map. The *Maps* key (F3) toggles between them. Either map may be expanded or contracted, using the *Zoom* and *UnZoom* keys (Z and X).

The Satellite/Radar Map: This map displays the geographical features of the region, and is oriented so north is toward the top. When the Satellite map is on the display, the "MAP" light is illuminated.

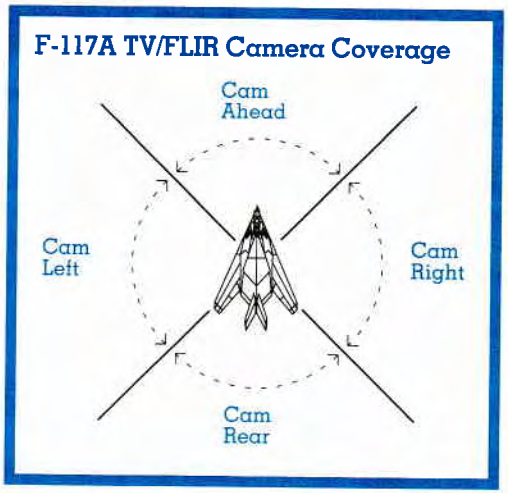
Enemy radar signals are displayed on this map: dotted lines represent pulse radar; solid line are Doppler radar. Ground search and airborne early warning and control (AEW&C) radars are displayed as expanding circles, while ground fire-control and aircraft radars appear as short arcs.

Missiles, aircraft, and important ground targets also appear on this map as color-coded dots. Your aircraft is white, other aircraft are red, and missiles are yellow. Your mission targets, flash and glow; ground radar installations are black.

The Tactical Display Map: This map portrays the local tactical situation. It is oriented so the top corresponds to your current heading. When the Tactical Map is on the display, the "TAC" light is illuminated.

The map graphically depicts aircraft, missiles, ground radar sources, airfields, and incidental ground targets. A 16 km square grid is superimposed for range referencing.

Color-coding: Aircraft and missiles are color-coded; dark red planes are at a lower altitude than you are, light red ones are at about the same, and yellow planes are above you; red missiles are IR seekers, and yellow ones are radar-homers or visually-guided.



Right-Side Multi-Function Display (MFD)

This MFD appears on the right side of the cockpit and has four basic functions: to display images from your tracking system, provide an interface with your inertial navigation system INS, or to display summary information during flight (there are two types of summary information: weapons and orders). Tap the appropriate key to activate the desired function.

Tracking Camera: Your F-117A is equipped with a TV and forward-looking infrared (FLIR) camera, capable of scanning 360° to a range of about 80 to 100 kilometers in daytime and slightly less at night. To switch between your TV camera and FLIR tap *FLIR* (F6). When you are flying in deep night, you'll probably have to use the FLIR to identify what you are seeing in the right MFD.

On-board computers are programmed with target data that allows the camera to lock onto targets within its current field of view, providing a zoomed TV/FLIR view of the target along with its name, range, and bearing. Primary and secondary targets are indicated when the system locks onto one of these. For a more detailed explanation of the uses of the Tracking Camera and how it relates to the targeting system, see pages 68-73.

Activating and Moving the Camera: You can activate the camera (FLIR or optical) or change its current field of view by tapping *Cam Ahead* (/), *Cam Rear* (>), *Cam Left* (<)or *Cam Right* (M). Switch your tracking camera from optical to FLIR using the *FLIR* Key (F6).

When your Tracking Camera is active, the "TC" light is illuminated; if you're using the FLIR, the "FLIR" light is lit; the direction indicator tells what direction the camera is currently pointing.

Selecting and Designating Targets: The onboard computer contains a list of important targets in the area. Tap *Select Target* (B) to move the tracking camera to the next nearest target within 80-100 kilometers. In addition, you can reprogram the tracking camera to aim at any target on the ground. Simply aim your nose at the target and tap *Designate New Target* (N): the camera will find the nearest new target.

Waypoints: Displays waypoint data for each of the four INS waypoints (F7, F8, and shift F8) (See page 53, for details). When waypoints are displayed, the "WAY" light is illuminated.

Weapons: Displays weapons currently on board your F-117A (F5). When weapons are displayed, the "WPN" light is illuminated.

Mission Orders: Displays a summary of your current mission orders. When you have accomplished your primary or secondary mission, the summary is updated appropriately. When your orders are displayed, the "ORD" light is illuminated.

AIRCRAFT CONTROLS

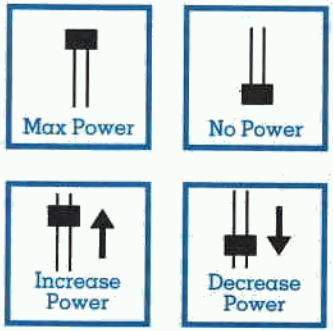
Control Stick

The F-117A has a standard aircraft control stick. Pushing the stick forward pitches the nose down, pulling it back pitches it up. Pushing the stick left rolls the plane to the left, while pushing it right rolls the it right.

The more you push the stick, the more the aircraft pitches or rolls in that direction. When you release the stick (center it) the aircraft maintains its attitude.

The control stick may be represented by a physical joystick, numeric/cursor keypad, or some other device. See "Controls Summary" in the Appendix for details.

Throttle and Fuel



The throttle controls the power output of your engines. Maximum throttle gives maximum speed but uses up fuel faster and increases your electromagnetic visibility (EMV).

Thrust Controls: The *Max Pwr* key (Shift +) immediately opens the throttle, giving you maximum thrust. The *No Pwr* key (Shift -) immediately closes the throttle, shutting down the engines. The *Increase* key (=) opens the throttle a small amount. The *Decrease* key (-)closes the throttle a small amount.

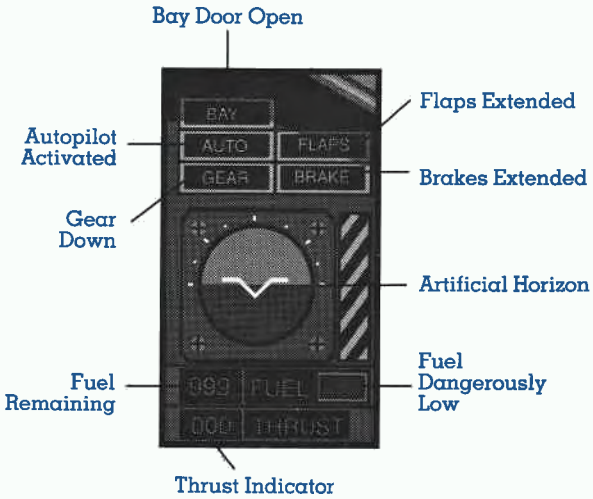
Thrust Indicator: In the lower right side of the cockpit is the Thrust Indicator, a digital readout of throttle, expressed as a percent of total potential. "100" is maximum power; "50" is half power, and so on.

Fuel Remaining: When your onboard fuel tank is full the digital readout reads "999." as you fly, the number decreases, showing the amount of fuel you have remaining in your tank.

Fuel Warning: The warning light to the right of the fuel gauge flashes whenever your fuel tanks are dangerously low.

Extra Fuel: If you are carrying extra fuel in your weapons bay, you can pump that fuel from the bay into the main tank by tapping *Select Weapon* until "EXTRA FUEL" appears on the lower left of the HUD. Then tap *Fire Weapon* (Return) to move the fuel from the bay into your main tanks.

Equipment Indicators



Equipment Controls

Artificial Horizon: This instrument indicates your current pitch and roll. It is particularly useful when flying in deepest night when the horizon is difficult to see.

Landing Gear: The *Gear* key (6) toggles your landing gear up and down. The "GEAR" light illuminates when the gear is down; If the light flashes, you are going too fast for the gear to be down, and there is danger that the gear will be ripped off.

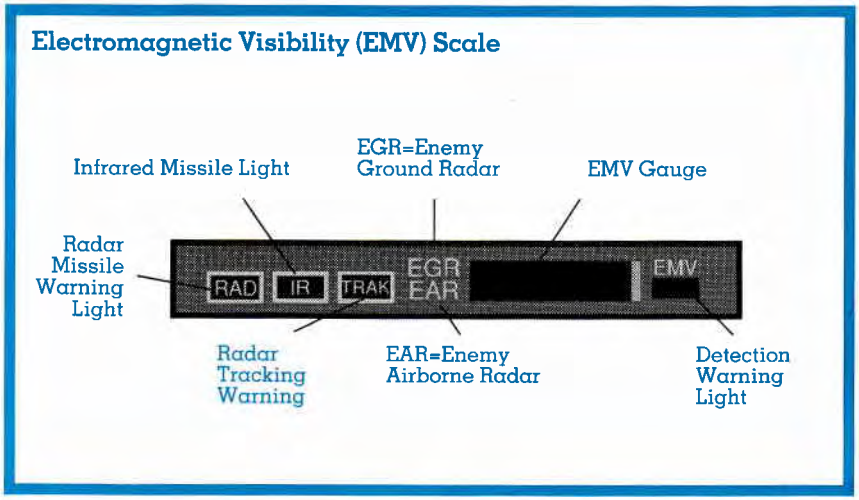
Autopilot: The *Autopilot* key (7) toggles the automatic pilot on and off. Autopilot sets at a minimum altitude of 500' and flies you toward the next INS waypoint (it does not, however, avoid hills and mountains!). When the autopilot is on, the "AUTO" light is illuminated. Turn off autopilot simply by touching the control stick. Note that if your avionics are damaged (the "AV" damage light is on), the autopilot doesn't function.

Weapons Bay Doors: Before using any weapon in your bays you must open the weapons bay doors, using the *Bay Doors* key (8). The "BAY" light flashes when the bay doors are open. After launching the weapon you should toggle the doors closed again. Note that damage to you bay doors (the "BD" light is lit) jams the doors open.

Flaps: The *Flaps* key (9) toggles the wing flaps between extended and retracted. When the flaps are extended the "FLAPS" light illuminates and the aircraft slows and gains lift. High speeds (in excess of 300 kts) can rip off the flaps, causing serious damage.

Brakes: The *Brake* key (0) toggles the airbrake in and out. When the brake is extended the "BRAKE" light illuminates and the aircraft slows down. When on the ground, the *Brake* key toggles the landing gear brakes on and off.

Ejection Seat: Tap *Eject* (Shift F10) to "punch out" of your plane. Your F-117A has an ACES II ejection seat, one of the safest, most flexible designs available. Your best chance of surviving a bailout exists if your altitude is between 2,000' and 14,000' while flying level or climbing slightly.



EVASION AND DEFENSE SYSTEMS

Electromagnetic Visibility (EMV) Scale

This gauge shows the current "stealthiness" of your aircraft.

Your EMV: The "visibility" of your plane to enemy radars appears as a bar extending from the left of this gauge. Your EMV increases as you climb to a higher altitude, increase speed, open your bay doors, lower your gear, or use your jammers.

Enemy Radars: The bars that extend intermittently from the right of the scale represent incoming enemy radar signals. Enemy ground-based radars (EGRs) appear on the top, enemy aircraft radars (EARs) on the bottom. The bars are color-coded to give additional detection information.

Detection: If an incoming signal overlaps your EMV bar, it has detected you (the Detection Warning Light flashes and you hear a warning beep). A pink incoming signal means that a ground radar has faintly detected you; a yellow bar means you have been fully detected. If an incoming air radar signal appears white on the gauge an enemy aircraft has detected you.

The colors of search radar signals that appear on your Satellite map and HUD are colored identically to those on the EMV gauge, so that you can easily locate the radar that has detected you (see "Display Colors Summary," in the Appendix).

Warning Devices

Search Warning: Frequently a single search detection does not give the enemy sufficient data to recognize your plane, but when you have definitely been seen, a message appears on your HUD to indicate the enemy has "seen" your plane.

Radar Tracking Warning: Long-range and medium-range Surface-to-Air Missiles (SAMs) must track you for a time before firing. Tracking radar appears as a short, narrow arc on the Satellite/Radar map.

When enemy tracking radar tracks you, the "TRAK" warning light flashes. Note, however, that some short-range enemy missiles (some IR-homers, see page 82) do not use a radar tracking system. Therefore, "TRAK" is not a foolproof warning of impending attack.

Missile Warning Lights: If a radar-guided missile is homing on your aircraft, the "RAD" light flashes. If an IR (infrared-homing) missile is homing on you, the "IR" light flashes.

The appropriate light continues to flash as long as any missile of that type is pursuing you. If jammers or some other device confuse the missile, the light goes off. If the missile later finds you, the light flashes again.

Missile Proximity Klaxon: When a missile is within a few seconds of hitting your plane, the Missile Proximity Klaxon sounds, signaling you to react quickly or be hit! Typically you'll drop chaff or a flare, depending on the type of threat (chaff for radar missiles, flares for IR missiles).

Defenses

Flare: This is a small, finely tuned heat decoy. Tap *Flare* (1) to release a flare cartridge behind your plane. The flare light illuminates while the flare is active and the digital readout indicates the number you have remaining. For the next 2-5 seconds the intense heat of the flare will cause all enemy infrared-guided missiles to home on the flare instead of your aircraft.

Chaff: Tap *Chaff* (2) to release a chaff cartridge behind your plane. The chaff light illuminates while the chaff is active and the digital readout indicates the number you have remaining. For the next two or more seconds the aluminum sheets of the chaff cartridge will confuse all enemy radar-guided missiles, causing them to home on the chaff instead of your aircraft.

Important Exception: Enemy Doppler radar-guided missiles will not home on chaff unless your course is perpendicular to that of the missile. As long as the missile chases you from the rear, or attacks from straight ahead, chaff has no effect.

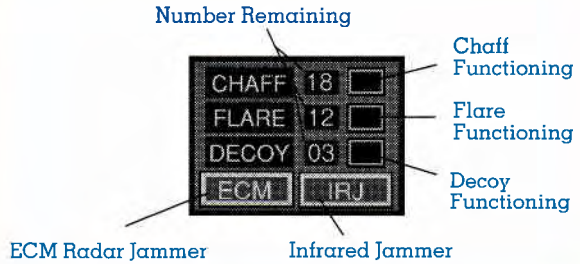
Decoys: Your F-117A carries three decoys. To launch a decoy, tap *Decoy* (5). The "decoy" light illuminates while the decoy is running, and the digital readout indicates the number you have remaining.

Each decoy is a computer-controlled radar emitter/reflector and an IR source. To enemy radar and infrared it looks like your plane, but stronger. The decoy gradually floats down via parachute and self-destructs before landing. Enemy missiles, aircraft, and ground radars are fooled by decoys, although the amount of time depends on the experience and skill of the opposition (typically from 20 to 60 seconds). During this time the enemy chases the decoy instead of you.

Infrared (IR) Jammer: The *IR Jammer* key (3) toggles this device on and off. When the jammer is running the "IRJ" light illuminates. This device emits heat pulses to confuse a missile's guidance system. The missile stops homing on your plane and flies straight ahead. The jammer is highly effective against "first-generation" IR missiles, but good only at long range against "second-generation" missiles (see page 83). Using the IR jammer reduces your speed, and it shuts down automatically to avoid overheating.

ECM Radar Jammer: The *ECM* key (4) toggles this device on and off. When the jammer is running the "ECM" light illuminates. This jammer "blinds" radar-guided missiles. The jammer is particularly effective against older "beam-rider" missiles, but good only at long range against "semi-active" radar-homers (see page 79). The only drawback to using ECM is that your EMV is increased.

Defenses Indicators



Damage

The upper left of the cockpit has a bank of "telltale" lights that indicate which systems (if any) are damaged.

Missile Warnings (MW): When the "MW" damage light is illuminated, the Missile Warning system is inoperative. The "RAD" and "IR" missile warning lights no longer work.

Engine (ENG): When the "ENG" light is illuminated, engine damage has reduced the maximum thrust possible. Any additional damage further reduces thrust.

Flight Control (FC): When the "FC" damage light is illuminated, flight control computer damage makes the F-117A more difficult to control.

Avionics (AV): When the "AV" light is illuminated, avionics damage has disabled your Inertial Navigation System (INS) and autopilot.

Bay Doors (BD): When the "BD" light is lit, the weapons bay doors are damaged and jammed open, permanently increasing your EMV.

Jammers (JAM): When the "JAM" light is illuminated, your ECM and IR jammers no longer function.

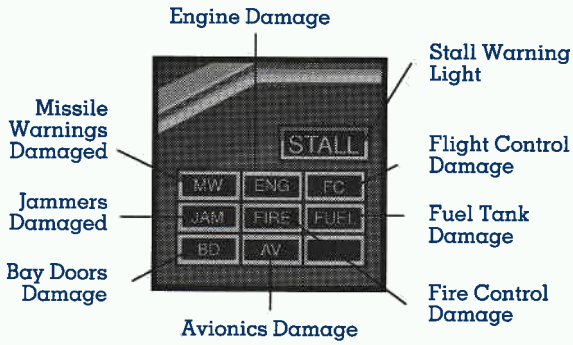
Fuel Tank (FUEL): When the "FUEL" light illuminates, damage and stress breakage is causing fuel to leak. Once a leak starts, any further damage increases the rate of fuel loss.

Fire Control (FIRE): When the "FIRE" light illuminates, your fire control systems are damaged.

Random Malfunctions: Your F-117A is an extremely complicated piece of equipment. Random malfunctions are possible in any of the systems at any time. The malfunction may include the reporting systems on board the craft. If so, you won't know that something has malfunctioned until you discover it doesn't work!

Malfunctions are more likely in intense combat situations, due to the heavy burden that places on your sophisticated electronic systems.

Damage Indicators



WEAPONRY

These instructions give the bare rudiments of weapons operation. Many important considerations and tactical tricks are described in "Chapter 3, Techniques and Tactics." See "Weapons Effectiveness," page 139, for a chart showing weapon effectiveness against various targets.

Selecting Weapons

The name of the weapon currently armed and ready for use always appears in the lower left corner of the HUD.

Weapon: Tap *Weapon* (F5) to display the contents of your weapons bays on the right MFD. The bay currently selected is highlighted, and the current armament appears in the lower left corner of the HUD.

Tap *Select Weapon* (Space Bar) to change the currently-selected weapon in your fire control system. Each key press switches to the next weapons bay, and the change is indicated both on the HUD and in the Right MFD Weapon display.

Cannon: Your 20mm cannon is always available for use (unless it is out of ammo or damaged).

Firing Weapons

Launching Weapons: Tap *Fire Weapon* (Return) to launch a weapon. This fires one missile or drops one bomb. The currently-selected weapon is the one used. See pages 68-73, for more specific instructions on launching weapons.

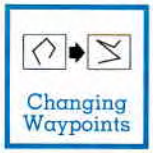
The *Reconnaissance Camera* (135mm/FLIR Camera) is "fired" like a weapon from an open weapons bay. Each "shot" takes one picture.

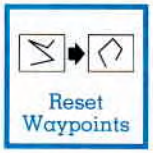
Special Equipment can be air-dropped by opening the bay doors and "firing" it out. It floats to the ground on a parachute. It is also loaded or unloaded on the ground at appropriate airstrips automatically (a message appears on your HUD when loading or unloading is complete).

Cannon: *Fire Cannon* (Backspace or Button 2) fires one burst.

NAVIGATIONAL SYSTEMS

Inertial Navigation System (INS)





Concept: The INS has up to four programmable "waypoints," to map a flight plan. The default waypoint setup puts the first point halfway between your starting base and primary target. The second is the primary target, the third is the secondary target, and the last is your landing point.

Waypoints Display: The *Select Way Pt* (F7) and *Change Way Pt* (F8) keys display a list of INS waypoints on the right-side MFD, and your projected flight path from waypoint to waypoint on the Satellite Map on the left.

The waypoints list display shows the current time at top, the ETA to each waypoint, and a fuel gauge across the bottom. The fuel gauge is a bar graph, predicting fuel consumption based upon your current speed and altitude. The far right side of the bar (black region) indicates fuel already consumed, the center parts (white for current waypoint and blue for others) indicates fuel needed to reach each waypoint, and the far left side (green region) indicates fuel reserves.

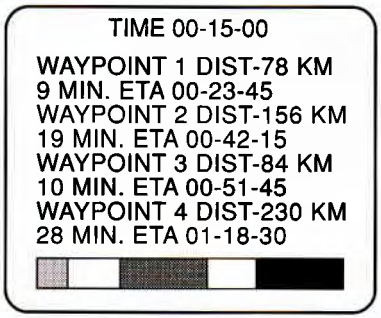
Selecting Waypoints: The waypoints list has one point highlighted (in white). This is the waypoint currently indicated by the INS cursor above the Heading Scale on your HUD.

To select a new waypoint, tap *Select Way Pt* (F7). Then use the *Last Point* (keypad 9) and *Next Point* (keypad 3) keys to move the highlight up and down the list. As you move the highlight the HUD's INS cursor moves accordingly.

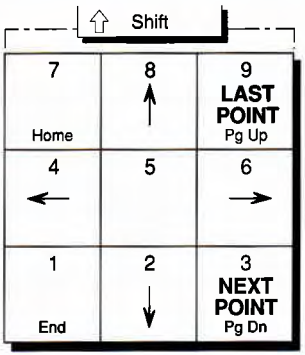
Changing Waypoints: To change a waypoint to a new location, tap *Change Way Pt* (F8). Then use the *Last Point* (keypad 9) and *Next Point* (keypad 3) keys to select the waypoint you wish to change. Finally, use the keypad waypoint keys to actually move the waypoint. You can watch the results in the left MFD on Satellite Map.

Tap *Reset Way Pt* (Shift F8) to reset all waypoints to the original waypoints.

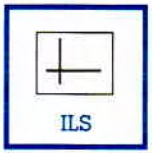
Waypoints CRT



Change Waypoints



Instrument Landing System (ILS)



The *ILS* key (F9) toggles the ILS display on and off. When the ILS is on, a vertical and horizontal bar appear on the HUD to guide you to the nearest friendly airbase.

Principles of Operation: The ILS is designed to aid you on final approach, steering you down a descending "glide slope" to the runway. If you are flying a pattern to land, use the ILS to guide you to the airport, then turn it off until you are "on final." The ILS guides you to the runway or carrier deck, but ends there. Rather than produce inaccurate readings over the runway, the ILS automatically turns off before it degrades to useless.

Vertical "Course" Bar: To use the ILS, fly the plane so that the vertical bar lines up with with vertical ticks of your Nose Indicator. This means you're on course toward the airbase.

Horizontal "Glide Slope" Bar: The horizontal bar of the ILS represents the "glide slope," an imaginary sloping line extending from the airbase into the sky. If the bar is above the horizontal ticks of your Nose Indicator, you are beneath the glide slope. You can either fly straight ahead until you "intercept" it, or climb to get to the glide slope faster. If the bar is beneath your Nose Indicator, you are above the glide slope and should descend until the bar aligns directly with the Nose Indicator.

POSTFLIGHT DEBRIEFING

After the mission you are debriefed. Your commander goes over the mission step by step, evaluating each event as it occurs and assigning a numerical score. Basically, if you accomplish the mission and follow the Rules of Engagement (see below), you'll do very well. The more difficult the opposition, the more credit you'll get.

ENDING A MISSION

Safe Landings

When you land, stop, and turn off your engines, the mission is over. You *cannot* refuel or rearm to continue the mission. Stealth missions are costly, carefully planned "one shot" operations. If a mission fails, higher-ups will decide later whether to try again, and if so, when, where and how.

Crashes

If you're using Easy or Realistic Landings, crashing the aircraft ends the mission *and* your career. To remain alive, you must eject before the plane hits the ground. Of course, selecting "No Crash" eliminates this problem – but greatly reduces your potential score.

Bailing Out

If you survive a bailout, you now have to worry about where you did it. Ejecting over the sea, far from an enemy coastline, is ideal because the aircraft sinks out of sight and you can be rescued. The next best location is over friendly territory. Again, you can be rescued, but fragments of the wreckage may be found by the public or by enemy spies. Bailing out over enemy territory is bad; even though your F-117A has a self-destruct mechanism, fragments of the plane will certainly be found by the enemy, teaching them valuable secrets of US stealth technology. In addition, you'll probably be captured and suffer a public trial and humiliation before the USAF manages to get you back.

SCORING

Objectives

Above all follow the Rules of Engagement and accomplish the primary objective – it's hard to do badly if you achieve this. Failing that, at least accomplish the secondary objective. If you fail both of these, it is difficult to gain any credit.

Cold War: It's important that nobody detect you. Visual sightings by enemy aircraft do the most damage. Enemy radars that positively track your plane are also bad.

Needless to say, random destruction is also unacceptable in Cold War, and destroying friendly planes and ground installations is the worst possible event. However, destruction of neutral or civilian targets is almost as bad. The least embarrassing events are destruction of enemy military targets, although even that should be avoided. In fact, the only time it is "permissible" to destroy targets is if your mission orders require it, the enemy has sighted or tracked you, or if the enemy fired first.

Limited War: It's also important to avoid detection during a Limited War, although the penalties aren't as great. Your commander wholeheartedly approves of attacks on enemy forces, including military aircraft and obvious military installations, but civilian targets (passenger airliners, oil wells, refineries, bridges, etc.) cause political problems and lower your score.

Conventional War: In this situation your commander doesn't care if you are detected, unless of course your plane is damaged by enemy fire (F-117As are very expensive).

You gain credit for destroying anything in enemy territory, even civilian targets (although military ones are worth more). In fact, your commander rather expects that you'll do a bit more than just hit the objectives. The only possible negatives come from the destruction of neutrals and friendlies.

REPUTATION

Combat Decorations

If your rating on a mission is high, your commander will recommend you for a decoration. The five possible decorations, from easiest to most difficult to achieve, are:

AM: Airman's Medal, recognizing good performance.

DFC: Distinguished Flying Cross, for superior performance in combat.

SS: Silver Star for Valor, for heroism in combat.

AFC: Air Force Cross, for extreme heroism.

CMOH: Congressional Medal of Honor, America's highest military decoration.

You must be outstandingly successful against the toughest opposition to be nominated for the Congressional Medal of Honor.

Other Decorations

The *Purple Heart* is awarded to pilots who come home wounded. Surviving a mission with a badly damaged aircraft frequently yields this award.

The *Combat Readiness Medal* is awarded to almost everyone in a combat unit. Beyond this, the number of missions you survive determines what other ribbons you may receive: 5 missions for the *Overseas Ribbon - Short Tour*, 15 missions for the *Overseas Ribbon - Long Tour*, 30 missions for the *Longevity Service Ribbon*, and 60 missions for the *Longevity Service Ribbon with Gold Cluster*.

Promotions

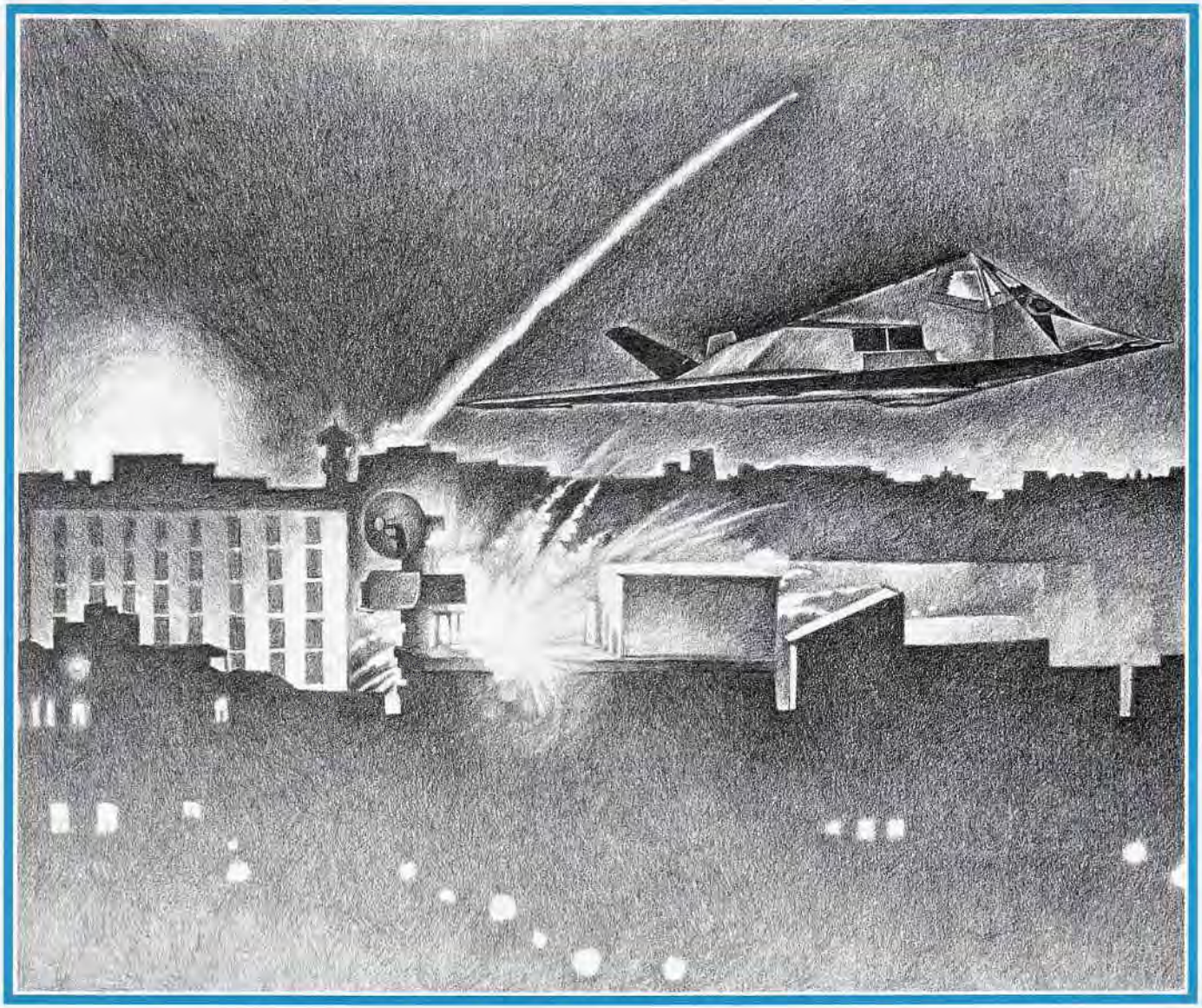
Your starting rank is 2nd Lieutenant. Promotions are based both on your total score *and* on your average score per mission. Therefore, if you "goof up" and do badly in a mission, you may need extra high-scoring missions before you qualify for promotion. In addition, you can't get promoted without sufficient experience.

Ranks available, from lowest to highest, include:

2nd Lt: Second Lieutenant
1st Lt: First Lieutenant
Capt: Captain
Maj: Major
Lt. Col: Lieutenant Colonel
Col: Colonel
B.Gen: Brigadier General

Brigadier General is not a flying rank. You don't have a chance of earning that rank until you're retired from active duty. No pilot is expected to fly more than 99 missions. After that the Air Force decides: are you promoted to Brigadier General, are you simply given a Washington desk job, or do they suggest you leave the service and seek your fortune in civilian life? Very few pilots survive 99 missions with a record good enough to earn their "star."

Incidentally, don't feel bad about a middling rank. In active fighter squadrons most pilots are First Lieutenants and Captains. Majors serve as flight leaders, Lieutenant Colonels as higher squadron officers or commanders, and full Colonels as squadron or wing commanders. Promotion to Major or above is increasingly difficult. A Lieutenant Colonel or Colonel still flying active combat missions is rare in the USAF.



3 TECHNIQUES AND TACTICS

HOW TO FLY

AERODYNAMICS AND FLYING

This discussion of lift and flight is not rigorous or precise in a scientific sense. It only provides a rudimentary portrayal of the physics of flight and its practical effect on aircraft handling.

Lift: Aircraft fly because of a pressure difference created by the difference in the speed of the air flowing over the top of the wing as opposed to the bottom. Air moves faster over the top of the wing than it does over the bottom, creating high pressure beneath the wing and low pressure above it. The wing is pushed upward to compensate, providing lift. When the pressure difference becomes great enough, the upward lift is greater than the plane's weight and the aircraft flies.

Speed and Lift: The amount of lift generated by the wing varies with airspeed. The faster the plane flies, the faster the air flows over the wings, and the greater the pressure difference. If your plane is in level flight at a certain speed, reducing the speed reduces lift, causing a descent (without nosing down).

Angle of Attack and Lift: The amount of lift generated also varies with the angle between the wings and the airflow. If you pitch up a few degrees, you increase the pressure difference and, therefore, the lift. If you pitch the nose down, the reverse occurs. The difference between the airflow direction and a horizontal line through the wing is the "angle of attack" (AOA). Angle of attack is visible on your HUD in NAV and GND modes. Whenever your Nose Indicator is above your Flight Path Indicator, the difference between the two is the Angle of Attack.

Level Flight: To achieve "level" flight at a given power setting, a pilot raises or lowers the nose until his vertical velocity is zero (no ascent or descent appears on the "VVI"). Note that a pitch of 0° may show ascent or descent. Nosing up or down to a new "angle of attack" adds or subtracts lift as needed to achieve level flight.

To achieve "level" flight at a given speed, the pilot gets into level flight, adjusts his throttle to achieve the desired speed, then adjusts his pitch to find level flight for that airspeed.

The Effect of Roll

The force of lift is always perpendicular to the wing, so if the wings are banked, the lift force is no longer straight up relative to the ground. Instead it has two components, one moving the aircraft sideways, the other straight up. This causes the plane to turn, and, since upward lift (the force opposing gravity) is diminished, to lose altitude.

During a turn the pilot can adjust the angle of attack by control stick "back pressure," that is, by pulling back slightly on the stick. The amount of adjustment is very small. Overcorrecting is a common error among beginner pilots.

Special Situations

Stalls: An aerodynamic stall occurs when the wing's angle of attack becomes too large. The air stops flowing smoothly over the wing, and instead part breaks away onto an independent path. This erases the pressure difference, vastly reduces lift, and generally causes the nose to drop. Stall speed varies considerably depending on many factors. Tight turns increase the stall speed. Note that simultaneously the act of turning tends to decrease your airspeed. As a result, stalls are quite common in tight turns. The F-117A has an audible stall warning horn, a Stall Warning Light in the upper left of the console, and a colored bar showing stall speed on the HUD's Airspeed Indicator.

The F-117A includes a computerized stall recovery governor that instantly reconfigures the wing edges for automatic recovery, making your job much easier. To recover from a stall, first level the wings, then bring the pitch back to normal. A stall invariably costs you altitude, so a stall at low altitude can be fatal!

Flaps: Lowering flaps extends the wing surface and increases the pressure difference, adding more lift. They also increase drag, which lowers your speed. However, flaps are only useful at low speeds (under 350 knots).

FLYING THE F-117A

The F-117A is unflyable. The design is one of the most surprising ever seen – many experts said it wouldn't fly when they first saw it. In fact, a pilot would find it very difficult – maybe impossible – to fly without the aid of sophisticated onboard flight control computers. This aircraft, like some others, is said to "fly by wire."

The pilot uses a normal control stick (much like your joystick) and uses it just like a pilot of a normal civilian aircraft. But the pilot is not communicating with the control surfaces of the aircraft; instead he is talking to the computer, and it is talking to the control surfaces. When the pilots says "bank," the computer interprets his command and makes the wings bank, all the while correcting this and that to keep the plane airborne.

Remember, when you are flying this aircraft, you are interfacing with a computer that is flying the aircraft!

Taking Off

While sitting on the runway, perform the following pre-flight check-out:

1. **Check Your INS.** Tap *Maps* (F3) until the satellite map is displayed on your left MFD. Now tap *Select Way Pt* (F7) to show the INS waypoints list on the right MFD. The INS cursor above the heading scale on the HUD indicates the direction in which you must fly to reach the first waypoint listed on the right MFD; by using the *Next* and *Previous Waypoint keys* (Shift/keypad 3 and 9) you can cycle through all the waypoints currently assigned. Advanced pilots may want to change the location of one or more waypoints at this time.
2. **Check Armament:** Tap *Weapons* (F5) to check your weapons on the right MFD. Use *Select Weapons* (Space Bar) to cycle through the weapons. Note the active weapon appears in the lower left corner of the HUD.
3. **Extend the Flaps:** Tap *Flaps* (9). Note the "FLAPS" light in the upper right corner of the console. Flaps increase lift during takeoff.
4. **Check the Catapult System (Carriers only):** When launching from an aircraft carrier, the brakes will be set. The "BRAKE" light will be illuminated.
5. **Start the Engines:** Start your engines by tapping *Max Pwr* (Shift +).
6. **Activate Catapult (Carriers only):** Tap *Brakes* (0) to release the brakes and catapult, hurling you off the deck.
7. **Accelerate Past Stall Speed:** As you move down the runway or carrier deck, watch the speed scale (left side of the HUD) carefully. A colored bar (Stall Speed Indicator) will gradually go down. When it drops below the center tick-mark, your plane is past stall speed.
8. **Climb into the Sky:** Pull back gently on the stick. As you start climbing, watch the altitude scale on the right side of the HUD.
9. **Retract Landing Gear:** Tap *Gear* (6) to raise your landing gear. Don't leave the gear down — both it and your plane can be damaged if left down at high speeds.
10. **Retract Flaps:** Tap *Flaps* (9) to retract flaps. You no longer need extra lift.
11. **Turn onto Course:** Pull the stick left or right until the INS cursor is aligned with the center tick on the heading scale. Alternatively, you can simply tap *Autopilot* and let your autopilot turn you onto the correct course to the first waypoint. Since this is a stealth mission, you'll want to stay low. About 200' to 500' is ideal.

Smooth Flying Techniques

A Light Touch: Use a light touch on the *Control Stick*. The most common error is a "ham fist" on the stick, throwing the plane around the sky in wild abandon. Unless it's an emergency never push the stick to the limit.

Chasing the Gauges: When you change an aircraft's operating regime (move the stick, change the throttle, and so on), the effects of the change takes a second or two to "settle out" and show on the gauges. For smooth flying, make a change then observe the effects before making another. Constant adjustment and correction should be avoided, because all you'll do is "chase the gauges," overcorrecting every move.

Straight and Level Flight: To be a good combat pilot, you must master level flight. Do this in a training scenario, rather than real life.

Climb to an altitude of about 2,000' and level the aircraft so the nose of the plane points at the horizon. Now reduce the throttle to about 75% to achieve an economical cruising speed. Although the Nose Indicator appears level with the horizon, the HUD's altimeter and VVI probably show the plane is climbing or descending. If you're climbing, push forward on the Control Stick, then let go and observe the effects. If you're descending pull back a bit instead. Your objective is to keep the altimeter rock steady.

You'll notice that your Flight Path Indicator aims at the horizon, but your Nose Indicator may be pointed above or below it, depending on your speed. Generally, the slower you're travelling, the higher you must pitch the nose to achieve level flight.

Now experiment a little. Tap *Brakes* (0). This slows down your plane. Watch the HUD and notice how the Flight Path Indicator drops. Meanwhile, on the sides of the HUD, your speed is dropping and so is your altitude. To achieve level flight at this new, lower speed pitch up until the Flight Path Indicator is level with the horizon.

Turns: As you pull the stick right or left and your roll angle increases beyond 45°, the stall speed rises from the normal 120 knots (kts) range to over 200 kts (in a 90° roll). Tight turns "bleed off" airspeed, so a long, tight turn may cause a stall. Keeping an eye on the airspeed and stall speed is particularly important when making tight turns at low altitude, because stalls cause you to lose altitude rather quickly.

In extremely tight turns (where you roll 80°, 85°, or even 90°), you can tighten your turn rate by pulling back on the stick. However, this bleeds airspeed even faster, so keep a close eye on the Stall Speed Indicator bar.

Loops are easy in the F-117A, but ballistic ("straight up") climbs can be maintained only for short periods.

Remember that any prolonged vertical maneuver greatly reduces airspeed, which risks a stall if you didn't start the maneuver with a lot of speed. However, going vertical is very handy for changing direction, since you can roll while vertical, quickly pointing your nose in the desired direction, then push down into level flight again.

Low Altitude Flying: At altitudes under 500', expect increased buffets, downdrafts, and other irregularities that make flying difficult. Also beware of low ridges and mountains. It's easy to fly into a mountain if you're not looking. Good pilots develop a "cross check" routine of scanning the entire HUD periodically, to make sure everything is okay.

In "No Crash" and "Easy" flight modes you have a barometric/laser altimeter. If you drop below 200' this device automatically but gently pushes your plane back up. Be warned, the device automatically turns off when the landing gear is down, or when the gun is firing. The device is *not* proof against power dives, stalls, or other radical maneuvers, but works fine in normal flight regimes. In fully realistic flight the automatic altimeter is turned off, allowing skillful pilots to cruise at even lower altitudes.

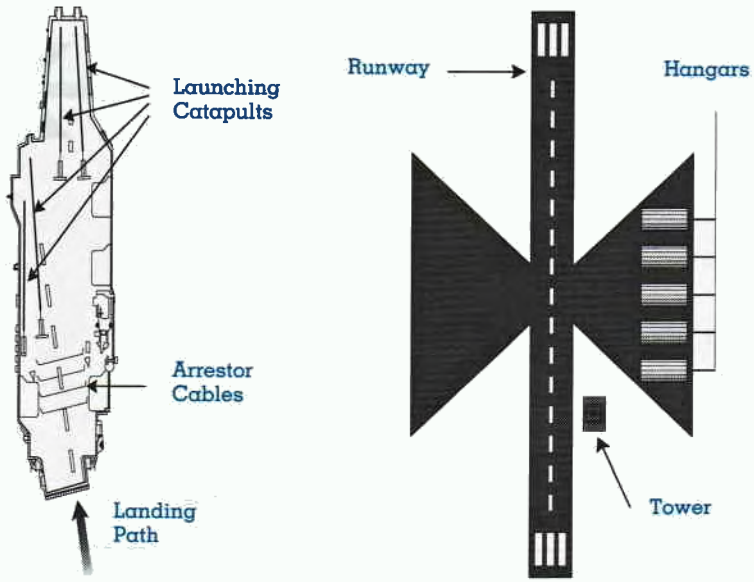
LANDING THE F-117A

Airbases: All airstrips have a north-south orientation and a center stripe down their middle. On approach, a course of 000° (if coming from the south) or 180° (if coming from the north) will align you with the runway.

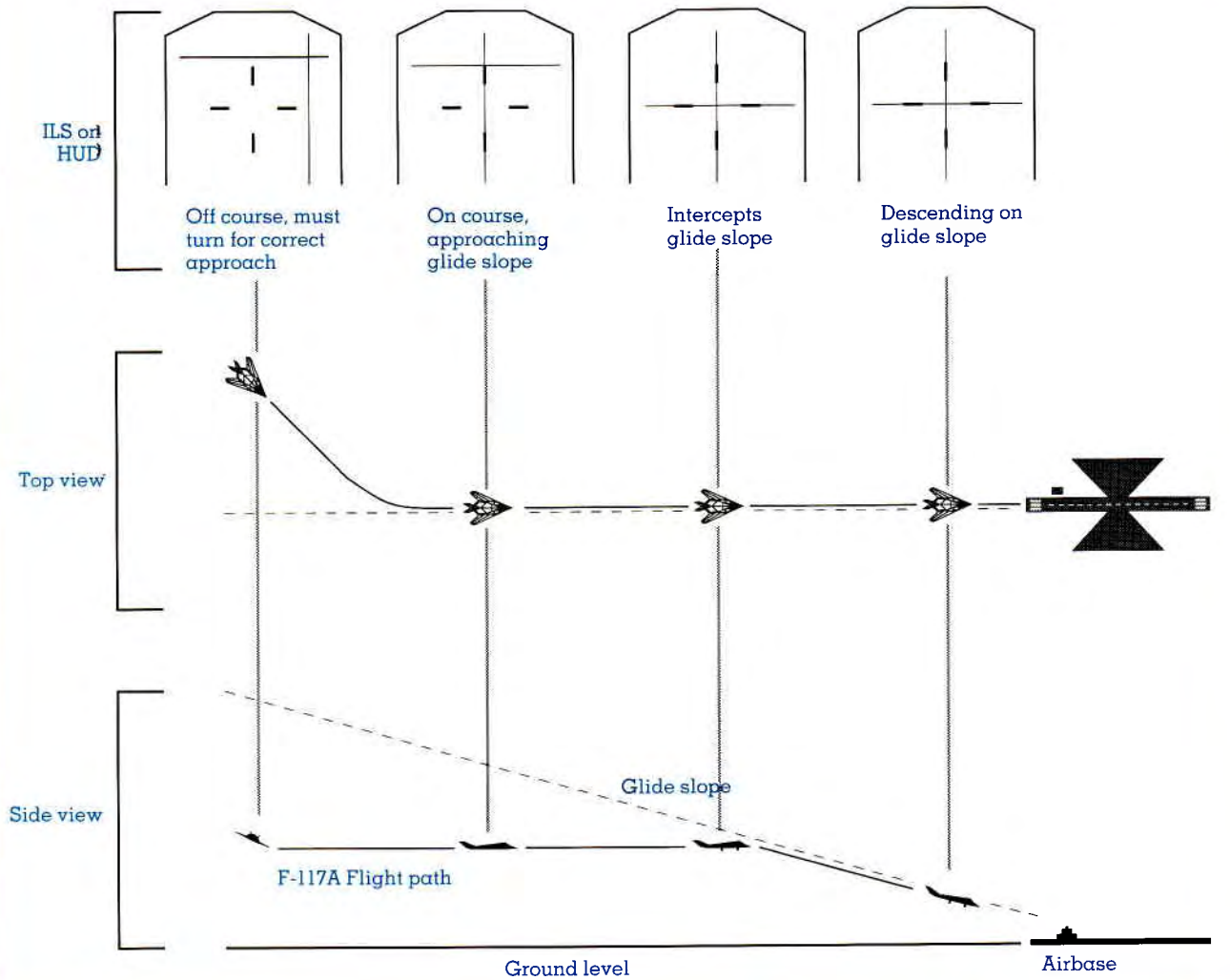
Airbases are more than twice as long as your safe landing distance at 200 kts — a large safety margin. Aircraft carriers have arrestor cables near the stern. You must touch down before or on these cables in order to stop before rolling off the deck. Do not attempt to land on the bow of an aircraft carrier because there are no arrestor cables there. Furthermore, regular aircraft spotted for launching may be positioned there, and you certainly don't want to crash into them!

Aborted Landings: If you get in trouble landing, open the throttle to full power and retract the flaps and landing gear. Climb away and come around for another try. Do not make sudden movements with the control stick while landing or aborting. Wait for your airspeed to exceed 300 kts before making any big turns or similar maneuvers. Until then, gross maneuvers with the control stick may stall the plane, causing a fatal crash.

Typical Airstrips



Using the ILS (Instrument Landing System)



Using the Instrument Landing System (ILS)

To use the ILS, tap *HUD Modes* (F2) as necessary to switch the HUD to NAV mode, tap *Cam Ahead* (/) to activate the Tracking Camera, and tap *ILS* (F9) to activate the ILS. The ILS and camera will automatically track the nearest friendly or neutral landing site. It will *not* track rough airstrips behind enemy lines.

Line Up Your Approach: The first step is to line up on the correct course to the airbase (or aircraft carrier). To do this, fly at 500' to 1,000' to a point about 40 to 50 kilometers (km) north or south of the base and turn until the ILS vertical bar is centered on your Nose Indicator.

Intercept the Glide Slope: Once you're on course, you want to intercept the glide slope represented by the horizontal bar. Descend until the horizontal bar is slightly above the horizontal ticks of your Nose Indicator. The horizontal bar gradually drops until it aligns with the horizontal ticks of the Nose Indicator. When this occurs, you are intercepting (flying through) the glide slope.

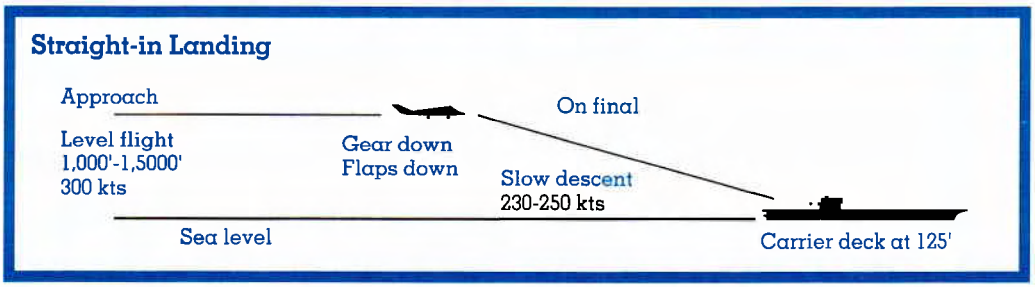
Descent: Once you've intercepted the glide slope, begin your descent. Keep the horizontal bar centered, which means making a gradual descent. You must manage the descent like a normal landing (see "Descend on Final," below).

Touch down: The ILS will not guide you to touchdown. It is not accurate in the immediate vicinity of the base. It turns off automatically before you reach the runway.

ILS and Landing Patterns: The ILS is designed to guide you to the airbase. It does not control your plane through a landing pattern.

Straight-in Landings

1. **Line Up Your Approach:** Use the ILS to line up a correct approach. Beginners intercept the glide slope about 40-50 km from the runway. Attempting to find the approach and make a landing less than 20 km from base is *not* advised for the beginner.
2. **Throttle at 70%:** Fly your approach at 500' to 1,000'. Reduce the throttle to about 70%, which should reduced your speed to about 300 kts. Eventually you'll need to pitch up (raise the nose) a little to maintain level flight.
3. **Flaps Out, Throttle 50%, Gear Down:** Now extend the flaps and reduce the throttle to about 50%. This slows the plane to about 230 kts. As you reach this speed, lower your landing gear. If you're moving too fast, extend the brakes – tap *Brake* (0) – for a brief period.
5. **Descend On Final:** When the ILS' horizontal bar reaches the middle of the HUD Nose Indicator, you should start descending down the glide slope.
   Reduce the throttle slightly. If you were in level flight, you will gradually descend with your Nose Indicator above the Flight Path Indicator.
   Use the ILS horizontal bar to control your rate of descent. Adjust the throttle to keep the bar in the middle of the Nose Indicator.
   Finally, keep an eye on your airspeed and Stall Speed Indicator. If the stall bar indicator gets within 25 kts of your current airspeed, your throttle is too low. Conversely, if your airspeed is over 250 kts, extend the brakes for a brief period.
6. **Touch Down:** Your altimeter reads 0' on a runway, and 125' on an aircraft carrier. These are your "touchdown" altitudes. The safe touchdown vertical velocity is shown by an arrow on the VVI of your altimeter. A vertical velocity of 400'/minute or less (4 ticks on the scale) is always safe. In certain conditions a higher vertical velocity is allowable. Once you're on the runway, cut the power by tapping *No Pwr* (Shift -), and engage the brakes by tapping *Brakes* (0).
   Aircraft Carriers: Landing on a carrier is slightly more difficult, since you must touch down in the arrestor cables area. To avoid overshooting the cables, increase your descent by lowering the nose a little, then at the last second extend the air brake by tapping *Brakes* (0) as you pull the nose up.
   If you miss the carrier's arrestor cables, don't bother trying to touch down. Instead close the brakes tap the *Max Pwr* (Shift +).



OFFENSIVE ACTIONS

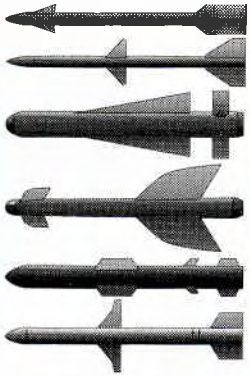
This section provides a short primer on how to use your weapons. Also, see page 139, for a chart indicating your various weapon's effectiveness against various targets.

FINDING AND HITTING A TARGET

1. **Find the Target:** Your primary and secondary targets are stored in your INS, initially as waypoint 2 and 3. If you've moved the waypoints, you can reset them by pressing *Reset Way Pt* (Shift F8).
   To reach the target, call up the waypoints by pressing *Select Way Pt* (F7), select the appropriate waypoint by tapping *Next Point* (Shift/keypad 3), then steer toward it following the INS cursor above the HUD Heading Scale.
2. **Check HUD Mode:** Change the HUD to the correct mode. Use *HUD Modes* (F2) to select the right mode: AIR (for firing at aircraft), or GND (for firing at ground targets).
3. **Use Tracking Camera:** Lock your tracking/targeting system onto the nearest target ahead, by tapping *Cam Ahead* (/). The display remains blank if there are no targets ahead within 80 to 100 km.
   To track other targets, tap *Select Target* (B). The tracking/targeting system is limited to targets stored in your onboard computer database. This group, of course, always includes your primary and secondary targets. To find the right target, you may have to tap *Select Target* (B) several times. When the primary or secondary target is located, your right MFD informs you.
   To track a target not stored in your onboard computer tap *Designate New Target* (N). The nearest potential target ahead is temporarily added to the computer's database. Once you've added a target to the database, it remains in the computer, and becomes part of the group that *Select Target* (B) cycles through. You can store only one new target in the database at a time.
4. **Select Weapon:** Tap *Select Weapon* (Space Bar) to cycle through the weapons in your bays. (Your cannon is always available.)
   Make sure you have the correct weapon selected. The size and color of the Tracking Box on the HUD indicates how effective the current weapon is against that target (see Display Colors Summary in the Appendix).
5. **Aim and Fire:** Different weapons are aimed in different ways, described below. Depending on the weapon selected, make sure it is correctly aimed at the target before you fire.
6. **Observe Results:** Friendly AWACS aircraft observing your mission report the results. Sometimes a hit damages a target without destroying it, sometimes you miss entirely, and other times a hit may be ineffective. Ineffective hits are caused by using the wrong weapon, or because the weapon malfunctioned.

FIRING YOUR MISSILES

Self Guided Missiles



AIM-9M Sidewinder
AIM-120 AMRAAM
AGM-65D Maverick
Penguin-3 ASM
AGM-84A Harpoon
AGM-88A HARM

All your missiles are self-guided (fire-and-forget) weapons, and there are several available to you. Some are used against enemy aircraft and others are used against ground targets. All fire-and-forget missiles are aimed and fired in a similar fashion (described below).

Missile Targeting Envelope: If the HUD is in AIR mode and an air-to-air missile is your current weapon, the Missile Targeting Envelope appears on the HUD, outlining the limits of your missile's seeker head; though your Tracking Camera can lock-on to a target any where, the air-to-air missile itself can lock-on to in-range enemy aircraft only within this circle. In GND mode, no targeting envelope appears, but a missile cannot lock onto a target that is not currently visible through your HUD.

Oval Lock-on: When the Tracking Box turns oval (and the "LOCK" light on the console begins flashing), the missile is locked-on to the target and has a good chance of hitting. When the oval turns red (and the "LOCK" light stops flashing), the missile has superior accuracy. Additionally, when the missile locks-on, a box (the "Lock Box") appears in the Tracking Camera display, and when you have attained superior accuracy, the Lock Box begins repeatedly contracting.

To fire, open the weapons bay by tapping *Bay Doors* (8) and then tap *Fire Weapon* (Return/Enter).

Restrictions and Suggestions: Missiles drop about 300-400' – with whatever airspeed, climb rate, or dive rate your plane has – before their own power carries them away. As a general rule, launching below 500' or in a power dive is not a good idea, and may even be dangerous. It is also unwise to launch while in a tight turn or inverted, as the missile may tumble when leaving the bay, losing guidance or even smashing into your plane. Once the missile is launched you can change to new targets, new weapons, and maneuver as you wish.

FIRING YOUR CANNON

20mm Cannon

Your cannon has a maximum range of 6 km and an effective range of about 3 km.

Air-to-Air Anticipation Firing: Your cannon's fire control system uses a "historical gunsight" that shows where your shells would be landing, if you'd fired a few seconds ago. Unless you're tracking a target, the fire control system assumes the range to be 6 km, and places the gunsight to show where the shells would be had they been fired 6 seconds earlier (the approximate time it would take the shells to travel 6 km).

If you *are* tracking a target, the system uses the current range to the target to calculate where to place the sight on your HUD. The Tracking Box shows the targeted enemy airplane and the range to the target appears in the right MFD.

To fire, you must "anticipate" when the enemy and your gunsight will meet. For example, if the enemy and your gunsight are converging and the range to the target is 6 km, you should open fire about 6 seconds before they converge. If you estimated correctly, they will converge just as your gunsight moves onto them.

Air-to-Ground Walking Fire: Attacking ground targets is much easier, since they don't move. The easiest way is by "walking" your fire over the target. Do this by flying low (about 500'), opening fire about 6 km from the target and observing where the shells hit the ground. Guide your plane to "push" the advancing explosions onto the target. Unfortunately, this technique consumes ammo rapidly unless you fire short, well-spaced bursts.

BOMBING

PAVE TACK Laser-Guided Bombs

Laser-guided bombs are essentially motorless missiles that glide from your plane to a target "painted" by the PAVE TACK laser mounted on your plane. Operating these weapons is a lot like launching self-guided missiles. You use the tracking/targeting system in exactly the same way with only a few exceptions.

Oval and MFD lock-on: The Tracking Box on the HUD frames your target and the Tracking Camera is locked onto it. When the Tracking Box turns oval, the bomb is locked onto the reflected laser energy and has a good chance of hitting. When the oval turns red, the bomb has superior accuracy.

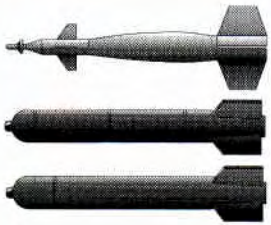
However, because you must release the bomb so close to the target, you often can't see the Tracking Oval when it turns red; for this reason, you must rely upon the console "LOCK" light and Lock Box in the Tracking Camera to tell you when the optimal release time is.

The Lock Box appears on the right MFD and the "LOCK" light begins flashing when the Tracking Box turns oval. When the optimal release time is reached, the "LOCK" light ceases flashing, and the Lock Box on the right MFD begins repeatedly contracting.

Toss Bombing: Glide bombs travel as fast as your plane, so if you release at low altitude, they hit the target when your plane is about directly overhead; if you're not careful the explosion can destroy you.

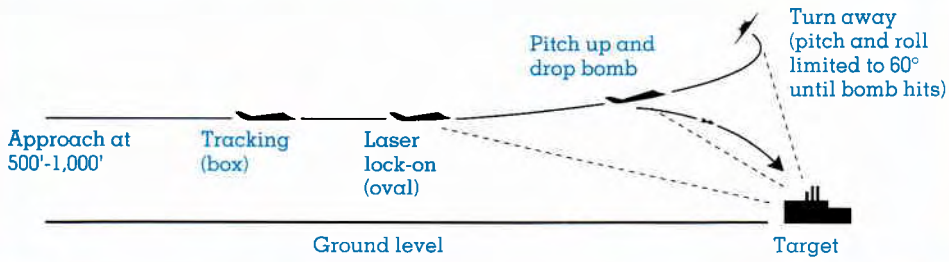
The standard attack technique is called "toss bombing." Approach fast and level at about 500'. When 3-6 km from the target pitch up into a 30-40° climb, tap *Bay Doors* (8) to open the bay, and watch the right MFD. When optimal release time is reached (the Lock Box begins contracting and the "LOCK" light stops flashing), tap *Fire Weapon* (Return/Enter) to release the bomb and turn away.

Laser-Guided Bombs



GBU-12 Paveway
CBU-72 FAE
MK 20 "Rockeye" II

PAVE TACK Laser-Guided Toss Bombing

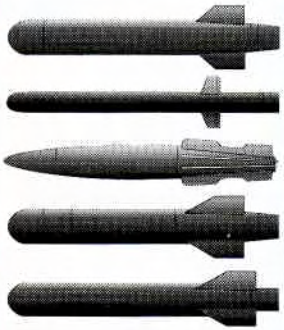


Level Bombing: You can also level bomb with glide bombs. As a general rule, though, you'll need to attack from at least 2,000' altitude. Here you can lock onto the target at 4 km range. Attack immediately and turn away. Needless to say, however, high altitude attacks make you a sitting duck for enemy radar and SAMs.

Restrictions and Suggestions: You must keep the underside of your aircraft facing the target until the bomb hits. If not, the laser guidance breaks and the bomb will almost surely miss. You can fly over the target instead of flying past at an angle, but you must rise above 3,000' to do this safely. However, the blast has a danger zone of roughly 3,000', so you must gain enough distance or altitude to avoid the blast.

Retarded Bombs

Retarded Bombs



Mk 20 Rockeye
Durandal
Mk 82-1 Snakeye
Mk 35 Incendiary Cluster
ISC BB-1 Minelets

Retarded bombs are unguided but have parachutes or special fins to slow them down very quickly as they fall. As a result, you can be far away by the time they impact, allowing safe low-altitude bombing runs.

Level Bombing: Dive bombing and toss bombing don't produce useful results with retarded bombs, so you must use level bombing. In this standard technique for low-altitude runs with retarded bombs, fly straight and fast over the target at 600-800', releasing the bomb(s) according to cues from the Flightpath Guide and Ranging Bar on the HUD.

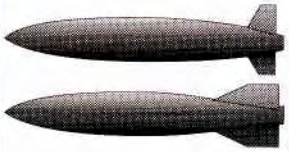
Flightpath Guide: When using retarded bombs, the diamond-shaped Flightpath Guide appears on your HUD. Turn to align the Flightpath Indicator to the Flightpath Guide. You can be above or below the Flightpath Guide without losing accuracy, but being left or right of it may cause a miss.

Ranging Bar: As you approach the target, the Ranging Bar appears on the HUD. As you near the target, the bar begins to collapse; the cue to release is when the line becomes a single dot. You may wish to extend your brakes to make the bombing run more manageable.

To Release the Bomb, tap *Bay Doors* (8) to open the bay, then *Fire Weapon* (Return) to release the weapon. If your brakes are extended, retract them immediately after launch to escape the blast area.

Restrictions and Suggestions: Retarded bombs are the easiest and safest weapons to use, and one of the most popular among USAF pilots. If you keep up speed in your bombing run, you can safely release from 600', even though the blast area is 3,000'. The Ranging Bar and Flightpath Guide flash if you're too low for safe release. However, the targeting system predictions assume you'll continue to fly "as is." If you drop the bomb, then immediately turn up and away, you could drop a bomb within the "danger area" and escape.

Free-fall Bombs

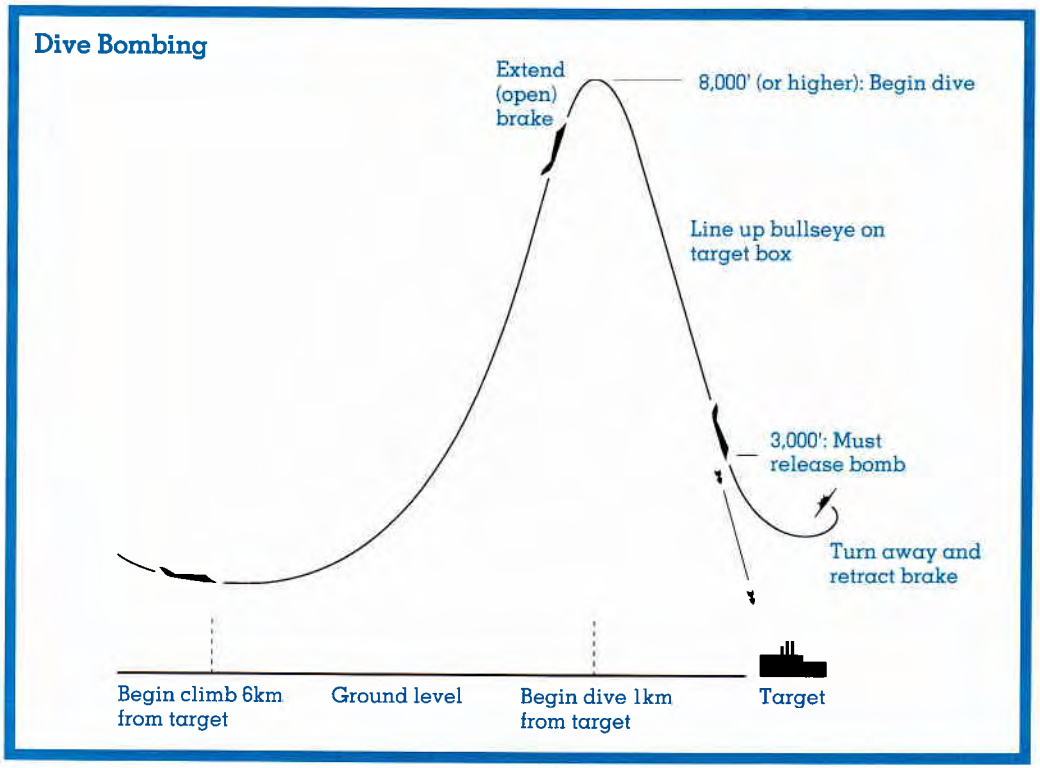


Mk 82-0 Slick
Mk 122 Fireye

These are traditional bombs that arc down at high speed toward the target. In level bombing, the techniques for using them are identical to those for retarded bombs except that you need to be considerably higher to release them safely. A safe minimum altitude for releasing a free-fall bomb in level bombing is 3,000' as opposed to 600' for retarded bombs.

Level Bombing: You use the Flightpath Guide and Ranging Bar just as you do for retarded bombs, but you have one additional HUD cue: the Bombsight Fall-line and Bullseye. In level bombing this indicator may be ignored.

Bombsight Fall-line and Bullseye: This indicator appears on your HUD as a line extending from your Flightpath Indicator to the place on the ground a bomb would hit were it released now. At that point is a red oval bullseye. In level bombing the fall-line indicator usually extends off the bottom of the HUD, with the bullseye out of sight below. But in dive bombing it is indispensable.



Dive Bombing: To make a dive-bombing attack, start by flying low toward the target. Switch your HUD to GND mode, make sure the correct weapon is selected (Mk 82-0 Slick or Mk 122 Fireye), and put your Tracking Camera onto the target. Now follow these steps:

1. *Guide on the Bombsight Flight Path:* Approach the target by flying straight at the diamond-shaped bombing flight path indicator. It's okay if the indicator is above or below your flight path, but make sure it's not to the left or right.

2. *Climb to Attack Point:* When the target is about 6 km away (you can tell by looking at the right MFD), zoom up into a 55° climb to an altitude of 8,000' opening your bay doors as you climb (tap *Bay Doors* (8)). Your objective is to reach 8,000' about 1.5-2 km from the target.

3. *Dive onto the Target:* Level out, flick open the brakes (tap *Brakes* (0)). At just under 1 km away, push down into a steep (80°) dive and align the Bomb Bullseye with the target box. Keep an eye on your altitude because you must release the bomb before reaching 3,000'. If you can't line up the Bullseye and Tracking Box before reaching 3,000', pull out and try again.

4. *Release Bomb and Turn Away:* If you manage to keep the bullseye steady within the target box before reaching 3,000', release a bomb immediately (tap *Fire Weapon* (Return)), then another if possible. After the release pull up sharply and roll away in a 90° turn. Close the brake (0) as you do this, to maintain maximum speed into the turn. Then close the bay doors (8).

Suggestions: The zoom climb to 8,000' is the most critical phase of the attack. If performed flawlessly, a 55° climb will cover 4 km of ground, assuming you start at maximum level speed at 200' and wish to arrive at 8,000'. Some pilots prefer to use a slightly shallower zoom climb up to 10,000', but this exposes you longer to enemy detection.

Climbing to a dive bombing position usually broadcasts your presence to the opposition. Therefore, once you're turning away from the target after the bombing run, look over and check the missile warning lights for an attack.

The most common mistake when dive bombing is forgetting to open the brakes at the top of the climb. With the brakes closed you plummet so fast it's almost impossible to line up the target and release the bomb before reaching 3,000'.

Restrictions: The HUD bombing symbols flash if you're within the blast area of the bomb (within 3,000' of the predicted drop point). Do not drop the bomb unless you're confident you can escape the blast.

PHOTOS AND SPECIAL EQUIPMENT

135mm/IR Recon Camera

The 135mm/IR Camera is a reconnaissance camera mounted in a weapons bay. It is fixed forward (unlike your target Tracking Camera, which moves) and looks down.

Camera Operation: To configure your HUD and cockpit for camera operations:

1. Switch the HUD to GND mode by tapping *HUD mode* (F2).
2. Select the bay containing the camera by tapping *Select Weapons* (Space Bar).
3. Aim the Tracking Camera at the target by tapping *Cam Ahead* (/); tap *Select Target* (B) if necessary.
4. Tap *Bay Doors* (8) to open the bay doors.

Taking Pictures: When you open the bay, you see the ground below and just ahead of your plane in the right MFD, which is now viewing through the lens of the camera. Fly so that the cross symbol ("+") in the lower center of the HUD passes through the center of the Tracking Box. When this happens, you'll see the target pass through the lens on the right MFD. As it does, hit *Fire Weapon* (Return) one or more times to take the pictures. You'll see a message on the HUD indicating a good picture (when and if you get one).

Special Equipment

Delivering or Picking up Equipment: As a stealth pilot, you'll be required to make deliveries of highly classified materials; you may also be asked to pick up top secret items. Finding a secret airbase and landing there is a major challenge. They have no ILS system – just a few flares at either end of the runway! Furthermore, the runway is very short; it's only half the length of a runway at a major airbase.

To pick up or deliver equipment at a secret airbase, you must safely land at the airbase. Equipment is unloaded or materials delivered to you automatically. A message in the HUD indicates when this has occurred and you can take off again.

Dropping Equipment: To drop equipment, tap *Select Weapons* (Space Bar) until "EQUIP" appears in the lower left corner of the HUD. Tap *Bay Doors* (8) to open the bay, then, as you pass over the radio beacon, launch the equipment by tapping *Fire Weapons* (Return/Enter).

The minimum safe altitude to drop equipment is 500'. Try to avoid dropping it from altitudes above 1,000', since the higher you are the less accurate the drop.

DEFENSIVE ACTIONS

RADAR AND STEALTH TACTICS

Radar

Radar sends high frequency electromagnetic waves through the atmosphere at virtually light speed. These waves are reflected from solid objects –some return to the radar set, which includes a receiver. By measuring the strength and angles of returning waves, and time it took to return, radars estimate the range, position, heading, and size of an object.

Radar waves bounce best from solid, dense, flat, perpendicular surfaces. Traditional aircraft shapes, especially aircraft engine intakes and vertical tail fins make excellent radar reflectors.

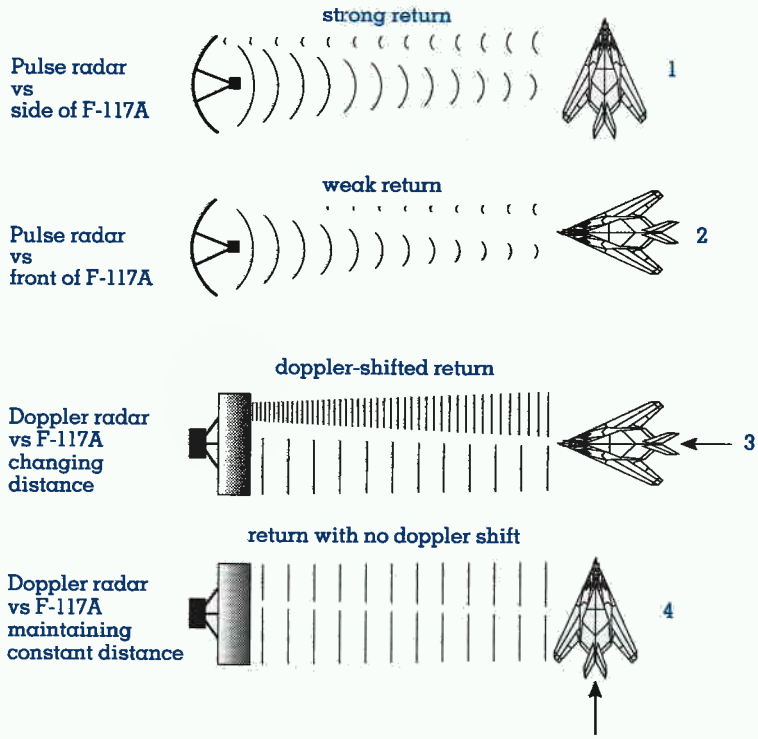
Radar Effectiveness: The effectiveness of radar varies with terrain, range, and type (pulse or Doppler). Radar is most effective over open water or flat countryside. In wooded and rolling hills radar effectiveness is less, while in mountainous country it is greatly reduced. The lower the radar effectiveness, the weaker the signal on your EMV scale: the bars representing enemy radar signals become shorter.

Radar Range: Radar effectiveness is dramatically affected by range; the closer you are to a radar, the stronger its signal. Maximum range for a radar varies dramatically with the set. As enemy radars emit signals you can graphically see their ranges on the Satellite/Radar map on the left MFD (*Maps*, F3).

Pulse Radar: Pulse radar is represented by dotted arcs on your satellite map. It is least effective when your nose or tail is pointing toward it, and most effective when you fly at right angles to it. Therefore a common tactic is to fly directly at a pulse radar, then just after it emits a signal make a tight turn and fly away from it again.

Doppler Radar: Doppler radar is represented by solid arcs on your satellite map; it is generally more powerful than pulse. Doppler radar is most effective when you're flying toward or away from it, and least effective when you fly at right angles to it. Therefore a common tactic is to fly toward a Doppler until just before it detects you, then turn and fly in an arc around it, keeping a constant distance.

Pulse and Doppler Radars



Figures 1 and 2 illustrate an F-117A reflecting pulse radar. When the F-117A has a low signature, the return can be so weak that he plane is "visible" to the radar. Note that the radar power varies, so the F-117A might be "visible" to a more powerful radar at that range. Power also varies with range, so the F-117A could become visible to either at a short range.

Figures 3 and 4 illustrate an F-117A returning the pulses of a Doppler radar. Here the change in frequency is more important than the strength of the signal (although the F-117A's low signature still has a minor effect). If the F-117A is changing distance to radar as it flies (Figure 3), it generates a Doppler shift. The radar recognizes this and detects the plane. However, if the F-117A remains at a constant distance (Figure 4), there is no Doppler shift and the plane is not detected.

Stealth Technology

The radar reflections of an object are greatly reduced if its shape minimizes the returning waves. This does not make the object invisible, but does make it very hard to "see." For example, if a normal airplane is visible to radar at 200 km, a carefully shaped airplane might be invisible beyond 50 km! Creating this shape in a form that is also aerodynamic requires extremely complex computer modeling. As the world's leader in computer applications, it's inevitable that the US would be first in this field. The SR-71 spy plane is an early example of such shapes in aerodynamics; the redesign of the B-1 bomber fuselage is another example. Both these aircraft, though, have curved fuselages that tend to scatter radar energy equally in all directions, and therefore aren't entirely successful.

In addition to shape, certain rubber and ceramic compounds "absorb" radar waves, making the return signal weaker. Known generically as Radar Absorbent Material (RAM), it can be incorporated into paints, or planted in "wedges" along the surface of a wing or fuselage.

Finally, an airplane's heat signature is an important consideration. Many airplane-killing missiles (IR-guided ones) home on heat sources like friction-heated parts of the craft, such as leading edges of the wings, tail, and air intakes. The main defense against heat-seekers is heat-resistant materials, and masking and dispersal of hot engine exhaust.

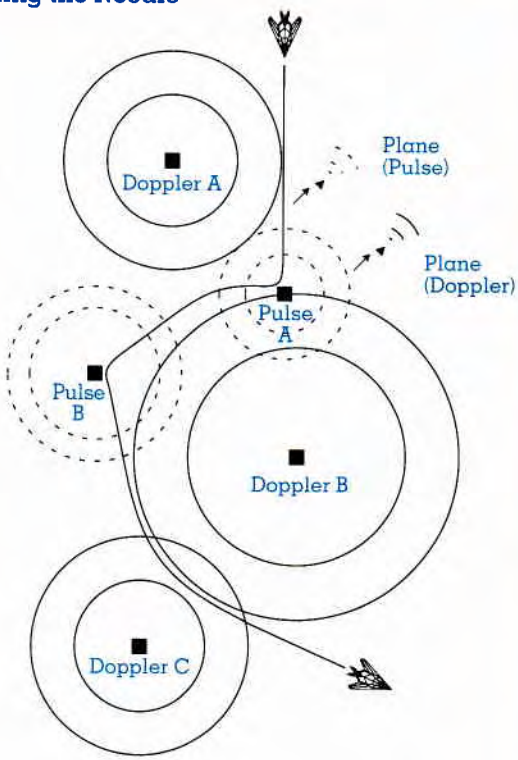
The F-117A is a combination of all these design considerations. It sacrifices speed, maneuverability, and payload for maximum stealth. The fuselage is made up entirely of flat "facets" that scatter radar energy in a controlled, predictable pattern, which, under most circumstances, will not reflect radar transmissions back to the transmitter. Even if the energy *does* strike one of the plane's flat surfaces, the effect is transitory because the angle of incidence is constantly changing due to the plane's motion relative to the transmitter. The tail is twinned, does not extend vertically, and is swept back like the wings themselves so that radar energy is reflected 45° left and right into the sky behind the aircraft (there is no other reason for the subsonic F-117A to have near-delta wings). All vertical surfaces on the F-117A are angled at least 30° so that, in level flight, no truly vertical surfaces are present.

The air intakes of the engines are masked. Upper and lower hull and wing surfaces are covered with RAM. All weapons are carried internally, since external pylons and armaments are excellent radar reflectors. All leading edges incorporate heat-resistant surfaces and are as sharp as possible both to reduce air friction and to reflect radar energy away from the transmitter.

Stealth also demands a new approach to combat operations. For decades jet aircraft have carried radars of increasing power, using them to aim weapons, check altitude, and fly low at high speeds. All this radar broadcasting reveals a plane long before enemy radars discover it. A stealth aircraft must fly without active radar emissions. The F-117A uses visual, thermal, and laser systems instead of radars. In addition, it has a radio burst decoder that is compatible with other USAF transmission equipment. On an active mission the F-117A constantly receives data bursts from friendly AWACS planes and ground radars.

Overall, the F-117A is most difficult to detect at very low altitudes. Even at higher altitudes (over 10,000') it is far less visible on radar than a normal aircraft. This not only allows the F-117A to "sneak up" on the enemy, it also reduces the range and accuracy of enemy weapons.

Threading the Needle



The F-117A selects a route past the edge of Doppler A's effective range, slipping in behind the two patrol planes while their forward-only radars are facing the wrong direction. It charges Pulse A, turning away when Pulse A is off. It then skims around Doppler B, charges Pulse B (as it did A) and turns away when B is off. There is no "safe" route available between Doppler B and C. The pilot could fly between them, but instead selects to skim around B and fly into C somewhat. Since C has the smaller effective range, it is weaker, and therefore (the pilot reasons) less likely to see the plane. Of course, the pilot could get lucky and find that Doppler B or C shut down for a period, allowing him to pass through the temporary gap.

Stealth Tactics

EMV: The F-117A's stealth configuration is most effective when flying level at low altitudes (at 500' or less, and preferably about 200'). The EMV is further reduced if the engines are throttled back to cruise speed (70% power). Level flight, which presents a horizontal profile, is best. The steeper the turn, the more topside or underside surface is presented as a radar reflector, and thus your EMV rises.

With respect to Doppler radar, your flight path is of crucial importance. Changing distance relative to a Doppler radar increases the risk of detection manyfold. If you remain at a constant distance, arcing around the radar, Doppler detection ability drops dramatically.

Opening the bay doors, firing a weapon, or using the ECM jammer all raise your EMV, making the plane more visible. On the plus side, if you want to deliberately lure the enemy to a certain location without wasting a decoy, then turning on your jammer, opening the bay, and spiralling upward in a tight turn often raises the EMV enough to make you visible. You can then close up, dive down to 200' again, and zoom away while they chase phantoms.

Threading the Needle: As a stealth pilot, you must plan carefully, seeking the best route through enemy radar defenses. You must find a route in and out that either makes you invisible, or visible for the shortest time possible.

Penetrating enemy radar umbrellas is tricky. Remember to arc around Doppler radars, but fly directly toward (or away from) pulse radars. The plotting of paths through radar areas is sometimes termed "threading the needle."

Pulse radars are shorter-ranged and less efficient, so Dopplers are your biggest problem. If you must fly into a pulse radar's effective range to avoid a Doppler, you can arc around just inside and hope your EMV is low enough, and their crews sleepy enough that they don't see you.

Even the best of plans must be modified once the mission starts. Enemy fighter patrols and IL-76 Mainstays can force you to change your plan, while the periodic shutdowns of enemy radars can suddenly open new opportunities. You must be flexible.

Low Altitude Tactics: On long missions with flight legs outside effective enemy radar range it's perfectly safe to use the autopilot and cruise at 500'. When within enemy radar range, get as low as you can. Fly through valleys – between hills and mountains – if possible. Although coming up over ridge lines is fun, every time you crest a ridge you take a chance of detection.

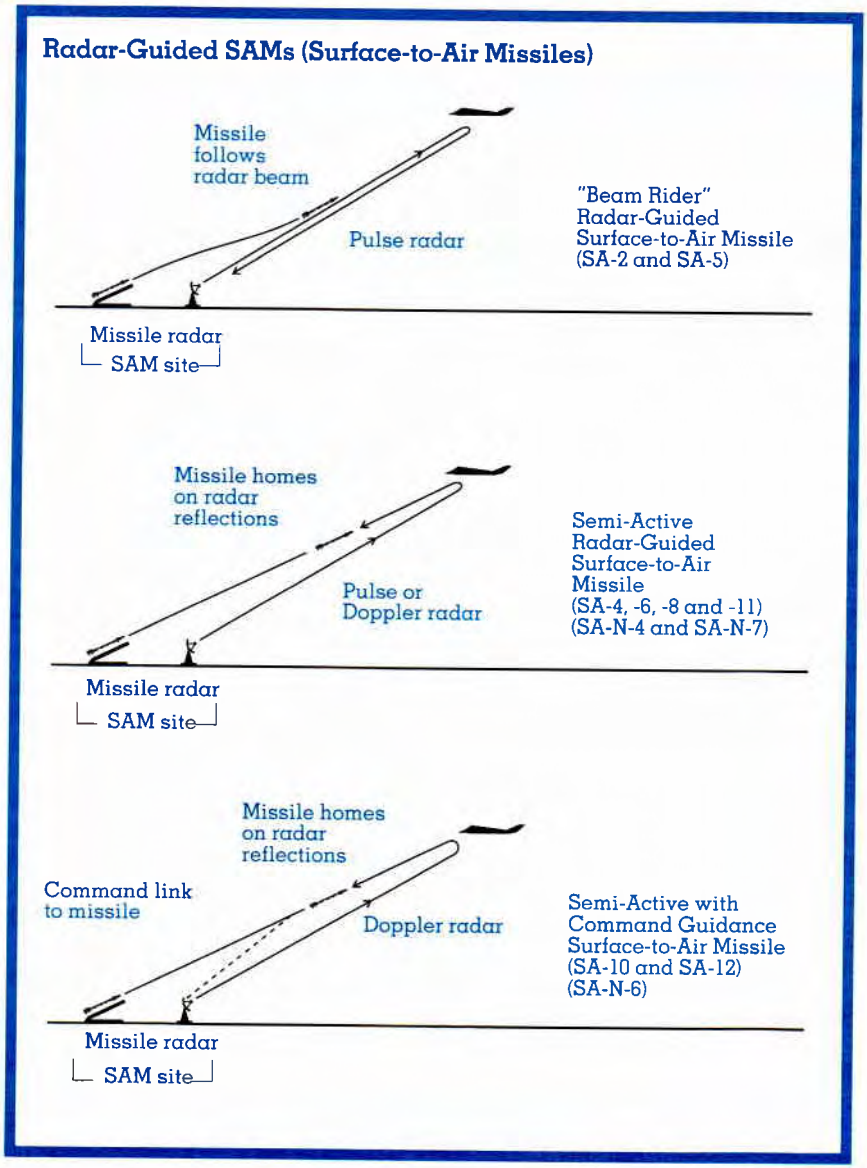
One especially sneaky tactic is to fly extremely low (200' or less) and throttle back your engine to about 30%. You'll need to extend flaps and pitch up to stay airborne, but your EMV gets extremely low.

Decoys: In Cold or Limited War, you must avoid leaving a positive radar ID. If your flight path takes you too close to enemy radar, you can try leaving one or two decoys behind. This can prevent them from getting a positive radar ID on you.

Dash: Many radars turn off periodically. If you see a critical Doppler radar station stop broadcasting, that may give you just the time you need to get past without being seen. Dashing through a radar's area while he's off the air is always risky; you never know if he'll "wake up" and find you, but sometimes there's no other way.

Blast: If you can't think of any better way to get through the enemy radar screen, a final device is to open a gap in the radar defenses, using a Maverick or HARM missile to destroy a radar at some critical sites. Of course, you've got to dash through the gap and get away quickly, since enemy aircraft are drawn like flies to the site of an attack. Other radar stations will "wake up" and stay on the air after an attack. One way to "set up" a blast attack is show yourself briefly in one location, drawing enemy fighters away from the area you plan to fly through and/or attack.

Disappearing: If you *are* detected and attacked by radar-guided missiles (either the "TRAK" light is on, or the "RAD" missile warning is lighted), you can evade the attack by reducing your EMV. If the enemy radar loses sight of you the missile loses guidance and flies blindly ahead. It continues until either the enemy finds you again and steers the missile back on course, or the missile runs out of fuel.



DEALING WITH SURFACE-TO-AIR MISSILES (SAMS)

To cope with enemy SAMs, you should understand the principles of their operation. Then you can intelligently apply appropriate defenses.

Radar-Controlled SAMs

Concept: Medium- and long-ranged SAMs are controlled by radar. Radar-guided missiles appear as yellow lines on your Tactical Display (left MFD). There are three types of radar-guided SAMs: beam riders, semi-active, and command guidance. All use the same three-step process to engage targets:

1. *Radar search:* Search radar scans the sky for alien planes. Search radars scan an entire 360° area periodically (watch your EMV and satellite map for this).

2. *Radar tracking:* When a search radar finds your plane, it "hands off" the prospective target to a narrow-beam fire control radar, usually running on a different frequency, which locks onto your craft (the "TRAK" light illuminates).

3. *Radar control:* When the operators are sure the beam is tracking correctly they launch a missile (The "RAD" light illuminates).

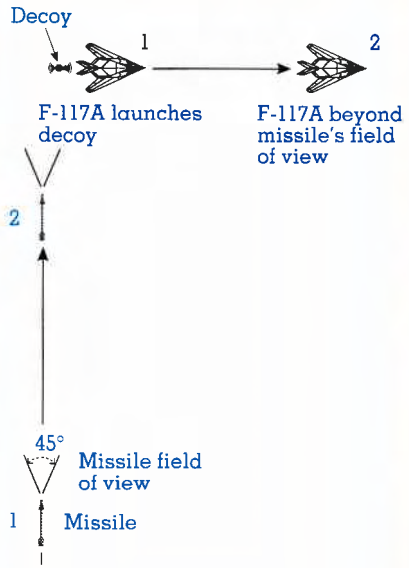
The narrow-beam radar continues tracking your plane so the missile's course can be updated and corrected. There are two common methods of doing this, the older "beam rider" (or "command guidance") technique, and the newer "semi-active homing" technique.

Beam Rider SAMs: While the narrow-beam radar continues tracking you, the SAM guides along the beam. As long as the tracking beam remains on your plane, the SAM will hit.

Semi-Active SAMs: Semi-active SAMs have radar receivers and computers on board. The tracking radar on the ground "paints" the target with a radar beam and the missile's nose receiver "catches" the reflections. The missile homes on these reflections until it hits you.

Command Guidance SAMs: These modern missiles use semi-active guidance, but the firer has a command link to the missile, as well, which he can use to override the semi-active guidance. This means that if the missile loses guidance or is otherwise confused, the ground controller can turn the missile around and try again.

Decoys & Missiles



At point #1 the F-117A drops a decoy. The missile homes on the decoy while the F-117A continues forward. At point #2 the F-117A is now beyond the missile's "field of view". Once the missile passes the decoy, it will see no target and fly off blindly.

Evading Radar-Guided SAMs

Reduce EMV: The basic way to evade radar-guided SAMs is to disappear from their radar. If their signals are just barely overlapping your EMV, you should find a way to simply "disappear." Obviously, the further you are from the enemy radar, the weaker the signal. Therefore you may wish to simply turn and run, until the signal is too weak to "see" you. If the enemy is a Doppler radar, at various points you should turn parallel to the radar. When you do, his signal weakens. Also, reducing your altitude, lowering your engine power, and levelling out your flight will help. Make sure your bay is closed, your gear up, and the ECM jammer is off.

Decoys: A decoy will fool enemy radar for 20 to 60 seconds, depending on the skill of the enemy. During this time missiles (and aircraft) will pursue the decoy instead of you. This gives you a perfect opportunity to outmaneuver the missile by escaping its 45° field of view.

ECM: Your ECM (electronic counter-measures) radar jammer is an excellent defense against beam-riders. As long as it's running they are flying blind, and therefore unable to hit you. ECM jammers are useful only at long range against semi-active SAMs. Remember that if you continue flying toward a jammed semi-active missile, eventually it will "burn through" and start homing on you.

Caution: ECM jamming makes a lot of noise. Therefore, don't use a jammer against semi-active SAMs unless you're going to turn away.

Chaff: Each chaff cartridge deploys a cloud of tiny tin-foil strips that reflect enemy radar. For two or more seconds the strips form a huge radar reflector, effectively blinding the missile, like a smoke screen. Therefore, the classic chaff technique is to wait until the missile is just a couple seconds away (i.e., when the Missile Proximity Klaxon sounds).

At that instant, tap *Chaff* (1) to fire a chaff cartridge and turn away. The blinded missile will fly straight into the chaff. *Warning:* Chaff may not fool a Doppler-guided missile (such as SA-10, SA-12, SA-N-6, or AA-10). In this case, you must turn perpendicular to the missile (see "Outmaneuvering Missiles" below).

Warnings and Responses: Your F-117A gives you four separate warnings that you are under missile attack:

1. Your first warning of a radar SAM attack appears on your EMV scale and your HUD when enemy search radar finds you; you'll notice the search radar signal overlap your EMV, the EMV light illuminates briefly, a warning beep sounds, and a message appears on the HUD.

2. Your second warning is when the narrow-beam tracking radar locks onto your plane, setting off the "TRAK" light on your console, and initiating another warning tone. During these stages reducing the EMV is your best response.

3. Your third and most important warning comes when a missile has been launched and is tracking you: the "RAD" missile warning light begins flashing and another message stating the type of missile launched appears on your HUD. Reducing your EMV at this point *may* derail the enemy attack, but if you're too close to the radar you must use other defenses. Against a beam-rider turn on the ECM jammer (tap *ECM* (4)) and change course. Against a semi-active missile either jam with ECM or drop a decoy, then change course (some pilots use both – decoy first, then the jammer for insurance). However, this technique only makes sense if you can escape the missile's 45° field of view before the decoy and/or ECM effects end.

4. Your final warning is the Missile Proximity Klaxon, which sounds when the missile is just a few of seconds away. Check the console – if the "RAD" light is flashing then a radar missile is inbound. *Immediately* drop a chaff cartridge and turn away.

Infrared (IR) Homing SAMs

Concept: Short-range SAMs are usually IR-homing. IR missiles appear as red lines on your Tactical Display (left MFD). Like radar-guided SAMs, the largest and most powerful use a three-step process to find and engage you:

1. *Radar search:* A search radar finds your aircraft (watch the EMV scale).
2. *Radar tracking:* A tracking radar follows your aircraft (the "TRAK" light).
3. *Missile launch:* The IR homing missile is launched (the "IR" light).

For the remainder of the flight to the target, tracking radar is unnecessary, because the missile guides itself.

Some shorter-ranged IR SAMs use a much simpler method:

1. *Search:* The enemy detects you either with search radar or simple eyesight.
2. *Missile lock-on:* The missile "locks-on" to hot surfaces of your plane.
3. *Missile launch:* The missile is launched and guides itself to the target.

Shoulder-Launched IR SAMs: The existence of man-portable IR SAMs makes your life difficult. The enemy frequently waits until point-blank range to launch these missiles, the preferred technique being to launch them during your attack run.

Carried by infantrymen, in trucks and jeeps, or stacked inside a building door, they are virtually undetectable until fired. Wherever significant enemy military ground forces are deployed you can expect to encounter these weapons. This includes rear area headquarters and depots as well as front-line troops (you'll know where these concentrations are expectted to be from your intelligence briefing).

First-generation IR Homers: Early IR-homing systems required a large heat signature to "lock-on" to. The only area of a jet hot enough was the engine exhaust, so the missile wouldn't "lock-on" until aimed at the rear of the plane. Further, the homing head wasn't sophisticated or sensitive enough to distinguish between the jet exhaust and the sun – or even hot rocks on the ground.

Your IR jammer is almost guaranteed to confuse first-generation IR-homers. As long as you leave the jammer on, the missile will be unable to follow your plane. Remember, though, that the jammer slows you down, and eventually overheats, which shuts it off automatically.

You can even outmaneuver first-generation IR missiles by turning tightly toward them. This "rotates" your hot exhaust away from the missile's view. The missile may try to turn and follow, but a tight enough turn always outmaneuvers it (see "Outmaneuvering Missiles").

Second-generation IR Homers: Modern IR-homing systems are far more effective. They are fine-tuned to "recognize" temperature variations typical of aircraft, including not only the exhaust, but *all* surfaces heated by air friction. This heating typically occurs at the nose, wing roots, and across the upper surfaces of the plane.

Your IR jammer is effective only at long ranges against second-generation IR-homers.

Evading IR SAMs

Reduce EMV: Unfortunately, reducing your EMV has no effect upon IR SAMs already launched, but if you become invisible to search radar, it can prevent the enemy from launching others. EMV reduction methods are the same as described above.

Decoys: A decoy will fool enemy IR missiles for 15 to 60 seconds. Tactics are therefore like those for decoys against radar-guided missiles – get outside the missile's view before the decoy expires.

IR Jammers: This device is a heat strobe that sends out heat pulses that confuse a missile's guidance system. Unfortunately this equipment employs a generator to provide power, reducing your airspeed by roughly 15%. In addition, it shuts down before it overheats and melts and will not function again until sufficiently cooled.

First-generation IR missiles are easily confused at almost any range by the IR jammer, but second-generation IR missiles are more "intelligent." They are "fooled" by IR jammers only at long ranges (in fact, at closer ranges, some second-generation IR seekers actually lock onto the jammer). It is, therefore, unwise – and sometimes dangerous – to leave a jammer running when second-generation IR missiles are close.

Flares: Although called "flares," these are small, finely tuned heat decoys. A flare lures IR missiles toward it, but only during the 2-5 seconds it burns. After that the flare dies and the missile resumes seeking. Therefore, wait for the Missile Proximity Klaxon, drop a flare, then turn away.

Warnings and Responses: Your first warning of an IR missile attack may be identical to that of a radar-guided one: your EMV light illuminates briefly, you hear a warning beep, and a message appears on the HUD. At that point it's impossible to tell whether the detecting radar site will launch an IR or radar-guided SAM. However, when the missile is launched, the "IR" missile warning light begins flashing and you receive a message on the HUD announcing the type of missile launched.

In many cases, however, your first warning of an IR attack is the "IR" missile warning light, because many IR SAMs don't use search radar – just eyesight searching.

If you know the missile is a first-generation, (which you will if you've studied up on enemy SAMs), you can turn on the IR jammer and change course. Otherwise, you'll have to wait for the Missile Proximity Klaxon – which may be a very short time because many IR missiles are fired from very short ranges. Often, the flashing "IR" light is followed almost immediately by the klaxon. When you hear the klaxon and see the "IR" light flashing, your first act *must* be to drop a flare and dodge!

Alternatively, of course, you can outmaneuver the missile – if you're really good.

Outmaneuvering Missiles

It's important to remember that defense devices aren't perfect. Some missiles can "burn through" ECM, all continue seeking after your decoy or chaff expires, and Doppler missiles will ignore chaff if you're on the wrong course. Therefore, it's important to maneuver out of the missile's field of view when the defense expires. If you don't, the missile may re-acquire you and resume tracking! (A truly skillful pilot may outmaneuver an enemy missile without any mechanical aid. Smart pilots normally use both their equipment and their skills.)

Techniques for outmaneuvering IR missiles and radar missiles are essentially the same. But since IR missiles tend to be smaller and more maneuverable – second-generation IRs are often the most maneuverable – you're best off relying on decoys, jammers, and/or flares against them.

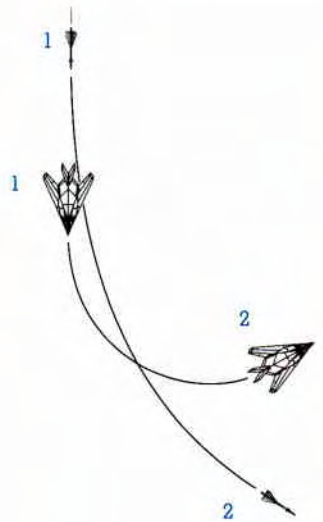
Evading the Missile's View: SAMs can only "home" on targets within the acquisition arc of their seeker. This arc is a bare 45° directly in front of the missile. If decoys, jammers, or whatever temporarily confuse a missile, you can evade attack by moving outside this 45° arc. Usually the quickest escape course is one perpendicular to the missile's heading.

Turning inside a Missile: When a missile is close, you still have a chance to outmaneuver it, because you can turn faster than it can. If a missile is trying to fly up your tail, roll over onto a wingtip for a tight turn, then pull straight back on the control stick. Keep an eye on your airspeed because the plane will soon the plane will stall in this attitude, but the missile makes a wider turn, causing it to zoom past harmlessly.

Turning toward a Missile: If a SAM approaches you from the side, gradually turn toward it, increasing the tightness of your turn as it comes closer. The objective is to keep the missile's course at right angles (perpendicular) to your own. This tactic works because the missile cannot turn with you. Instead it gradually falls behind, zooming past your tail.

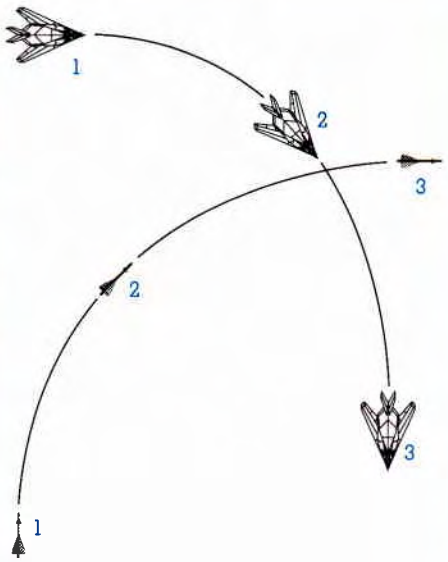
Evading Frontal Attacks: If a SAM approaches you from the front, wait until its between 8 and 12 km away (about two thirds of a grid square on the tactical display). Then make a quick 90° turn. This puts the missile facing your side. Now roll over 180° and turn toward the missile.

Turning Inside a Missile



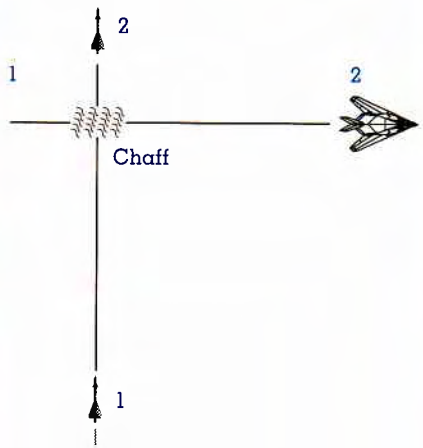
Here your F-117A turns so tightly the missile can't "stay with you" and passes harmlessly off to the right. This is a common tactic for evading IR homing missiles.

Turning Toward a Missile



Here an F-117A is evading a missile using maneuvering power alone–its tighter turning circle. As the F-1117A turns, the missile tries to turn toward it, but cannot turn fast enough. The missile falls behind the F-117A and passes harmlessly.

The "Doppler Cross" Missile Evasion



The F117A observes an enemy Doppler-guided SAM approaching (SA-10, SA-12 or SA-N-6), and until his course is perpendicular (at right angles to) the missile, as shown in position #1. Then the F117A drops chaff (as shown) or a decoy, and continues on a perpendicular course, keeping athe missile at a constant range. Flying on a different course can be disastrous, as the missile will "see the Doppler shift as you change range.

Doppler Missiles: Enemy missiles with Doppler guidance systems are a special danger. These missiles will not home on chaff unless your course is perpendicular (at right angles to) the missile. If the missile chases you from the rear or attacks from straight ahead, chaff has no effect. Only three SAMs currently have Doppler guidance: the SA-10, SA-12, and SA-N-6. Only one air-to-air missile has Doppler guidance: the AA-10.

AIR-TO-AIR DUELS

USING AIR-TO-AIR MISSILES (AAMS)

The MicroProse F-117A (with "enhanced capability") carries two types of AAMs; the AIM-120 AMRAAM and the AIM-9M "Sidewinder." (The Lockheed F-117A carries no air-to-air weapons at all; it's never expected to be seen by enemy fighters, much less go out looking for a fight with them.) Like all your missiles, these AAMs are self-guided, "fire-and-forget" weapons that are easy to use and possibly the world's best. The techniques for targeting and firing these weapons are identical to those for other self-guided missiles (see page 68).

AIM-120 AMRAAMS: Your AIM-120 AMRAAM missile is one of the best medium-range weapons in the world. It is the only "fire and forget" radar-guided missile in US inventory. It has sufficient circuitry to penetrate most defenses, and maneuverability enough to chase down most enemy fighters, not to mention bombers and transports. Because the AIM-120 has roughly twice the range of the Sidewinder, pilots typically open with the AIM-120, then switch to Sidewinders if any enemy aircraft survive to that range.

AIM-9M Sidewinders: The short-range AIM-9M Sidewinder is probably the best dogfighting missile in the world. It is more maneuverable than the AMRAAM, giving it a better chance of "hanging on" to a twisting, turning target. Since it is IR-guided, the best place to fire the Sidewinder is up the enemy's tailpipes. Next is from above, diving down onto the top (hot side) of the enemy plane. The third best position is directly into the enemy's nose. Shots against an enemy plane as it crosses in front or you, or at its underside (the cold side) have very little chance of hitting. The main weakness of the Sidewinder is its limited range.

Missile Ranges: The maximum range of a missile depends not only on its motor, but your plane's speed at launch and the direction of enemy movement. The initial "lock-on" range corresponds to missile maximum range if you're at maximum speed. However, if you're moving more slowly, the missile may not get the extra boost needed to reach the target.

A much more important consideration is the enemy's heading relative to you. If he's flying toward you, even a maximum range launch is likely to reach him. However, if the target is flying away the missile may have a long "stern chase" ahead of it. You should probably wait for optimal lock-on before launching.

Technique: When firing a missile, always remember to open the bay doors, and wait for the lock-on. If you don't wait for the target box to become oval-shaped, you're firing without lock-on, and will almost certainly miss. Then look at your airspeed. If you're moving fast (around 500 kts) or the target is closing, a maximum range lock-on shot will probably hit. However, if your speed is low or the target is flying away you should wait until the range closes, ideally until the oval turns red.

Missile accuracy doesn't take into account enemy defensive equipment or evasive maneuvering. First-line and elite fighter aircraft may prove more difficult to hit. Although the "Mainstay" AEW&C craft maneuvers poorly, it has superior defensive equipment. You may find that guns are necessary against Mainstays flown by a capable crew.

Firing Attitude: Also remember that AAMs, like other missiles, will fall 300-400' before their motor can guide them away. Until then the missile has your speed and VVI. If you're diving at the ground, the missile may slam into the ground before it can fly away. Firing in a tight turn, or while inverted, can cause the missile to tumble as it leaves the weapons bay. The wisest method is to fire only when you're level and above 500 feet.

Target Discrimination: Sidewinders and AMRAAMs always home on the most prominent target, which is usually the nearest. They will do so even if you were tracking someone else. In Cold and Limited War, beware of this limited "brainpower" in your missiles. You may be tracking a primary or secondary target, fire a missile, and discover it goes for one of the closer fighter escorts!

Notes: Your F-117A uses a Tracking Camera instead of weapon guidance radars. This system "downloads" appropriate launch parameters to the AIM-120 AMRAAM. Although the AIM-120 itself uses radar, it is not activated until the missile is launched. As a result, missile targeting does not increase your EMV. Of course, opening the bay doors to fire does. A skillful stealth pilot opens the bay doors just before a launch, or during a dogfight.

USING THE 20MM VULCAN

The Lockheed F-117A does not have a cannon of any sort, because it's not expected to need one; so if you prefer flying the Lockheed version, you can ignore the following. The MicroProse F-117A will definitely need a cannon, and does, of course, carry a good one.

Jet aircraft travel so fast that conventional machine guns and cannon cannot guarantee a hit: a plane could literally fly between the shells. Therefore, modern aircraft cannon are either a group of guns (such as the twin 23mm cannons in many Russian MiGs) or a multi-barrel Gatling gun (such as the six-barrel 20mm M61A1 on most American jets). Aircraft cannon have an effective range of about 0.5-3 km and a maximum range of 6 km. Inside 0.5 km there is a significant danger of "collateral damage."

More About the Historical Gunsight: Your F-117A has the most modern and advanced gunsight available: a "historical" gunsight with automatic laser range-finding. If you're not tracking a target, this gunsight "assumes" you are firing at maximum range (6 km). If you're tracking a closer target, the shorter range is used for gunsight calculations.

The gunsight computer constantly calculates range, flight path, and ballistics and displays where your shells *would be* if they were hitting the target now. The gunsight continually calculates firing, delays the appropriate time and displays potential hits as they would occur. Therefore, the sight is "assuming" you fired at the correct time in the past.

The gunsight on your F-117A uses a laser range-finder slaved to the Tracking Camera, rather than the traditional ranging radar. This means you can use your gun without increasing your EMV; however, when you begin firing, of course, you create heat and this makes you more detectable.

Anticipation Firing in Air-to-Air Engagements: It takes about six seconds for M61A1 20mm shells to travel the maximum 6 kilometer range. Therefore, to hit a target you must judge the speed at which the target and your sight converge. You should fire about six seconds before they meet. If the range is less than 6 km, wait a little less. For example, at 3 km wait until target and sight are three seconds apart; at 1.5 km wait until target and sight are one second apart, and so on.

You can use this sight like an old fashioned predicting sight. That is, wait until the sight is on the target, then shoot. But at 6 km range you'll have to hope the target stays on the same course for six seconds to insure a hit.

In short, the key to using a historical gunsight is anticipation. Don't wait for the sight to reach the target. Instead, learn to *anticipate* the meeting of sight and target, then shoot.

DEALING WITH THE ENEMY

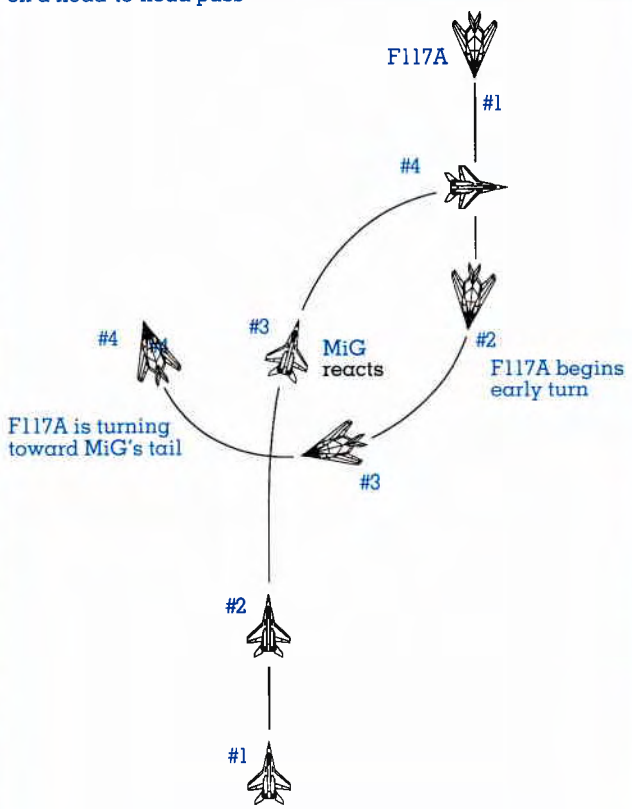
Ambush

The best way to meet the enemy is to surprise him by sliding up behind him. Enemy aircraft have only forward-facing radars (except the IL-76 "Mainstay" AEW&C craft) and will probably be unaware of your approach if you come up from behind.

Traditionally fighter pilots prefer to attack from above. This gives them an energy advantage in any dogfight, but missile tactics and the importance of secrecy make height less valuable for a stealth pilot. Gaining altitude makes you visible to enemy radar, which in turn may warn your targets. Therefore, approaching low and from behind is often wiser. Only if your missile attacks fail and the enemy discovers you should you begin to seek an altitude advantage.

If you're surprised or "bounced" (attacked from above) by enemy fighters, immediately look for incoming missiles and take appropriate defensive action. Missiles arrive faster than aircraft, and therefore must be avoided first. Only then can you begin dogfighting or attempt to escape.

The Early Turn
on a head-to-head pass



An F117A executes an "early turn" against a MiG fighter. Note that by position #4 the F117A is already closing on the MiG's tail.

Missile Exchange

Often an air-to-air battle begins soon after you've destroyed a target, and enemy fighters are vectored to intercept. The result, quite frequently, is a head-to-head face-off.

In this Old West-style showdown each side starts with an exchange of long- to medium-ranged radar-guided missiles. Be prepared to decoy, jam, and possibly chaff the "incoming." Once your radar missile is away, switch to a Sidewinder. You may get a second close-range missile shot if the AMRAAM fails.

The Early Turn: One of the most difficult, but useful maneuvers in a head-to-head match is the early turn. Against inexperienced pilots it's easy, since greenhorns usually keep boring in, hoping for a cannon shot. Against experienced opponents an early turn requires fine timing; if you turn more than a second or two ahead of the enemy you're telegraphing your intentions. If you wait too long, you get no advantage.

Dealing with Enemy AAMs

Radar-Homing AAMs: The Russian AA-10 Alamo is a "fire and forget" missile just like your AIM-120 AMRAAM. All other Russian radar-guided weapons are semi-active homers, which means that the firer must continue to "paint" you with radar, because the missile homes on the reflected radar energy.

You avoid radar-homing AAMs just like SAMs (see "Evading Radar-Guided SAMs," page 80). That is, use reduced EMV, ECM jamming, and ultimately chaff. Decoys can be very effective. Note that the MiG-25 and MiG-31 carry extremely long-ranged radar AAMs. Low EMV, ECM and decoy tactics are especially effective against these weapons.

IR-Homing AAMs: All IR-homing AAMs are self-guided, "fire and forget" weapons. Of these the AA-8 is the most dangerous because of its second-generation IR seeker and great maneuverability. If enemy MiGs and Sukhois close to AA-8 range (8 km) you're often in big trouble.

Techniques to evade IR AAMs are the same as those used against IR SAMs (see "Evading IR-Guided SAMs," page 82). That is, use the IR jammer at long range, flares at short range; decoys also work.

In practice, many IR-homers are fired at short ranges during a dogfight. This means you've got to leap onto the IR jammer when you get a launch warning, then dodge out of the missile's 45° field of view immediately. At dogfighting ranges missile flight times are very short – you don't have time to fool around! If this fails, or you delay too long, the Missile Proximity Klaxon will go off. Now you've got bare seconds to react: dump a flare immediately and dodge.

The older AA-2, AA-6, and AA-7 use first-generation seekers. The enemy must get on your tail before these missiles lock on. Keep him off your tail and you avoid this entire class of weaponry.

Dogfighting Maneuvers

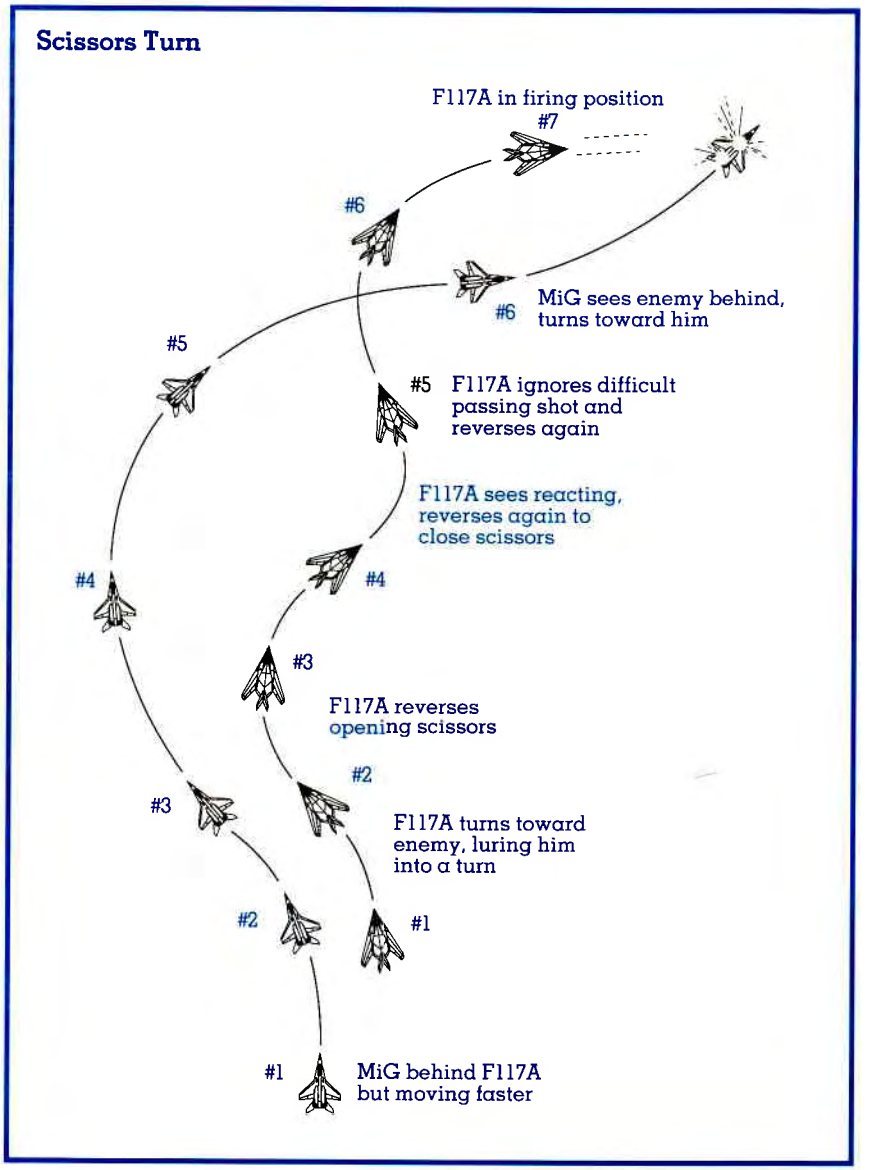
The essential rule in dogfighting is to get on the enemy's tail. On all fighter aircraft, guns and missile guidance systems only face forward. If you're on the enemy's tail, you can shoot and he cannot. If you can't get on his tail, at least try to place his aircraft ahead of you as much as possible, so you have the maximum number of firing opportunities.

Maintaining higher speed or altitude is valuable in a dogfight. A plane slower and lower can only dodge attacks. A plane faster or higher can attack or retreat as desired. Having a higher speed or altitude is termed the "energy advantage."

If the enemy is behind you, there are various classic escape maneuvers: Turning Inside, the Scissors, the Immelmann, the Split-S, and the Yo-Yo. Not only should you master them, but also learn to recognize them.

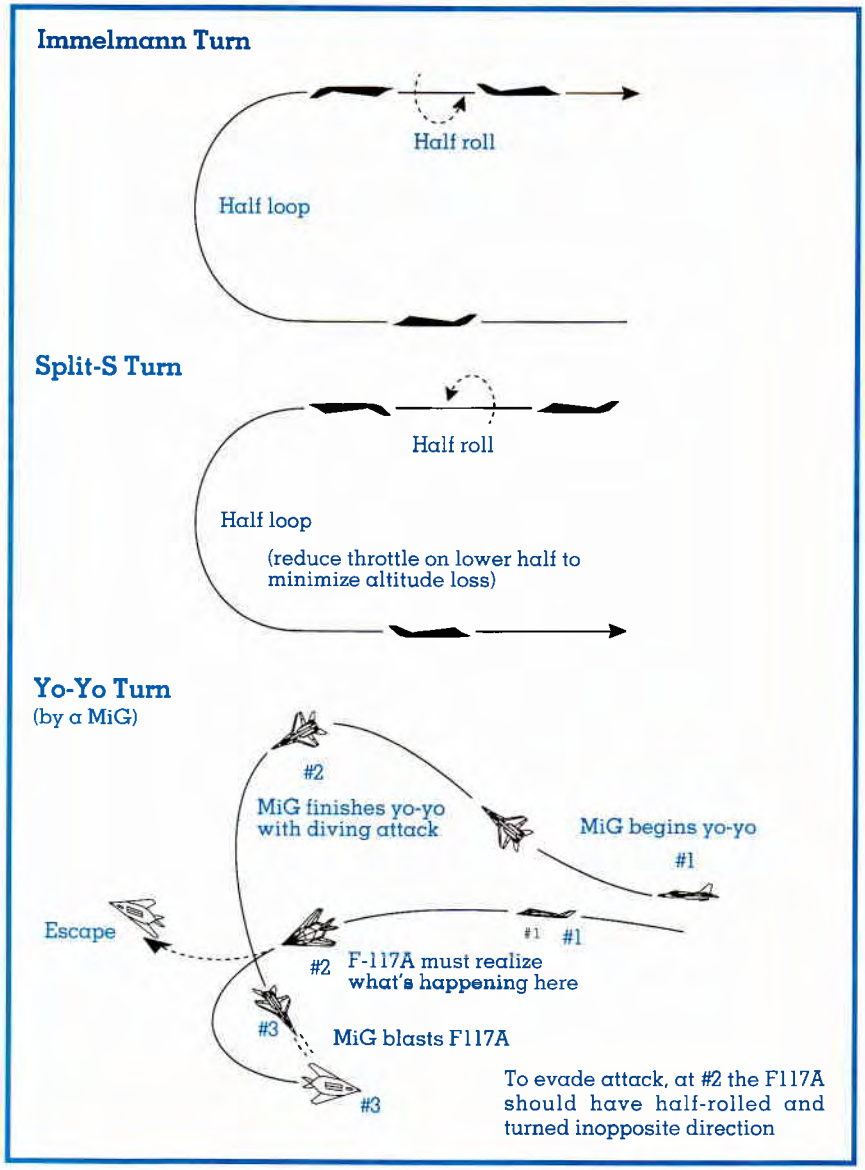
Turning Inside: The simplest solution to an enemy plane coming up behind you is – turn toward him. If you're turning faster than he, you'll gradually circle around and get on his tail. This kind of a "turn match" is frequently seen when greenhorns dogfight.

Of course, if the enemy is turning faster than you, he will eventually come around behind you. If this happens try something else immediately. The longer you wait the worse it gets, until he lines up a shot and toasts you.



Scissors: A more complex way to out-turn an enemy aircraft is the scissors maneuver. Begin a turn toward him, but once he begins to turn with you, quickly roll over to turn in the other direction. This opens the scissors. As the enemy realizes you've turned away and turns toward you again, you reverse the procedure and roll back toward him again. If your turns were quicker and tighter than his, and/or you're a slower plane, he will eventually pass in front of you. This allows you to get onto his tail.

Novice pilots trying to turn with you can be lured into a scissors with ease. Even if their planes turn better, their slow reactions to each scissor opening and closing will quickly give you the edge. More experienced enemies may avoid this tactic by anticipating your next turn and blasting you (if they're less maneuverable), or by pulling up and over in a Yo-Yo (if they're faster).



Immelmann Turn: This maneuver is an excellent way to reverse direction quickly. First you perform a half loop upwards to reverse direction, then a half roll to right your aircraft. If an enemy aircraft is behind you, an Immelmann can bring you nose-to-nose with him. Note that an Immelmann gives you to an altitude gain but costs speed, since a half-loop upward slows you down significantly.

Split-S Turn: This maneuver complements the Immelmann. Begin by rolling inverted, then pull the stick back to half-loop downward. Many pilots begin the loop before the roll is completed, rolling the plane while looping. The Split-S causes you to lose considerable altitude, so it's often wise to reduce throttle and/or use speed brakes to minimize altitude loss.

The Split-S complements the Immelmann because you gain speed and lose altitude. Unwary fighter pilots have sometimes tried to Split-S into or away from the enemy without remembering their altitude. The result can be a Split-S right into the ground!

Yo-Yo Turn: This maneuver is used mainly by higher-speed jets against slower opponents. Therefore the relatively slow F-117A has little occasion to use it. However, you may see enemy MiGs attempting it against you! This turn also requires excellent cockpit visibility, something the F-117A definitely lacks.

In a Yo-Yo turn you climb and roll toward the enemy – until he's visible out the top of your canopy. Then pull over into a dive while still turning. During the dive you roll the plane to help line up your shot. Very often you'll take that shot while inverted.

Because a Yo-Yo requires good spatial perception, first practice it using the Slot View (if alone) or Tacti View. In combat conditions switching to a wide angle view is extremely helpful in pulling the HUD around onto the enemy after you come over the top. Then you can switch back to normal view again.

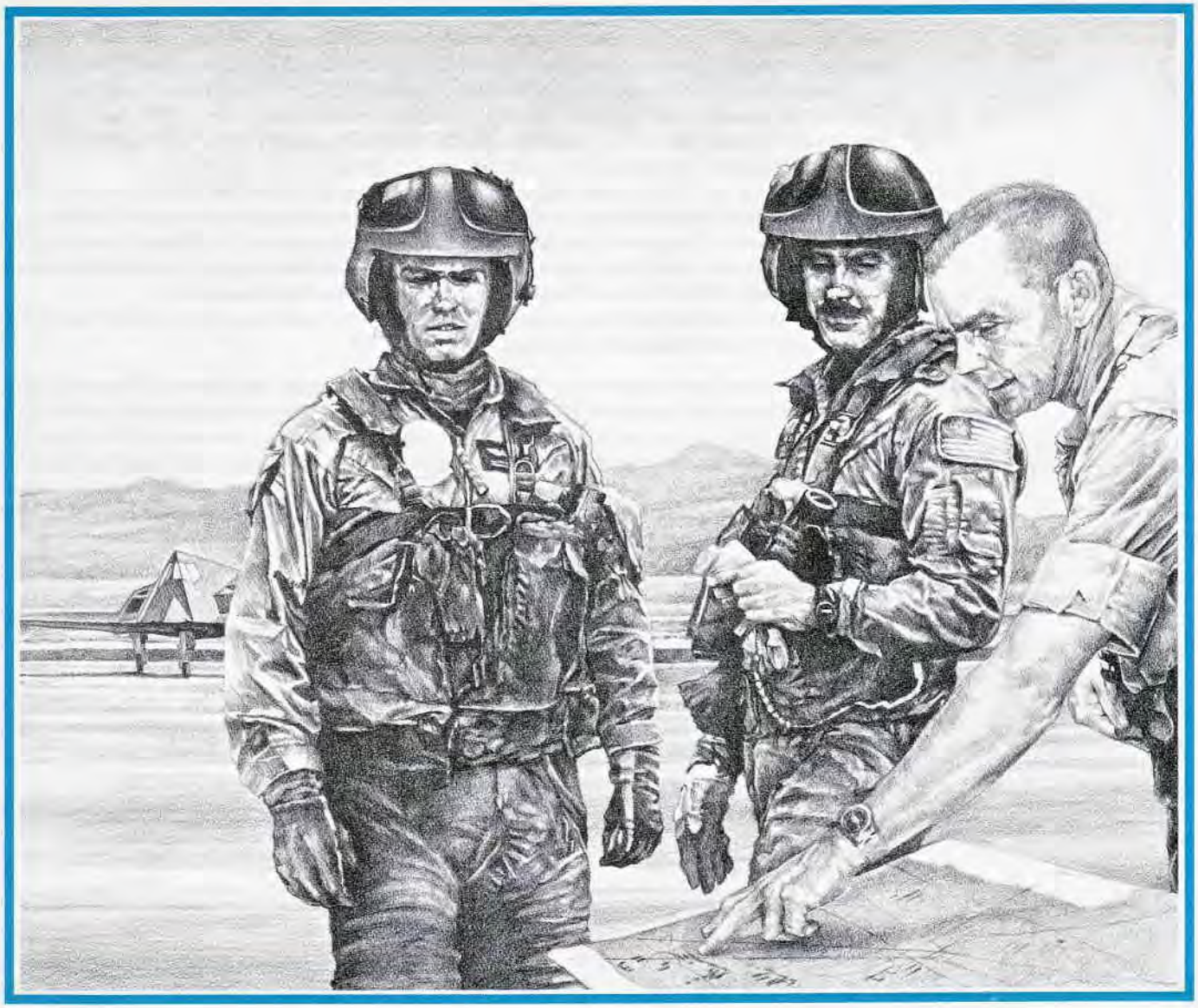
In effect a Yo-Yo is a very big turn in three dimensions. Most of the turn radius is "consumed" with the climbing and diving, allowing a faster plane to travel farther and turn wider, yet still come out on the tail of the more maneuverable plane. American F-4 Phantom pilots used this maneuver with great success against slower but more maneuverable MiG-21s over North Vietnam during the Vietnam war.

Note that the best defense against a Yo-Yo is to reverse your turn, or to use the third dimension yourself (usually by going into a split-S).

Enemy Guns

The enemy has cannon equivalent to yours in range and power. However, the enemy still uses old "predicting" gunsights. This means they are required to get behind you before they can make a decent shot. In addition, all but the most elite pilots will be slow to fire, since they must place the gunsight on the target and keep it there to score a hit.

If you sense the enemy is behind you and ready to fire cannons, "jinking" (small, violent moves in random directions) can throw off his aim.



4 MISSION BRIEFING

MISSION TYPES

RULES OF ENGAGEMENT

Rules of Engagement (ROE) set forth guidelines restricting what targets a pilot can and cannot attack and to what extent you may expose your fighter. In Cold and Limited War situations it is imperative that the enemy not know exactly who or what performed the attack. This allows the politicians to say whatever they want.

Cold War

In Cold War situations the State Department must have "deniability" for every mission. If the mission is successful and the political climate good, the US may claim credit for the deed. In other cases, however, America may not wish to attach its name to the action.

You may attack and destroy specified targets only. Engagement of other targets is prohibited unless if they fire first, or have spotted your plane. You must avoid visual detection by the enemy. Enemy air or ground forces that do detect you should be destroyed, to prevent embarrassing disclosures. Neutrals are considered friendly at all times, and you should avoid detection by them at all costs.

You are warned when enemy radar returns are good enough to spot your craft, or when enemy aircraft come close enough to visually identify you. These enemies should be destroyed, although the effort can be counterproductive if the attack generates lots of additional sightings!

Limited War

The State Department may require deniability, since American aid to the combatants may need to be secret. However, since there is a war, and military targets are being destroyed, you will be rewarded for destroying enemy military targets.

Conventional War

You may attack and destroy specified targets only. Other targets with active weaponry (i.e., which could attack your craft) may be attacked. You may attack these military targets even if they haven't seen you yet. You must never attack non-military targets unless required by orders. Neutrals are considered friendly at all times, and you should avoid detection by them.

In a Conventional War you are allowed unrestricted conventional attacks on enemy territory. This includes civilian targets formerly forbidden. However, targets that represent an immediate military threat are most important. Therefore, destroying enemy aircraft, airbases, SAMs, radars, depots, HQs, etc., gives more reward than bridges, oil refineries, oil wells and platforms, etc. Even conventional wars are fought for short-term goals (such as the Grenada invasion in 1983, the Falklands Islands campaign of 1984, and Desert Storm of 1991).

You must attack and destroy all targets specifically required by your orders. In addition, any other targets in enemy territory may be destroyed, including civilian targets. If able to select additional targets, select those with immediate military capability first. Neutrals are considered friendly at all times, and you should avoid detection by them.

AIR-TO-AIR MISSIONS

Ambushing a Leader

Here an important personage is travelling by plane; your job is to make sure he doesn't arrive! The plane takes off about the same time as your own. Remember that his plane, your objective, is the flashing dot on the satellite map (left MFD).

Although it's possible to just fly to his destination and wait, roving fighter patrols or local air defenses will eventually spot you. In general, the wiser approach is to find the best way to "sneak through" enemy patrols and SAM radars to intercept him *en route*.

In Limited or Conventional War you can take down his plane and escort with AMRAAMs. In a Cold War situation you'll need to close for a clean Sidewinder or gun shot. Remember, though, that if the fighter escorts get a visual ID on your plane you must "zap" them too. If your attack location is well away from any ground radars or Mainstay AEW&C planes, you can attack from above, hit your man, drop a decoy to confuse them, and zoom away with maximum speed at low altitude (say 200').

Intercepting Terrorists or Commandos

In this mission you know a transport plane, accompanied by fighters, will head for friendly territory. Your objective is to eliminate them before they arrive. The problem is, you don't know their destination.

As you take off, watch the enemy aircraft carefully. Circle around a bit, observing their course until you can guess their objective. Once you know their goal, it's easy pick a nice quiet spot to ambush them. Often you can stay in friendly territory all the way!

Eliminating a Fighter Patrol

Enemy fighter groups usually patrol near their own air defense systems, and are supported by Mainstay AEW&C planes, so going in after them can cause quite a battle. One trick to avoid this mess is to publicize your presence in a nearby area with little or no SAM coverage, and with no nearby airbases. If you can lure the fighter patrol to this spot, the battle may be much easier.

Once you've "dangled the lure," take a low profile, so you can ambush the enemy fighters as they arrive. As in many other aspects of modern warfare, getting the first shot is a big advantage.

Destroying a Recon Bomber

In most cases you must chase an enemy plane on its way home. Catch and attack him as quickly as possible. The longer you delay, the closer he gets to SAM cover and fighter aid. This is one mission where climbing to a higher altitude can be rewarding – you travel faster and farther at high altitude.

Attacking a Cruise Missile Bomber

These aircraft cruise deep behind their own lines, guarded by SAMs and closely escorted by fighters. Given the defenses, attacking these planes is like hitting a ground target. You need to sneak or punch your way through defenses, elude counterattacks, and blast the primary, just like a strike mission.

Taking Down the Mainstay

The IL-76 "Mainstay" AEW&C plane is the most difficult aircraft target. Sooner or later its radar will see you, forcing you to fight through fighters and SAMs to reach it. Make your approach as stealthy as possible. Destroying one or two crucial SAM radar sites on your way in can be useful – it opens a radar-free corridor to the target, and at the same time may draw off enemy interceptors, perhaps even some of the Mainstay's fighter escort.

STRIKE MISSIONS

Dropping off or picking up items deep behind enemy territory seems rather straightforward. After all, you don't have to fly into SAM batteries or go head-to-head with fighter patrols.

Secret Airstrips

Instead, a secret airstrip challenges your flying skill. You must manage a landing without an ILS to guide you. Worse, the strip is only half the length of a normal runway. You must land gently, at low speed (under 160 kts, preferably), and touch down near the start. Otherwise you'll roll off the other end and crash! To make matters worse, the strip's lights are only for a limited time. Make a note of the time the lights go off, then periodically check the Waypoints screen on the right MFD to see how much time you've got. Once the lights are out landing is virtually impossible.

Airdrops

In these missions your job is to avoid action and just fly over a radio beacon that's quite clear on your HUD. The only real worry is reaching the beacon before it is turned off. Make note of the "turn off" time and periodically check the Waypoints screen. Once the beacon turns off there's no way to find the drop site.

Photo Recon Runs

Photo runs over enemy troop concentrations and/or near SAMs are especially nerve-wracking. You may need to take out a SAM before making the run. If shoulder-fired SAMs infest the area, your only hope is to dump a decoy before your start, run your IR jammer as long as you can, and/or periodically dump flares.

Striking SAMs

Destroying a SAM battery requires that you "sneak up" on it as best you can, then nail the radar first with a Maverick or HARM. With the radar out of action, the missiles are helpless. Unless there are other SAMs nearby you can have a strafing "picnic" until a fighter patrol shows up.

Remember that the safest place around a SAM battery is directly above it. The radar cannot look straight up, and the longer-ranged missiles (such as the SA-2, -5, -10 and -12) have a minimum range of 4 to 5 km.

Hitting the Sub Pens at Severomorsk

The Severomorsk submarine pens in the North Cape are a unique and special target. These must be attacked by toss bombing from the north: you must place an FAE *through* the sea doors. This means flying straight at the mountain and pulling up at the last second.

Beware of the Krivak-class frigates patrolling to seaward of this base.

Sinking Ships

Don't underestimate enemy warships, especially those of the Soviet Northern Fleet. The larger ships have exceptionally good radar and very powerful SAMs. Patrol ships can be knocked out with a single missile, but a task force has so many ships that any close approach means you'll be dodging missiles left and right.

When fighting a Conventional War with Libya, or in the Persian Gulf, be careful about attacking merchant ships. Avoid those on the high seas or near friendly coastlines; only attack ships close to enemy ports or shore. Otherwise, you could end up hitting a neutral ship by accident.

AREAS OF CONFLICT

THE PERSIAN GULF: 1984

Introduction

Since the overthrow of the pro-US Shah in 1979, Iran has been ruled by Shi'ite radicals. In September, 1980, Iraq attacked Iran, beginning a costly war. Both combatants are viewed with distrust by the Arab states along the Persian Gulf. Iran's use of international terrorism as a tool of foreign policy has not improved the nation's image.

Level of Conflict

Cold War: Iran's use of terrorism has been very effective to date. America's confused response to the hostage crisis in the early 1980s created a dangerous rift between the two nations.

Limited War: Iran and Iraq have been fighting a limited war since 1980. US forces may eventually become involved in assuring the continued flow of oil through the Straits of Hormuz.

Conventional War: The Soviets could invade Iran as part of a wider NATO-Warsaw Pact conflict, or as a counter to the Shi'ite radicals, who would like to spread their revolution to the USSR's Moslem population.

Iranian Military Forces

Under the Shah, Iran's oil-rich finances were invested in US military equipment. Since the revolution many of these complex weapons have failed for lack of spare parts and maintenance, while many of the rest have been damaged or destroyed in the Iraq war.

Air Defenses: MIM-23B "Hawk" batteries are Iran's longest-ranged SAMs. Rapier batteries, sold by Britain to Iran, are fast, but shorter-ranged, and hindered by a fire control system that is primarily visual. The Tigercat, an antiquated British design, appears in less-important areas. Many Tigercat sites have little or no radar, since the missile is designed for visual control. The Seacat is a naval version of the Tigercat, found on Iranian Vosper Mark 5 type frigates.

Air Force: This service arm is composed primarily of US-built aircraft acquired during the Shah's rule. Before the outbreak of the Iran-Iraq war the Air Force had a nominal strength of 75 F-14 Tomcats, about 200 F-4D and F-4E Phantom IIs, and 140 F-5E Tiger IIs. Iranian fighters are equipped with AIM-9H Sidewinders, one of the best first-generation IR AAMs. The F-4 Phantoms are designed to carry the AIM-7F Sparrow, a long-range radar-homing missile.

Iran has few naval reconnaissance bombers, and most of those are P-3C Orions with inoperative electronic gear. However, it's possible that long-range Soviet Tu-95 "Bear" bombers may make an appearance, flying from Afghanistan or Yemen.

Esfahan
Zagros Mountains
Dezful
Yazd
Ahvaz
Al Amarah
Masjed Soleyman
Dasht E Lut
IRAQ
IRAN
Kerman
Bandar Khomenyi
Shatt al Arab
Shiraz
Neutral Zone
KUWAIT
Kuwait City
Bushehr
Kharg Island
Ras Shaffaniyah
Kut
Bandar 'Abbas
Bandar-e Lengeh
Persian Gulf
Strait of Hormuz
SAUDI ARABIA
Bahrain
Dhahran
Qatar
QATAR
Gulf of Oman
Dubai
Al Hufuf
Dahana Desert
USS Nimitz
Abu Dhabi
Ruweiss
Tarif
As Salamiyah
OMAN
UNITED ARAB EMIRATES
Muscat

Iran has a variety of small, medium and large air transports, including the American C-130 Hercules and Boeing 707 and 747 transports. The exact types available vary greatly, depending on the supply of spare parts and the presence of knowledgeable mechanics. Given Iran's dislike of the West, some consider it likely that she will shop in Russia for the next transports bought, perhaps the new and very flexible An-72 "Coaler."

Naval Forces: The Iranian Navy has suffered greatly in the Iran-Iraq war, since most resources go into the army and air force. Many ships were damaged in the fighting and remain in disrepair; others have deteriorated badly for lack of maintenance.

It is believed that one or more of the four Vosper Mark 5 frigates are still functional. These 1,100-ton ships include a surface-to-surface missile (SSM), Seacat SAMs, and a 4.5" gun turret. Occasional patrols by these or smaller ships can be expected in the region of Kharg Island or in the Straits of Hormuz.

Iran's Shi'ite "Guards" also man a large number of fast motorboats called "Mosquitoes." The crews carry rocket-propelled grenades to attack shipping, and shoulder-launched IR SAMs to protect themselves from air and helicopter attack. These boats are based all along the Iranian coast, especially at Bandar 'Abbas, and at a variety of offshore oil platforms.

Iranian Cities and Targets

Upper Khuzestan Triangle – Dezful, Masjed Soleyman, Ahvaz: These cities are the main "rear areas" behind the Iraq-Iran battlefront. They have a variety of SAMs. Although all originally had airbase facilities, it is believed that only Masjed Soleyman's is still intact.

Abadan: This city is located at the final junction of the Tigris and Euphrates Rivers. Numerous battles in and around this area have destroyed a large part of the city. The surrounding countryside is now reverting to a poisonous marshland in the aftermath of heavy fighting, which included the use of chemical weapons.

Bandar Khomenyi: This is the main Iranian military base behind the southern part of the Iran-Iraq front, a major staging base for military supplies and munitions of all sorts. It has a large airbase, powerful SAM batteries, and a major military HQ.

Kharg Island: This oil-rich island is covered with refineries, storage tanks, and port facilities. Until the Iran-Iraq war it was the greatest oil terminal in the world. Repeated attacks have ruined many of the facilities. Now protected by SAM batteries and missile boats, it is still Iran's main outlet for oil. Beware that some offshore platforms in this vicinity are now used by Shi'ite "Guards" as military bases.

Bushehr: This important coastal city was once a major oil port, but is now completely overshadowed by neighboring Kharg Island. The military forces on its airbase and SAM batteries are not always first rate, but it is home port for frigates and missile boats.

Shiraz: This inland city is one of the largest Iranian cities; it contains the nerve center for Iran's southern military command. There is an exceptionally large airbase here, and it is protected by a powerful SAM battery.

Esfahan: Nestled in a a large pass of the Zagros Mountains, Esfahan is the "gateway" to northwestern Iran. As a transportation and population center it naturally boasts an airfield, and SAM sites protecting it.

Bandar-e Lengeh: This western city on the Straits of Hormuz has a minor military base, including an airfield and SAM battery. However, its primary function is civilian, serving the large oil fields in this area.

Bandar 'Abbas: This city is Iran's major military base on the Straits of Hormuz. Major Iranian Navy elements are based here, as well as the latest SAMs and a large, well-equipped airbase.

Friendly Bases

CVN Nimitz at Sea: This huge 80,000-ton nuclear carrier is the class ship of the latest and most powerful program of aircraft carriers. Normally assigned to the Pacific Fleet, it is prepared to visit the Indian Ocean at any time.

Ras as Saffaniyah: This is Saudi Arabia's northernmost oil terminal and port along the Gulf. Its airfield is in a useful strategic location. Basing privileges for a secret stealth mission can be arranged with the pro-American Saudi monarchy.

Dhahran and Al Hufuf: Dhahran is Saudi Arabia's largest city on the Persian Gulf, making its airfield an unwise choice for stealth aircraft operations. However, the Al Hufuf airfield slightly inland is a strategically useful and less public position for basing missions.

As Salamiyah: This small airbase outside of the capital Riyadh is a nice, quiet location where clandestine missions can be organized easily.

Bahrain: This small island nation is strongly pro-American, providing large naval and airbase facilities for US military forces.

Neutral Bases

Kuwait City: Iranian threats and attacks have caused Kuwait to seek US military support. The Kuwait City airport can be used to stage missions that demonstrate US support of Kuwait, or for emergency landings, but, fearful of increased Iranian hostility, Kuwait will not grant US basing rights.

Qatar: This small independent nation works hard at neutrality, probably because it has strong pro-US and strong pro-Iranian factions. Although missions aren't regularly staged from here, it is possible to launch specific clandestine missions or carry out emergency landings.

Ruweiss and Tarif in the United Arab Emirates: These small oil ports of the UAE are not especially friendly to the American cause. But the UAE is a decentralized government, and US pressure in the right places can permit clandestine missions or emergency landings.

Abu Dhabi and Khafi in the UAE: Abu Dhabi is the major city of the UAE, where neutrality is most important. Staging missions or emergency landings from here is very difficult, but not impossible. The large airfield at Khafi is the most strategically useful of all UAE airfields – it is the closest base to south-central Iran. But political problems make the use of this base difficult to impossible.

Muscat in Oman: Oman is careful to remain neutral in all affairs, but is strongly pro-Western. For example, much of its army is trained and officered by "retired" British military personnel. The military portion of the Muscat airfield is available for missions and emergency landings, provided everything remains secret and politically "deniable."

EUROPE'S NORTH CAPE: 1985

Introduction

The North Cape area is shared by four nations: Norway, Sweden, Finland, and the Soviet Union. Their political orientations parallel their geographic locations: Norway belongs to NATO, Sweden is a pro-Western neutral, Finland is a pro-Eastern neutral, and the USSR, of course, leads the Eastern Bloc.

Cold War: Because of the threat to the Atlantic posed by the Soviet Northern Fleet, NATO and Soviet forces are constantly sparring with each other, testing the other's responses and jockeying for position should hostilities erupt. Officially at peace, the two sides wage a covert conflict of intelligence gathering and military that could turn deadly in an instant.

Level of Conflict

Limited War: If US-Soviet foreign policy were conducted with greater hostility, the North Cape would be ideal for raids or retaliations.

Conventional War: If the balloon goes up, the Soviet Northern Fleet would make sorties into the Atlantic; Soviet troops would cross into Norway; Mainstays and MiGs would cloud the skies. Getting in and out with your skin intact would be very, very tricky!

Regional Military Forces

In terms of global politics, the North Cape is the single most important military region in the Soviet Union. Murmansk is its only year-round open-sea access to the Atlantic Ocean. Soviet SSBNs (ballistic missile nuclear submarines), the heart of nuclear deterrence, sail from here into the Atlantic and Arctic Oceans. The Soviet Northern Fleet protects these invaluable weapons, as well as maintaining a credible threat to NATO's Atlantic lifelines.

Norway fields a large, well-equipped force tailored for a dogged defense of its cold, mountainous homeland. The northern bases have only token Norwegian garrisons, but NATO plans to strongly reinforce the lightly defended northern areas with air, naval, and marine forces should the shooting start.

Sweden's armed forces are designed to make the USSR (or anyone) think twice about violating its neutrality. Swedish forces are well equipped and well trained, and boast a nationwide reserve system that makes a large part of the citizenry part-time soldiers.

USS Kennedy
Norwegian Sea
North Cape
Arctic Ocean
Lakselv
NORWAY
Barents Sea
Kautokeino
Pechenga
Murmansk
U.S.S.R.
Olenegorsk
Kiruna
Sodankiya
Monchegorsk
Kola
Peninsula
SWEDEN
Kandalaksha
Gallivare
Lappland
White Sea
Lulea
FINLAND
Gulf of Bothnia
Kem
Arkhangel'sk

Finland fields a much smaller and less sophisticated force than its neighbors. Although fiercely independent, Finland has learned to accommodate the desires of its powerful neighbor, the Soviet Union. The Soviets maintain this "friendly" attitude by garrisoning powerful military forces near the Finnish border, and strongly encouraging Finland to buy Soviet military equipment.

Soviet Air Defenses

The Kola peninsula is vital to the USSR because it provides access to NATO's lines of communications. However, its close proximity to Russia makes it particularly vulnerable to NATO counterstrokes. Consequently, the Kola peninsula is likely to prove one of the most challenging anti-aircraft environments in the world.

Long-range SAMs: The older SA-2s and SA-5s have been undergoing continual upgrade to SA-10 and SA-12 quality. The entire system is enhanced by the LPAR early warning radar system at Kirovsk.

Light SAMs: Soviet ground forces in this area are outfitted with the usual battlefield SAMs, including the older SA-9 and SA-13 IR missiles, as well as the newer SA-8 and SA-11 radar guided ones. Mobile infantry carrying SA-7 and SA-14 shoulder-launched IR SAMs are a significant threat as well. Check out your Intelligence Briefing for "enemy troops."

The PVO and Naval Aviation

Fighters: This region is defended partly by PVO (National Air Defense) units, with MiG-25 and MiG-31 interceptors using long-range radar-homing AAMs. Naval aviation fighters operating from carriers or land strips include the Yak-38 V/STOL jet and the new Su-27 multi-purpose fighter. During wartime shorter-ranged units may arrive, including MiG-29 and Su-27 dogfighters with short-range IR missiles as well as long-range radar weapons.

Reconnaissance Bombers: Many long-range Tu-95D "Bears" are based in this area, to keep tabs on NATO naval activity in the North Atlantic. A nuisance in peacetime, these planes pose a more serious threat in war. Eliminating them – and thus blinding the Soviet high command – is always a high priority in NATO war plans.

Transports: The Soviet Union possesses numerous air transports for its huge force of airborne units. The most modern of these is the jet propelled An-72 "Coaler," which is particularly suited to fast, high priority missions like inserting commando teams or transporting critical command personnel.

AEW&C Aircraft: The Soviets routinely deploy IL-76 "Mainstay" aircraft in the region. The 300+ mile radars on these planes may be your most formidable enemy.

The Soviet Red Banner Northern Fleet

The USSR's Northern Fleet offers both tempting targets and a significant threat. Its modern Sovremennyy-class destroyers carry SA-N-7 missiles, while Krivak-class frigates sport the SA-N-4. The larger Kiev-class carrier has the powerful SA-N-6, a sea-going equivalent of the SA-10. These warships are more than capable of defending themselves. Stationed off the northern coast, they significantly extend the Soviet anti-aircraft umbrella.

In addition to these ships' SAMs, Kiev-class carriers mount a complement of Yak-38 "jump-jet" fighters. While less capable than ground-based fighters, the British Harriers in the Falklands taught the world not to underestimate the capabilities of such planes.

An upcoming addition to the Northern Fleet is a class of huge aircraft carriers fitting out in the Crimea. Tentatively titled the Kremlin-class, these ships are expected to join the fleet soon.

Soviet Cities and Targets

Murmansk: This major city is the Soviet Union's only ice-free port with access to the Atlantic Ocean. Its great piers and depots support not only a steady stream of merchant shipping, but the powerful Red Banner Northern Fleet. Murmansk is literally "at the end of the line," in this case a long railway line that runs southward 700 miles to Leningrad.

Murmansk is the nerve center of the USSR's powerful air forces, including both air defense planes and naval aviation of the Northern Fleet. Satellite airfields surround the city, including large bases at Kildenstroy and Kilpyaur. The great Severomorsk submarine pens are also near Murmansk. This underground base is the home port for the new Typhoon-class ballistic missile submarine.

The Northern Fleet includes, roughly, one aircraft carrier, 75 other major surface warships, one marine brigade, 133 submarines, and 446 naval aircraft. The protection of its bases is the duty of 12 divisions of the Red Army (about 300,000 men) and 150 planes of Frontal Aviation (air force planes supporting the army) and the PVO (air force interceptors guarding the border).

Pechenga: This town is the USSR's forward-most military base in the far north and the inevitable staging point for any invasion into NATO territory. Although it has an airbase and strong SAM defenses, the Polyarnyy airbase complex to the east is somewhat larger.

Monchegorsk and Olenegorsk: Near the base of the Kola peninsula, these two towns are major airbases for long-range naval aviation bombers, as well as providing fighter and SAM cover to the railroad link between Murmansk and the south.

Kandalaksha: This small port city is the main population center at the base of the Kola peninsula. South of the city lies the Loukhi air defense complex, including a large SAM battery that covers this section of the Murmansk-Leningrad rail line.

Arkhangel'sk: Although closed by ice during the winter, Arkhangel'sk (the USSR's largest city on the Atlantic) has excellent transportation connections to the interior of Russia, and is almost totally invulnerable to enemy attack. In addition to large port facilities, the city is surrounded by military defenses, the most notable being the complexes at Severodvinsk and Kushkushara, and units of the Northern Fleet which patrol offshore in the White Sea.

Friendly Bases

Kautokeino: Located in the barren tundra of the Finnmarksvidda, the Kautokeino airfield is well suited for operations across the top of Finland to Murmansk. The population is very small and the entire area well defended by tundra swamps and bogs in summer, or sub-zero blizzards in winter.

Lakselv: Located at the base of the Porsangen Fjord, Lakselv has an airfield ideally suited to operations into Russia. It is far enough from the border to survive the first few days of fighting, but close enough for easy access.

CV Kennedy at Sea: Just recently, the Navy Secretary announced a new wartime policy of sending aircraft carriers deep into the Norwegian Sea, to challenge the USSR's fleet near its home. Although considered suicidal by some, this policy is certainly useful for launching stealth missions. Here CV67, one of the conventional carriers with the US Atlantic Fleet, makes a quick dash to the North Cape to launch your mission.

Neutral Bases

Available neutral bases in this region are all Swedish. Sweden is strictly neutral in international politics, but economically closely tied to the Western bloc. Given recent events and aggressive Soviet moves, it's not unlikely that a few clandestine stealth missions, or emergency landings, would be allowed at northern Swedish airbases.

Kiruna: The northernmost airfield in Sweden, this base is located in the nearly unpopulated foothills of the Esrange Mountains.

Gallivare: Although this airfield is also far north in Sweden, Gallivare is a junction of rails and roads. In the summer months it is a popular tourist area, with the Muddus National Park a few miles to the west. Stealth missions operating from this base must be very discreet.

Lulea: This fairly populous city is the main Swedish military base in the Northern Region. It is also a port on the Gulf of Bothnia, the northernmost arm of the Baltic Sea.

Sigonella
Ragusa
SICILY
GREECE
MALTA
Halfar
Mediterranean Sea
Heraklion
CRETE
USS America
Tripoli
Al Bayda
Jabal Nafusah
Misratah
Line of Death
Al Jabal al Akhdar
Benghazi
Gulf of Sirte
Al Hammadah al Hamra'
Sirt
Cyrenaician Desert
Ras Lanuf
Port Brega
Sirte Desert
LIBYA
Jabal as Sawda
Al Haruj al Aswad
Jabal Zaltan
Idhan Awbari
Sabha

LIBYA: 1986

Introduction

Libya is ruled by Col. Mu'ammar al-Qadhaffi, leader of the secret army organization that deposed the former king in 1969. The capital city is Tripoli and the nation's chief source of wealth is oil sold to western nations.

Level of Conflict

Cold War: At times Libya has enthusiastically backed international terrorism. The US has already attacked tactical military targets in retaliation for Libya's role in numerous incidents of international terrorism in Europe and the Mediterranean.

Limited War: The Libyan army has fought minor border clashes against Egypt, a US ally, that – so far – has proved considerably superior. Future limited wars between Libya and any of her neighbors are possible.

Conventional War: In the event of NATO-Warsaw Pact conflict, Libya is expected to provide bases for Soviet aircraft and warships operating in the Mediterranean. These bases could become the westernmost outposts of Soviet forces in the Mediterranean.

Libyan Military Forces

The Libyan Army has approximately 60,000 men, the Navy has 53 ships and 6,500 men, while the Air Force has about 530 planes, 30 combat helicopters, and 8,500 men. A paramilitary "Pan-African Legion" of about 10,000 also exists. In addition, Libya has built and supported a variety of training camps for terrorist groups.

Libya buys most of its armaments from the Soviet Union with money earned from selling its vast oil reserves to the West. Personnel are trained by Soviet military advisors, but national pride has prohibited any significant Soviet presence.

Air Defenses: Libyan air defenses use Soviet-built equipment. SA-2"Guideline" and SA-5 "Gammon" SAMs have been the backbone of Libyan air defenses, but are being replaced by SA-10 "Grumble" and SA-12 "Gladiator" systems.

Local ground forces use the SA-7 and SA-14 shoulder-fired missiles. These are also popular terrorist weapons, and can be expected in the vicinity of terrorist camps. Libyan army units also use various medium-range SAMs, including the SA-8, -9, -11 and -13.

Air Forces: The Libyan Air Force is composed of 140 MiG-23MF "Floggers," a small number of MiG-25 "Foxbats" and old MiG-21s, and various Mirage 5D fighter-bombers. Your primary opponents will be MiG-23s and 25s, although in Conventional War, or against higher quality pilots, you may encounter MiG-29 "Fulcrums" flown by Soviet pilots.

Libya's antiquated C-130H and C-47 air transports (built in the US) will probably be replaced by the new Soviet An-72 "Coaler" jet transport.

Naval Forces: The Libyan Navy is primarily composed of missile corvettes and patrol boats. The largest of these are the 770-ton Russian-built Nanuchka II-class armed with Styx surface-to-surface missiles, SA-N-4 surface-to-air missiles, and a twin 57mm gun turret. The other boats include the Soviet Osa-class, Italian-built Wadi M'ragh-class and the French-built La Combattante II types; these have poorer missiles and SA-N-5 SAMs, or no SAMs at all.

Libyan Cities and Targets

Tripoli: The capital city of Libya has a large military-civilian airbase at Idris, and is well protected by SAM batteries. Until recently these were long-range SA-5 "Gammons," but there are indications that Soviet military advisors have replaced them with SA-12 Gladiators. Tripoli is also the site of a major army HQ, various military depots, oil storage areas, and terrorist training camps. Missile boats often cruise off the coast.

Sabha: This southern town is the main military base supporting Libya's southerly border expansion. The most important military installations here are the large airbase and the SAM battery protecting it.

Misratah and Sirt: These two coastal towns harbor low-level military HQs and oil storage tanks for refueling ships. Sirt is a secondary naval base, supporting missile boats that cruise the western side of the "Line of Death."

Ras Lanuf and Port Brega: Ras Lanuf is Libya's largest and newest oil facility. Port Brega is an older facility, still in operation despite the completion of Ras Lanuf. A number of SAM batteries support the Port Brega airfield, west of the town.

Benghazi: This is the site of Libya's second largest military base and the Benina airfield. It boasts a military HQ and small oil storage facilities. Terrorists train in the western hills.

Al Badya: This sleepy coastal town in the mountainous Jabal al Akbar has major military significance. It overlooks the narrow Ionian Sea between Libya and Greece, making it an ideal site for anti-ship missiles. There is a small airstrip and SAM site as well.

Oil Fields: The great oil fields of Libya are in the southeast, where thousands of wells pump crude to Ras Lanuf and Port Brega. Most of the great fields have a few storage tanks on site, to hold crude oil temporarily.

Friendly Bases

Sigonella on Sicily: The US maintains a military base at Trapani. The Sigonella military field in southeastern Sicily is the main staging point for air attacks against the North African coast.

Neutral Bases

CV America at Sea: This 60,000-ton "Kitty Hawk" class conventional aircraft carrier, designated CV66, often serves with the US Sixth Fleet in the Med. A participant in recent raids against Tripoli and Benghazi, it is ideally positioned for strikes against Benghazi, the Gulf of Sirte, or targets deep in the Libyan desert.

These airbases are in neutral territory. You should not use these bases unless specifically so ordered, or if you must make an emergency landing.

Suda Bay on Crete: This airfield, near the city of Khania, is not a US base, although it has been a major NATO air and naval base.

Halfar on Malta: On the island of Malta, and once a critical position for the British Commonwealth in the Mediterranean, this base is now a neutral port and sometime tourist haven.

CENTRAL EUROPE: 1986

Introduction

Since World War II Europe has been divided into two hostile blocs. On one side are the communist East European nations, created in the wake of Soviet armies at the end of WWII. On the other side are the democratic Western European nations. Since 1949 the West has been linked by NATO; In 1955 the East formalized an equivalent organization – the Warsaw Pact – dominated by the USSR. From then to now the two greatest military organizations on earth have eyed each other along the East-West German border.

Level of Conflict

Cold War: This is the situation of the last 40 years. The two sides maintain a wary posture, generally trying to avoid overt provocations, probing each other to gain information, stir discontent in the enemy population, and gain psychological advantages. The F-117A, designed for clandestine penetration, is the perfect aircraft for the secret operations common in this situation.

Limited War: Now the conflict is at the brink of open warfare, but armies have not yet crossed borders. As hostilities escalate, the opportunity for stealth missions increases.

Conventional War: Warsaw Pact tanks pour over the West German border while NATO forces scramble to stem the onrushing tide. On one hand lies the specter of conventional defeat, on the other the disaster of thermonuclear war. Stealth aircraft, airmobile raiding groups, and long-range "smart" munitions make the dangerous crossing over the front to hammer Soviet rear echelons. If they can isolate the Pact spearheads from their base, they may give the politicians an opportunity to avert disaster.

Military Forces

The Warsaw Pact can deploy almost three million men, about 80,000 armored fighting vehicles, and 6,000 combat aircraft. Against this juggernaut, the Western powers can field around two million men, 40,000 AFVs, and 4,000 combat aircraft. The numerical imbalance is partially offset by the higher quality of the Western troops and equipment, presumably along with the traditional advantages of the defense.

Together, the two sides have almost ten thousand battlefield nuclear weapons in Europe. These range from small, sub-kiloton shells designed to wipe out troop concentrations, to multi-megaton city busters. Artillery, planes, and missiles of all types and ranges can deliver these weapons. At one time NATO felt it had to use nuclear weapons to compensate for numerical inferiority. Today it has an alternative plan: "Air-land battle, 2000." In this NATO uses superior technology, including its stealth planes, to attack deep in the rear of the Warsaw Pact armies, destroying their logistical support. If this innovative strategy works, NATO need not use nuclear weapons to stem the Red tide. However, failure would mean a choice between nuclear holocaust and the loss of Europe to the Soviet Union.

North Sea
DENMARK
Vandel
SWEDEN
Baltic Sea
Gulf of Riga
Klaipeda
U.S.S.R.
Kaliningrad
Stupsk
Gdansk
Kolobrzeg
Leck
Kiel
Hamburg
Lubeck
EAST GERMANY
Wittstock
Wittenberg
Wista (Vistula) River
Warsaw
Poznam
Hanovaria
Ahlhorn
Hanover
Berlin
NETHERLANDS
POLAND
Lodz
Lublin
Elbe River
Cottbus
Gutersloh
Magdeburg
Dortmund
Dessau
Wroclaw
Radom
Grossenhaim
Leipzig
Rhein River
WEST GERMANY
Dresden
Mittenwalde
BELGIUM
Krakow
Westphalia
Rhein-Main
Pilsen
Prague
CZECHOSLOVAKIA
Kaiserslautern
Nurnberg
Tabor
Ramstein
LUXEMBOURG
Bavaria
Budejovice
Brno
Karlsruhe
Karlsbad
Neuberg
Danube River
Konmarno
Budapest
FRANCE
Strassburg
Munich
Vienna
Leipheim
Memmingen
AUSTRIA
HUNGARY

Air Defenses

Equipment: Since the "Central Front" forms the focal point of the war, the anti-aircraft defenses on both sides are the most intensive in the world. The Soviets are certain to deploy large quantities of their most modern weapons, SA-10s and SA-12s, for area defense. In some areas the older, less effective SA-5 long-range systems may still be in place.

Radar-guided SA-8s and SA-11s are most commonly used for more local defenses, especially near important military concentrations or objectives. A few are even sited near larger SAM batteries to provide local defense. The shorter-ranged infrared SA-9s and especially SA-13s may appear instead if radar-guided weapons are not available.

At sea the Baltic missile boats typically have either SA-N-5 or SA-N-7 systems, although Krivaks and larger ships with SA-N-4s can be expected in wartime.

Pact Air Forces

The Soviet Air Force is the largest in the world, and one of the most modern. It deploys a wide variety of interceptor, bomber, and support aircraft. The Soviets know the value of air superiority and will give it high priority.

Fighters: With 6,000 combat aircraft to choose from, you can bet the Red Air Force will find a few to spare for you. If you're lucky, you'll see only second-line MiG-23s, but more likely quality dogfighters like the MiG-29 and Su-27 will be flying. In rear areas you're more likely to see long-range interceptors like MiG-25s and MiG-31s.

Bombers: One of the most troublesome enemy bombers you'll encounter is the Tu-95 "Bear" modified to carry cruise missiles. A number of these craft in orbit deep behind enemy lines gives them an "untouchable" airborne nuclear force.

AEW&C: The Soviet IL-76 "Mainstay" AEW&C was designed for work in this kind of environment. Flying "racetrack" orbits deep behind friendly lines, its powerful radars can see NATO air operations develop and radio appropriate orders to various fighter squadrons. The effort to develop these planes has been long and costly; the size, weight, and expense of the electronic gear is gigantic. Each plane is precious. Eliminating them would cripple Soviet air operations.

Transports: Thousands of air transports will shuttle back and forth on both sides of the front line, carrying troops, raiding parties, munitions, staff officers, etc. The new Soviet workhorse that flies anywhere and carries almost anything is the An-72 "Coaler."

Naval Forces

The Soviet Baltic fleet, headquartered at Baltiysk outside of Kaliningrad, controls 4 cruisers, 16 destroyers, 7 Krivak-class large frigates, 22 missile boats and other light warships, 21 amphibious assault ships, and 45 submarines. It also controls the East German and Polish navies, which have numerous additional frigates and missile boats. This force has two goals: to cover the northern flank of the Warsaw Pact from air attack, and to invade Denmark in the event of war.

Stealth missions will generally deal with the former, your problem being how to penetrate the warship screen in the Baltic. The SA-N-5 is a first generation IR homer, and no serious threat. The SA-N-4 uses older pulse radar guidance, but the new SA-N-7 is a more serious problem. Fortunately very few Baltic warships carry the powerful, long-ranged SA-N-10.

Pact Cities and Targets

East Germany: During a Limited or Conventional War the main strength of the Warsaw Pact forces will travel through here, surging into West Germany. The greatest natural barrier in East Germany is the Elbe River, running from the Czechoslovakian mountains northward to Hamburg. Destroying its bridges would cut off the Pact's forward troops from their bases.

Covering the Pact's forward areas are two main air defense complexes, one in the north near Wittstock and Wittenburg, another in the south just east of Leipzig and Magdeburg, including the big radars at Mittenwalde and Grossenhaim.

Poland: In a NATO-Pact conflict Poland is the "rear area" through which Soviet troops and supplies would flow toward the front lines. Many important HQs and depots are situated in the central and western part of the nation. The Wista-Vistula river system divides Poland in half, from north to south. Destroying the road and rail bridges can seriously damage Pact operations. Polish defense complexes include a powerful system west of Gdansk at Stupsk, and south of Lodz at Radom. In addition, Warsaw is a major transportation hub, so active SAM batteries can be expected in that area during wartime.

Czechoslovakia: This Pact nation, separated from Germany by the Ore Mountains and the rugged highlands of the Bohemian Forest, is likely to play a secondary role in wartime. Czechoslovakian defenses are also somewhat lighter than East Germany and Poland. Tabor is the most significant installation. Far to the east, guarding the entrance to Hungary and southern Poland, is another defense complex at Konmarno.

Kaliningrad: This region of the USSR, named after the major seaport of Kaliningrad (renamed from Konigsberg in 1945), is the Soviet "front-line" on the Baltic. It includes a major over-the-horizon (OTH) radar station, as well as the Klaipeda Airbase.

Friendly Bases

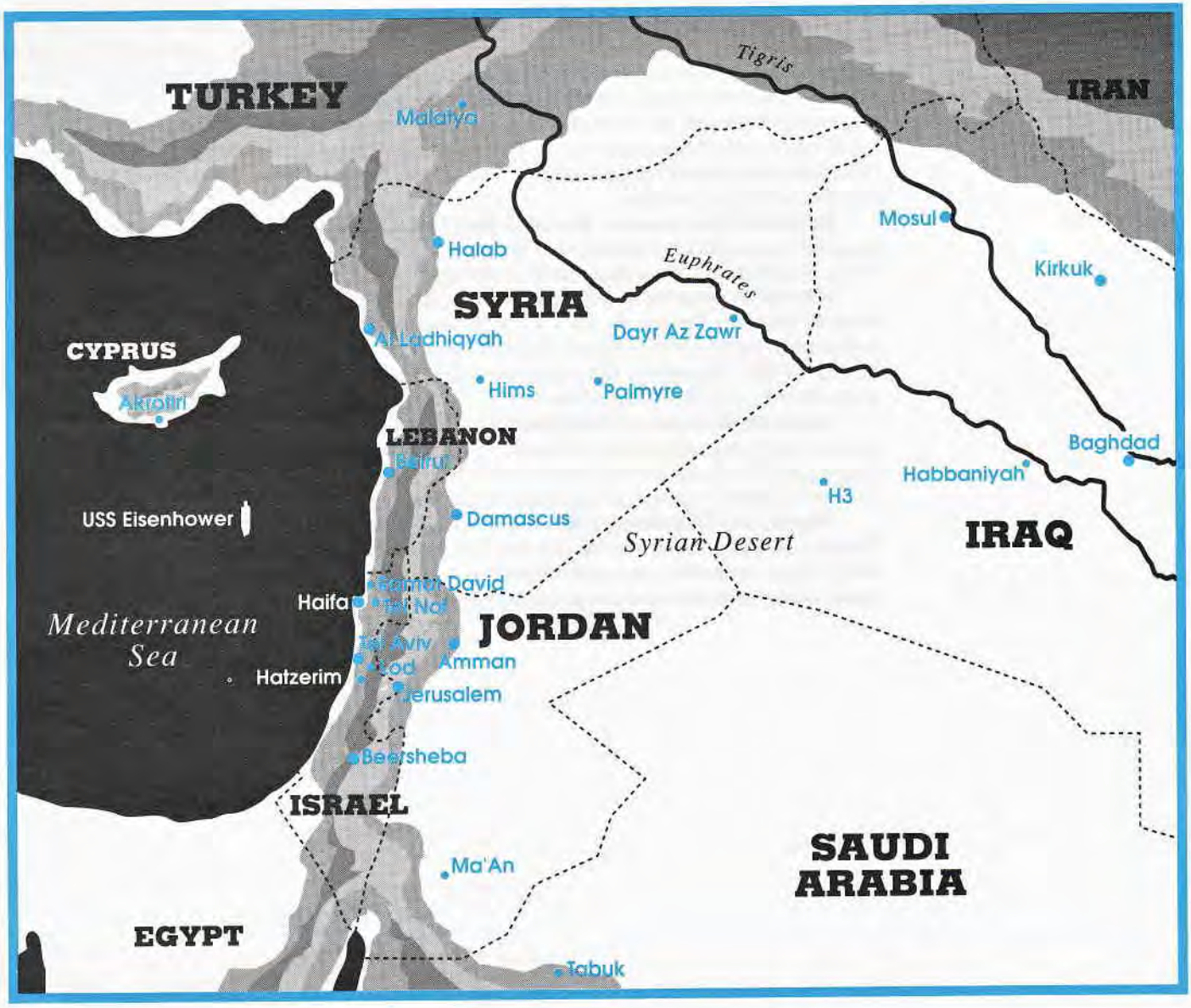
West Germany, Holland, and Denmark are studded with airfields that could serve as bases for stealth raids into Eastern Europe. They form a gentle, north-south crescent bulging west in the middle. Which is the most suitable starting point for a particular airstrike depends mainly on the location of the target. However, the F-117A's unique characteristics will be most effective in the areas only thinly covered by radar to the north and south of the main arena. Therefore, deep penetration raids will usually start from Denmark or southern Germany. Shorter tactical strikes, however, must fly directly into the mouth of the tiger.

Jutland Peninsula – Vandel and Leck: These far northern bases make ideal jump-off points for raids out across the Baltic. Often it's easier to deal with missile boats in the Baltic than the heavier SAM defenses in East Germany and Poland.

Northern Germany (Hanover) – Ahlhorn and Gutersloh: These bases, directly behind British Army Of the Rhine (BAOR), face across the flat, densely populated North German plain, the most likely axis of advance should the Warsaw Pact attack NATO. Therefore, they represent the most direct route to one of the greatest concentrations of hostiles in the world.

Central Germany (Westphalia) – Rhein-Main and Ramstein: These bases are the great, famous bases of American air power in Europe. Rhein-Main is one of the largest military bases in the world, while Ramstein is headquarters for the 4th Tactical Air Force, America's combat air arm in Europe.

Southern Germany (Bavaria) – Neuberg, Leipheim and Memmingen: These bases are all Luftwaffe (air force of the Federal Republic of Germany), but like many German bases, are entirely willing to host American aircraft as needed. Any of these bases makes an excellent jump-off point for missions into Czechoslovakia.


TURKEY
Malatya
Tigris
IRAN
Mosul
Halab
Euphrates
Kirkuk
SYRIA
Al Ladhiqyah
Dayr Az Zawr
CYPRUS
Hims
Palmyre
Akrotiri
LEBANON
Beirut
Baghdad
Habbaniyah
H3
USS Eisenhower
Damascus
Syrian Desert
IRAQ
Camp David
Haifa
Nat
Mediterranean Sea
JORDAN
Tel Aviv
Amman
Lod
Hatzerim
Jerusalem
Beersheba
ISRAEL
SAUDI ARABIA
Ma'An
EGYPT
Tabuk

THE MIDDLE EAST: 1989

Introduction

The Middle East has been the scene of constant tension and recurring warfare since the United Nations formed the nation of Israel in 1948. In the crucible of this conflict, the Israelis have forged a superior army and air force that has consistently outmatched its opponents. The threat to Israel today comes from Syria and Iraq, although Iraq has been significantly worn down by eight years of warfare with Iran. The Jordanians have adopted a near-neutral policy and are not expected to take an active part in any near-future conflict. Lebanon has been torn apart by civil war and invasions by Israel, Syria, and Palestinian refugees.

The Syrians and Iraqis are supported financially largely by the Saudi Arabians, but receive their weapons and training from the USSR. Jordan and Saudi Arabia act independently and have relatively strong ties to the West.

Level of Conflict

Cold War: For many years, Syria has engaged in the training and supplying of various terrorist organizations, including the PLO, which has proved a never-ending source of annoyance to the Israelis. In addition, several Western hostages are rumored to be held somewhere in Syria.

Iraq is in the process of building the region's most formidable armed force. The Iraqi military is working furiously to develop nuclear weapons, and already has large stores of chemical and biological devices. Saddam Hussein, Iraq's leader, ordered the use of these during the war with Iraq and is rumored to have used them against Kurdish rebels in his own country.

Limited War: An Iraqi-backed Syrian invasion of Israel is underway, and the Israelis have called upon the US for support. The Jordanians, as expected, are staying out of this fight for fear of losing what little armed force they have to defend themselves against their powerful neighbors.

Conventional War: In response to US air intervention in the Middle East, the USSR has sent air forces into the region to support its Syrian and Iraqi allies. No superpower can keep its hands off all the oil that comes from this vast desert region. This war could quickly flare into a global superpower confrontation.

Syrian Forces

Air Defenses: The Syrians use Soviet-built equipment and are trained by Soviet advisers. They possess over 75 batteries of surface-to-air missiles, mostly SA-2 "Guidelines" and SA-5 "Gammons." Ground forces are equipped with SA-7 and SA-14 shoulder-fired missiles, and these can also be expected in the vicinity of terrorist camps in Lebanon and Syria.

Air Forces: The Syrian Arab Air Force is composed of over 450 combat aircraft and 50,000 men. The majority of the interceptor aircraft available are MiG-21s and MiG-23s, with one squadron of MiG-25s. The MiG-25 squadron is reportedly serviced and manned by East Germans and Russians. Intelligence expects that MiG-21s and MiG-23s will be your primary opponents, although you may encounter MiG-25s and possibly new MiG-29s flown by Soviet personnel.

Syrian Cities and Targets

Damascus: This ancient city, the capital of Syria, is situated east of a gap in the coastal mountain ranges and was founded on the east-west trade route. Damascus is the major military base in Syria and home to a majority of the Syrian Arab Air Force. Substantial SAM batteries and a major airbase are located west and southwest of the city.

Dayr As Zawr, Hims, and Palmyre: These towns support airbases that guard Syria's northern and western border with Turkey. Dayr Az Zawr is located at an ancient crossing point on the Euphrates River. Palmyre is a desert oasis town near the center of Syria. Hims is northeast of Lebanon, helping to surround that country. All of these cities are protected by substantial air defense facilities.

Halab: Previously known as Aleppo, this city is located in the northern hills of Syria near the Turkish border. Aircraft based here cover the Turkish border and can reach south to Israel or into the Mediterranean.

Al Ladhiqyah: This town north of Lebanon on the Mediterranean coast is near the Turkish border and supports the airbase closest to Cyprus. It is not a shipping port but is a vacation spot and fishing center.

Iraqi Forces

Air Defenses: Iraq is just beginning to invest large resources in air defense, but currently has only 10,000 men assigned to this branch. Largely separated from enemies to the west and north, and just ending a bloody, protracted war with Iran, it has concentrated most of its defense against air attacks in the east. SAM batteries deployed are either SA-2 "Guidelines" or SA-5 "Gammons."

Air Forces: The Iraqi air force has modern equipment, but did not demonstrate a high degree of training or skill during the war against Iran. The main air defense aircraft are MiG-21s and Mirage F-1s, although a few MiG-25s and MiG-29s are known to be in service.

Iraqi Cities and Targets

Baghdad: The capital city of Iraq is located between the Tigris and Euphrates Rivers. Although low in strength due to war losses, major elements of the Iraqi air force are based here. Outside the city is a nuclear power plant that many believe is producing materials for nuclear weapons.

Mosul: The second largest city in Iraq also has heavy air defenses and a nuclear facility is thought to be operating nearby. Probably because of this, and the close proximity to Turkey, Mosul has heavy SAM protection.

Kirkuk, Habbabiyah, and H3: At these locations the Iraqis have airbases ringing their country. Kirkuk faces Iran and H3 is an outpost at a pumping station in the desert along a major oil pipeline to Syria.

Jordanian Forces

Air Defenses: Jordanian air defense is obsolete, relying primarily upon the antiquated MIM-23B "Hawk" missile system, a good weapon for the 1970s, but not for the late 1980s.

Air Forces: Jordanian air power, too, is limited to a couple of types. The main type of aircraft is the US-built F-5, an inexpensive strike fighter that is obsolete by today's standards. The other is the French Mirage F-1, an outdated fighter-bomber.

Jordanian Cities and Targets

Amman: Amman is the capital of Jordan and home for the major elements of the Royal Jordanian Air Force.

Ma'An: Outside this city is the Prince Hassan Airbase, where half of the air force's combat planes are deployed. Planes were placed here to reach the Sinai Peninsula, but now that the Israelis have made peace with Egypt, air elements here may be moved further north to cover the West Bank areas.

Friendly Bases

Akrotiri on Cyprus: Aircraft from this British airbase are capable of reaching targets along the Mediterranean coast. US or Israeli aircraft would not normally base here, but would use the facilities in an emergency.

CVN Eisenhower at Sea: This 80,000 ton Nimitz-class nuclear carrier often serves with the US Sixth Fleet in the Mediterranean. Here it cruises off the coast of Lebanon, positioned to strike anywhere along the Mediterranean coast. Carrying a complement of approximately 85 aircraft, the Eisenhower is constantly guarded by a combat air patrol of fighter planes.

Ramat David, Tel Nof, Lod, and Hatzerim: These Israeli airbases are home for the fighters and fighter-bombers of the air force many consider to be the best in the world. Backed up against the sea by enemies or non-friendly neutrals, the Israelis must be prepared to launch air defense or attack missions in any of three directions. A long-standing US ally, Israel's bases would be shared freely with US forces during wartime.

Malatya in Turkey: Turkey is a NATO ally and no friend of Iraq or Syria. This airbase is home for aircraft assigned to defend Turkey's southeast border, and from here planes can reach the capitals and other targets within both Iraq and Syria.

Tabuk in Saudi Arabia: This minor airbase serves as a defensive post along the Saudi Arabian frontier. In any armed conflict in the region, US aircraft would only be allowed to land here in an emergency, unless circumstances clearly called for Saudi Arabian support of US interests – or vice versa.

Mosul
Kirkuk
Tigris River
IRAN
Hadithah
Euphrates River
Baghdad
Habbaniyah
Amarah
Karbala
Basra
IRAQ
Jalibah
Kuwait City
Sea Island
USS Constellation
KUWAIT
Neutral Zone
Persian Gulf
Dhahran
Huffuf
SAUDI ARABIA
Tabuk
Buraydah
Ha'il
Shaqra
Riyadh

DESERT STORM: 1991
Introduction

The western end of the Persian Gulf protrudes into the center of the map, and around it lie the region's three most powerful nations: Iran, north of the Gulf; to the west, Iraq; and Saudi Arabia to the south. Between them all, sitting astride the most valuable oil fields on Earth, is the tiny Arab sheikdom of Kuwait.

Iran, the successor state to ancient Persia, is ruled by a radical fundamentalist Shi'ite Moslem regime, a brutal government that has actively tried to spread revolutionary fundamentalism to its neighbors. Iran has a large population and oil revenues to support a powerful military (though obtaining modern military equipment has been difficult since 1979, when it basically declared war on the world.)

Iraq is a populous Arab country centered on the fertile Tigris and Euphrates river valleys. It has a Shi'ite Moslem majority but is ruled by Saddam Hussein's Baath Party, which is dominated by Sunni Moslems. Wealth from oil revenues has enabled president Saddam to build a well-equipped, modern military, outfitted mainly with Soviet-built equipment and trained by Red Army advisers. In 1980, sensing potential weakness to the east, Saddam ordered an invasion of Iran. For eight long years, the two countries fought a savage and debilitating war of attrition. When a cease-fire was finally signed in 1988 neither side had gained anything except the deaths of hundreds of thousands.

The kingdom of Saudi Arabia is a vast, underpopulated desert ruled by a conservative royal family. Like its neighbors, Saudi Arabia has spent much of its considerable oil wealth on modern arms, purchased mainly from the West. Like other Gulf states, Saudi Arabia fears Iran's Islamic fundamentalism will incite rebellion among its own populace. Accordingly, Saudi Arabia lent monetary support to Saddam's Iraq during the Iran-Iraq war.

Arrogant, oil-rich Kuwait, with the highest per capita income in the world, is disliked by all three Gulf giants. Kuwait has also spent freely on armaments, but it is so small that it cannot really rely on arms for protection. Instead, it trusts its staggering wealth to pay for its troubles. Despite its long-standing border disputes with Iraq (over ownership of some of the richest oil-producing terrain known), Kuwait also supported Iraq with cash during the Iran-Iraq war.

1990 found Saddam Hussein in a bind. He had nothing to show for his disastrous eight-year war with Iran except staggering foreign debt; his economy was depressed and his personal myth as a great Arab leader in doubt.

To Saddam, it was clear that only a major move on the world stage could recoup his losses and put his regime back on the road to glory. Kuwait, virtually undefended, the richest piece of real estate in the world, seemed like an easy mark. Who would come to the aid of unloved Kuwait? If Iraq absorbed Kuwait in a lightning invasion, Saddam was confident that the nations of the world will bluster for a few weeks, take note of his powerful military, then accept it.

It was to be a costly mistake.

Within days following the invasion, US air, ground, and naval forces gathered in the area, and prepared to meet what was believed to be Saddam's next move: an invasion of Saudi Arabia. For several weeks the build-up continued and US forces dug-in to the desert in *Operation Desert Shield*. Almost unbelievably, the Iraqis did nothing but wait for the forces opposing them to get stronger. Soon, US forces were joined by soldiers from Great Britain, France, Egypt, Syria, and a host of others.

While the build-up continued Allied leaders demanded the "...complete and unconditional withdrawal of Iraqi forces from Kuwait." Saddam was recalcitrant. Soon the US-led coalition had achieved an irresistible force of men and equipment, airpower and seapower ...but Saddam refused to move.

On January 16, 1991 US air forces led by F-117A stealth fighters began a long withering bombardment of Iraqi strategic targets...

Level of Conflict

Cold War: During the build-up, the F-117A is used to fly reconnaissance sorties over Iraq and occupied Kuwait to determine the strength and dispositions of Iraqi forces.

Limited War: During the first few weeks of the aerial bombardment, Coalition forces are very careful to restrict their sorties to surgical strikes. The tense political environment of the Gulf makes wanton destruction unwise.

Conventional War: As the bombardment continues the target list is expanded until, when the ground troops finally go in, all military targets are fair game.

Iraqi Military Forces

Iraq has the world's fourth largest standing army, deploying around 50 divisions with nearly a million troops under arms. Many of these soldiers are poorly trained, poorly motivated, and poorly led, but at the core of the Iraqi army are the eight elite divisions of the Republican Guard, whose morale is high and whose equipment is first-rate.

Air Defenses: Iraq has invested heavily in surface-to-air missiles, especially SA-2 "Guidelines," SA-6 "Gainfuls" and SA-9 "Gaskins," but you may face almost any Soviet-made SAM in the catalog. Older SAMs like the SA-2s have been considerably improved by Iraq's domestic missile industry, which has added enhancements like modern infrared terminal guidance systems. Iraq also has a vast array of antiaircraft artillery ("Triple-A"), but it lacks modern fire control. It offers little threat, and isn't even represented in the game.

Air Forces: The *Al Quwwat al Jawwiya al Iraquiya*, the Iraqi Air Force, has over 500 modern combat planes, including a number of very formidable fighters and interceptors. The types you are most likely to encounter are the MiG-29 "Fulcrum," MiG-23 "Flogger," and the Mirage F-1E. The F-1E is built by the French Dassault Aviation company, and is a multi-role air superiority/ground attack fighter with modern avionics and the ability to carry Exocet anti-ship missiles. Normally the F-1 is configured to carry French Matra 550 air-to-air missiles, but the Iraqi planes may have been altered to enable carriage of Soviet AAMs.

Kuwaiti Cities and Targets

Kuwait City: At the head of the Gulf is Kuwait City, capital of Kuwait and home to nearly all the country's population. Occupying Iraqi troops have made the city an armed camp, within which the Baathist secret police conduct a reign of terror.

Sea Island: The pumping station here gushes crude oil directly into the Gulf, an act of Iraqi environmental terrorism.

Kuwait-Saudi Border: Look closely and you'll see Iraqi armored units awaiting the Coalition invasion, or orders to attack Saudi Arabia to the south.

Iraqi Cities and Targets

Basra: Iraq's second-largest city boasts an oil refinery and a major airbase. Fixed Scud launching sites are located to the west.

Jalibah and Amarah: These are major Iraqi airbases. Capturing Jalibah, west of Basra, will be a goal of Coalition troops when the ground war gets underway.

Baghdad: Iraq's capital and largest city, Baghdad is also the country's military command center. Targets here include the Defense Ministry, the Presidential Palace, a nuclear weapons research plant, an oil refinery and a major airbase.

Samarra and Qaim: Biological weapons plants are located in these towns.

Salman Pak: This is Iraq's most important chemical weapons plant.

Habbaniyah and Hadithah: Iraqi Air Force bases.

Mosul: Targets at this important northern city include a nuclear weapons research facility and an airbase.

Kirkuk: Another major city, defended by an Iraqi airbase.

Samarra: This town is the home of another major chemical weapons plant.

Irbil: The research facility here is an important part of Saddam's nuclear weapons project.

Friendly Bases

Tabuk, Ha'il, Buraydah, Shagra: These desert airstrips have been expanded for the use of Coalition planes making strikes into Iraq.

Riyadh: The capital of Saudi Arabia, and equipped with a large airbase, Riyadh is a frequent target of Iraqi Scud missile attacks.

Dhahran and Huffuf: Dhahran is perhaps the largest, most modern airbase serving the Coalition.

CV Constellation in the Gulf: Of course, Air Force (Lockheed) F-117As did not actually fly from Navy carriers in the Gulf War, but naval air played such an important part in the air campaign that we thought they shouldn't be overlooked. (And, besides, the MicroProse F-117A is fully equipped to launch from carriers.)

Takhli
Wattay
Phuc Yen
Gia Lam
Kep
Red River
THAILAND
Chao River
Hanoi
Cat Bi
Haiphong
Vientiane
Korat
Udorn
LAOS
Bangkok
Vinh
USS Constellation
Gulf of Tonkin
Don Muang
Dong Hoi
Gulf of Thailand
CAMBODIA
Hue
USS Kity Hawk
Mekong River
Ho Chi Minh Trail
Da Nang
Pnom Penh
VIETNAM
Ho Chi Minh City
Tan Sanh Nhut
Nha Trang
South China Sea

VIETNAM: 1994

Introduction

Now roughly 20 years since the end of the Vietnam war, the Vietnamese military is expanding its hold in Southeast Asia, seeking to become a regional superpower. Their first move was to officially absorb Laos into Vietnam, and divide it into several provinces under direct Hanoi control. Secondly, they pushed back into Cambodia under the pretense of solving the confusing political situation there, and ousting once and for all Pol Pot's threat of resurfacing as a tyrannical leader.

In the Soviet Union, meanwhile, the conservatives have had enough of reform and decadence, and have reasserted their dominance over the course of the nation's future. They are now fueling regional communist states into expansion and inciting revolution – just like "the good old days." Now, only pro-Western Thailand remains to stand against Soviet-backed Vietnamese expansion in Southeast Asia – looks like the "domino theory" should be dusted off again.

Level of Conflict

Cold War: As soon as it is clear that Vietnam has aggressive designs on her neighbors, F-117A sorties are initiated over the area for recon and selective strikes.

Limited War: With the annexation of Laos and invasion of Cambodia, US response intensifies. Ground troops are sent into the theater and aggressive air activity is initiated.

Conventional War: The Vietnamese invasion of Thailand initiates outright war between US forces and the Vietnamese army. The full power of the US military machine is again in action in Southeast Asia.

Vietnamese Military Forces

Air Defenses: The North Vietnamese use Soviet-built equipment and are trained by Soviet advisors. The majority of the SAMs deployed are SA-10 "Grumble" and SA-11 "Gadfly." Vietnamese ground forces are also equipped with good Soviet equipment; they carry SA-7B "Grail" shoulder-launched missiles, and some units are equipped with SA-9B "Gaskin."

Air Force: The majority of the fighter aircraft in the Vietnamese Air Force are MiG-21s and and MiG-23s, somewhat outdated but still effective. The Soviets have also sold a substantial number of MiG-25s, a few MiG-29 "Fulcrums," and, intelligence reports sightings of the Su-27 as well; the MiG-29s and Su-27s are probably being operated by Soviet personnel.

Navy: The Vietnamese Navy consists only of a few torpedo boats transferred to it from the navies of Communist China and the Soviet Union. From the Soviets came 190-ton SO-1-class boats and from the Chinese came Shanghai-II class" boats. Both these boats are antiquated compared to a modern navy, but their crews may carry SA-7B "Grails."

Vietnamese Cities and Targets

Hanoi: Surrounded by numerous airbases and SAM batteries, the capital city of Vietnam is one of the most heavily defended air targets in the world. Nearby airbases are located at Gia Lam, Phuc Yen, and Kep.

Haiphong: This city is a major Vietnamese port, and it is guarded by SAM missiles and a fighter airbase nearby at Cat Bi. Located near Haiphong are numerous military storage dumps and tank farms.

Vinh: This coastal city supports an interceptor airbase that defends the major bridges to the northwest, the approaches to Vietnam from Thailand, and the supply routes to the southwest.

Dong Hoi: This city supports a major Vietnamese airbase used for strikes into Thailand. Although often attacked by friendly forces flying in from the sea, it remains operational and its interceptors will attack US fighter-bombers heading west.

Da Nang: Formerly a major US base during the first Vietnam War, The Vietnamese have converted it into a major air defense center. Like Dong Hoi, its airfield and accompanying SAM batteries and radar installations protect the long Vietnamese coastline from US carrier attacks, and launch strike bombers into Thailand.

Nha Trang: Located to the east of the central highlands, aircraft from this base form another link in the air defense system that guards Vietnamese coastal waters from US seaborne air forces.

Ho Chi Minh City: Formerly Saigon, Ho Chi Minh City is now the chief industrial center of Vietnam. It is a major port, and is protected by numerous SAM batteries and security forces.

Tan Sonh Nhut Airbase: Located outside of Ho Chi Minh City, this is the largest and busiest airport and base in Southeast Asia. Military aircraft based here are used primarily to support supply operations into Cambodia.

Cambodian and Laotian Cities and Targets

Phnom Penh: The capital city of Cambodia has fallen under the control of the Vietnamese. Enemy planes are operating from the airbase outside the city and SAM batteries have been placed in the area.

Vientiane: Laos is now officially controlled by the Vietnamese, and enemy aircraft are based at Wattay, near the Laotian capital of Vientiane.

Friendly Bases

CVNs Constellation and Kitty Hawk at Sea: These 80,000 ton carriers have a complement of approximately 85 aircraft, and are placed in the Gulf of Tonkin to strike targets deep in Vietnam. The navy concentrates on transportation routes bringing supplies south and west into Laos.

Each carrier group consists of one carrier and a ring of escort destroyers. A combat air patrol of fighter planes is continuously overhead to intercept any approaching Vietnamese aircraft.

Udorn: Just over the border in Thailand from the former Laotian capital of Vientiane, aircraft based here reach out to bomb targets in Vietnam and Laos.

Don Muang: Located in the southeast corner of Thailand, this is an important base for attacks into the southern areas of Vietnam, and the coastal plains.

Korat: Located southeast of Bangkok in central Thailand, aircraft from here conducted bombing attacks on targets in Cambodia and Laos.

Takhli: This base northeast of Bangkok in Thailand was part of the air defense of the capital and was not an important base for war missions.

Bangkok: The capital of Thailand, its largest city, and only substantial port, the airbase here is used for staging attacks into Vietnamese-held Cambodia.

CUBA: 1995

Introduction

For many years the US has watched the tiny island nation of Cuba become more and more isolated from the West. Since the communist revolution there in 1959 the US and Cuba have lived in a constant state of mutual distrust.

In 1961, the US sponsored an abortive coup attempt against Fidel Castro's government. Styled "the Bay of Pigs," Cuban exiles, supported by minor US forces, attempted an invasion of the island. The 1,300-man invasion force landed on the south coast, but was quickly overwhelmed by Cuban forces led by Castro himself.

After discovering Soviet nuclear missile sites on the island in October 1962, President Kennedy slapped a naval blockade around Cuba. This action almost led to a full-blown military confrontation between the two superpowers, but the Soviet leader, Nikita Kruschev finally agreed to to US demands, averting a possible nuclear exchange.

Now, encouraged by the recent re-establishment of conservative factions in the Soviet Union, Fidel Castro has decided to expand his control of the Caribbean.

Level of Conflict

Cold War: Recently, Cuban military exchange with the Soviets has intensified. Rumors are that the Soviets have increased sales of arms and equipment and are sending more and more advisers. Terrorism against US-backed governments in Central America has increased; the flow of illegal drugs into the US through Miami (only 90 miles from Cuba) has also risen. The US strongly suspects these agitations are attributable to Castro's regime.

Limited War: It is clear that Cuban-sponsored terrorists are training on Cuban territory, and recently Castro initiated a subversive policy of aggression toward pro-US Honduras. The US has determined to make limited strikes against the island to force Castro to rethink some of his recent decisions.

Conventional War: Thinking the new Cold War between the superpowers will prevent US intervention, Cuba has sent forces into several surrounding island states. The Soviet Union has promised support should the US intervene.

U.S.
FLORIDA
Gulf of Mexico
Key West
(Naval Air Station)
Atlantic Ocean
Havana
Guira
Matanzas
Guines
San Julian
CUBA
Santa Clara
Chambas
Cienfuegos
Nueva Gerona
Cunagua
Ciego de Avila
Nuevitas
Camaguey
Holguin
Baracoa
Guantanamo
USS America
Antonio Maceo
Santiago de Cuba
Caribbean Sea

Cuban Military Force

The Cuban military has nearly 300,000 men under arms, a sizeable force for such a small country. By 1990 it was spending nearly $1.5 billion annually on military concerns, and by now that figure has increased significantly.

Air Defenses: Cuba, of course, uses Soviet-built equipment. Its old SA-2s and SA-5s are believed to have been phased out in the early 90s and replaced by the newer SA-10 and SA-12 systems. Local ground forces have acquired SA-14s and SA-16s.

Air Force: Cuba's rapidly expanding air force is made up primarily of MiG-21s, MiG-23s, and a few old MiG-17s. However, over the past five years the Soviet Union has sold Cuba a large number of MiG-29 "Fulcrums" and it is believed the MiG-21s are being replaced by these far-superior fighters.

Cuba also flies some of the best Soviet transports and helicopters for its airborne troops, including the An-72 "Coaler" jet transport.

Navy: Cuba is an island nation and boasts a substantial naval force for its size. It has 3 Mariel-class Soviet frigates, over 20 Osa I- and II-class missile boats, and a large number of smaller patrol boats. Additionally, it has several ex-Soviet Foxtrot submarines, and 15 or more minesweepers.

Cuban Cities and Targets

San Julian: Located at the westernmost end of Cuba, San Julian is one of the major air defense bases on the island. An airbase and powerful SAM battery protect the facilities here.

Havana: The capital city of Cuba, Havana has a major port and naval base, as well as an airbase (San Antonio de los Banos) and substantial air defense installations. Much of the nations sugar exports go to sea from this harbor.

Managua, Guines, and Matanzas: Southeast of Havana, one of the country's major military base complexes and an important base for fighters and interceptors is located. This is an extremely dangerous area for air operations because of the extensive SAM sites and ground forces that are likely to be found here.

Cienfuegos: Due east of the infamous Bahia de Cochinos (Bay of Pigs), Cienfuegos is a major naval facility and airbase.

Santa Clara, Chambas, and Ciego de Avilla: These locations are home to airfields and SAM installations.

Camaguey: A major road and rail junction, Camaguey is one of the largest cities in Cuba.

Santiago de Cuba: This old (1514), lovely seaport city is the capital of Santiago province and second largest city in the country. Scene of Castro's first abortive rebellion (1953), this city lies close to the US base at Guantanamo Bay. There is a minor military airbase here and a small SAM battery.

Antonio Maceo: This is one of Cuba's major fighter bases, rumored to house all the country's best fighter aircraft, most likely a squadron of MiG-29s.

Baracoa: A minor airfield and SAM site is located at this tiny coastal town. more importantly, military transports are constantly loading here to take Cuban forces abroad. It is said that this is the main embarkation point for forces heading to neighboring war zones.

Friendly Bases

Key West Naval Air Station: Located less than 100 miles from Havana, Key West is a logical location for staging stealth sorties against the Caribbean. Although a naval base, the new cooperation of the four services guarantees free access of the Air Force units to Key West.

Guantanamo Bay Naval Base: The US has maintained this base – "Gitmo" to the Marines and sailors based there – essentially since the Spanish-American War. It was developed as a US base in 1902 to protect the almost completed Panama Canal. Top-secret stealth sorties would probably be flown from Guantanamo, at least until a serious war erupted.

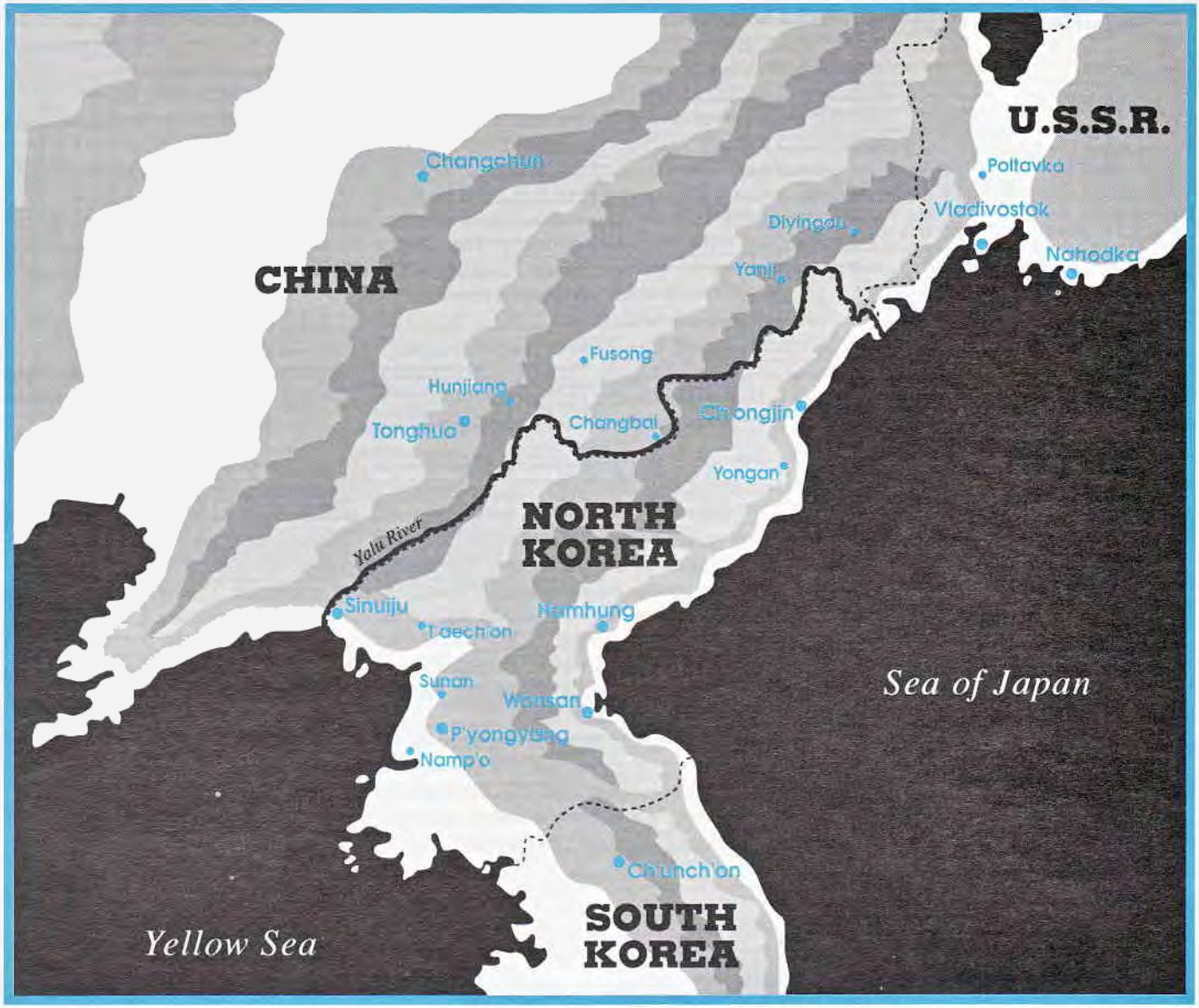
CV America in the Caribbean Sea: This 60,000-ton Kitty Hawk-class conventional aircraft carrier, designated CV66, has been transferred to the Second Fleet and now cruises south of the Cuban archipelago.

KOREA: 1997 Introduction

Since the end of the Korean War in 1953, the US has kept a large force in the Republic of Korea (South), defending its border with North Korea against possible invasion. China, too, has watched Korea uncomfortably since ending its involvement in that conflict. It is safe to say that the tension between North and South Korea could become a flashpoint for a US-Chinese confrontation, rapidly leading to a superpower conflict and possibly involving the USSR as well.

The Soviet Union and China, both nominally committed to the concept of a Communist future, have been wary allies for many years, and tensions between these two nations have been a source of uneasy comfort to the US. Should the two communist giants ever reconcile their differences (an unlikely scenario), the West would face a monolithic superpower with forces possibly in excess of 30 million, a vast nuclear arsenal, and some of the best military equipment in the world. This is the West's nightmare.

The area of the two Koreas represents the junction of three superpowers, the United States, the Soviet Union, and the People's Republic of China. North Korea is an extension of Chinese communist philosophy and could be viewed as a geographical extension as well. The primary base of the Soviet Pacific Fleet is located nearby at Vladivostok. The US maintains Eighth Army HQ in Seoul with a large contingent of ground and air forces immediately at hand in nearby Japan.


U.S.S.R.
Poltavka
Vladivostok
Nahodka
Changchun
Diyingou
Yanji
CHINA
Fusong
Hunjiang
Tonghua
Changbai
Chongjin
Yongan
NORTH KOREA
Yalu River
Sinuiju
Namhung
T'aech'on
Sunan
Wonsan
P'yongyang
Namp'o
Sea of Japan
Ch'unch'on
SOUTH KOREA
Yellow Sea

Level of Conflict

Cold War: Tensions between the North and South have intensified as scattered firing has erupted along the border. China is on alert status, claiming it has news of a major South Korean push into the North. The US, denying these claims, has maintained a policy of staunch resistance to any Chinese move of aggression. The Soviets have alerted their naval and air defenses for possible incursions into their territory, and are ready and willing to act. It is very dangerous to fly near Vladivostok.

Limited War: The North Koreans, alleging unacceptable atrocities by the South, has sent armored forces across the DMZ in the west toward Seoul; the eastern DMZ areas are still relatively quiet. The Chinese have yet to react, but intelligence reports indicate they will intervene quickly. The Soviet forces are on active alert and are waiting for the order to commence hostilities. Stealth missions will provide valuable information and may well get a point across.

Conventional War: The Chinese have begun supporting North Korean forces with air power, and the US has responded with open air operations against North Korean and Chinese targets. Though not officially "in the war," the Soviets are shooting at anybody that violates their airspace and beyond. This could quickly escalate into a major superpower confrontation – possibly WWIII.

Korean Military Forces

The North Korean People's Army (NKPA) is large compared to the size of the country, with more than 1,000,000 men actively under arms, another 200,000 security forces and an additional 2-3 million in the Workers' and Peasants' Militia. North Korea gets most of its military equipment from Soviet or Chinese sources.

Air Defenses: The Democratic People's Republic of Korea supports 4 SAM brigades equipped primarily with SA-2 "Guidelines" and SA-5 "Gammons." Units of these brigades are spread at various areas around the perimeter of the country, primarily at airbases and other important military sites. Recently, however, reports have been filed stating that SA-10 "Grumbles" have been delivered. Other ground forces of the infantry and armored divisions use SA-2s and SA-5s as well, and some deploy with the newer SA-8 "Gecko."

Air Force: The People's Air Force uses Chinese and Soviet aircraft (although Chinese fighters and interceptors are themselves essentially clones of Soviet craft), including MiG-17s, MiG-23s, MiG-25s, and MiG-29s.

Navy: The People's Navy too is equipped with Soviet vessels. Osa-class missile boats, 20 submarines (again surprising for a country of this size), and at least 3 frigates.

Korean Cities and Targets

P'yongyang: The capital of the People's Republic of Korea, P'yongyang has a population of over one million and is Korea's oldest city (dating from 1122 B.C.). It is the site of one of the People's Air Force's major bases and has powerful SAM batteries protecting it.

Wonsan: Almost due east of P'yongyang, Wonsan is the largest city on Korea's east coast and is one of its two major naval bases. The SAM batteries protecting it also provide air security for the large military airbase just outside the city.

Sinuiji: On the banks of the Yalu River just across from the Chinese city of Andong, Sinuiji houses another of North Korea's air force facilities and SAM sites.

Namp'o: Southwest of P'yongyang, Namp'o lies on Korea's western coast and houses a major naval and air facility.

Sunan and Taechon: North of P'yongyang, these two moderately-sized cities house airfields and SAM sites. Sunan is part of the complex of air defenses that ring the capitol of P'yongyang, while Taechon is near the border with China and is part of the general air defense of the country.

Ch'ongin, Yong-an, and Hamhung: These eastern coastal cities have bases which protect the country from air attack from the sea, forming the first line of defense against Japan-based US forces. The SAM sites in these areas are part of the country's general air-defense system.

Chinese Military Forces

The People's Liberation Army (PLA) is perhaps the largest armed force in the world. It has some 3,200,000 men in active armed service and some 20,000,000 security forces under arms; it also has an estimated 182,000,000 men fit for military service should mobilization ever be necessary, however it is doubtful whether the economy could support such a force.

China has had nuclear arms for a number of years with a force substantial enough to make it a "superpower." It has a large, world-class navy, though it doesn't appear in this game because Chinese access to the Sea of Japan is limited. Interestingly, China has some 35,000 marines, which, except for the US, gives it the the largest marine force in the world (the US has 136,000 and the USSR has around 15,000).

Most of its "high-tech" military equipment was cloned from antiquated Soviet models. Though it is well-known that China's own arms industry is modernizing, the pace of modernization is somewhat slow, especially in view of recent Western embargoes on military technology. The sheer size of the organization of the PLA makes it unwieldy and inefficient. Though, as the US discovered in the Korean War, it can respond quickly and fight fiercely.

Air Defenses: Chinese SAMs are primarily fixed-site SA-2s which the Chinese call HY-2.

Air Force: The PLA's primary fighters are MiG-17s and MiG-21s (J-4/5s and J-7s). Recon planes are usually MiG-17s and they have several antiquated Soviet bombers.

Chinese Cities and Targets

Tonghua: The major Chinese city in this part of northeast China is Tonghua. Located on a tributary of the Yalu River and a major east-west crossroads, this city is home of a major PLA airbase and air-defense station.

Hunjiang and Fusong: Northeast and north of Tonghua, these small cities are important air-defense centers in northeast China.

Yanji and Diyingou: These small cities are located in the easternmost areas of China and form the first line of defense against an attack from the Soviets at Vladivostok.

Changbai and Changchun: These small cities sport substantial SAM batteries and are a part of the larger air-defense system.

Soviet Military Forces

The Soviet Pacific Fleet and large air units are based in and around Vladivostok. All the most modern Soviet equipment is found in the region.

Long-range SAMs: The older SA-2s and SA-5s have been upgraded to SA-10 and SA-12 quality. The entire system is enhanced by the LPAR early warning radar system at Poltavka.

Light SAMs: Soviet security forces in this area are outfitted with SA-8 and SA-11 radar guided SAMs.

The PVO and Naval Aviation

Fighters: This region is defended partly by PVO units, with MiG-25 and MiG-31 interceptors using long-range radar-homing AAMs. Naval aviation fighters operating from carriers or land strips include the Yak-38 V/STOL jet and Su-27 multi-purpose fighters. During wartime shorter-ranged units may arrive, including MiG-29 and Su-27 dogfighters with short- and long-range weapons.

Reconnaissance Bombers: Many long-range Tu-95D "Bears" are based in this area, to watch the enlarged US presence. A nuisance in peacetime, these planes pose a more serious threat in war.

AEW&C Aircraft: The Soviets routinely deploy IL-76 "Mainstay" aircraft in the region. The 300+ mile radars on these planes may be your most formidable enemy.

Navy: The Soviet Pacific Fleet (based at Vladivostok) offers a significant threat. Its modern Sovremennyy-class destroyers carry SA-N-7 missiles, while Krivak-class frigates sport the SA-N-4. The larger Kiev-class carrier has the powerful SA-N-6, a sea-going equivalent to the SA-10. These warships are more than capable of defending themselves. Stationed south of Vladivostok, these units extend the Soviet air defense umbrella far into the Sea of Japan.

In addition to these ships' SAMs, Kiev-class carriers mount a complement of Yak-38 "jump-jet" fighters, and the new Kremlin-class nuclear aircraft carriers have also joined the Pacific fleet.

Soviet Cities and Targets

Vladivostok: Founded in 1860, Vladivostok is relatively young as Asian cities go. It is the home port of the Soviet Pacific Fleet, the chief Soviet port in the Pacific, and the terminus of the Trans-Siberian Railroad. A powerful contingent of Soviet Naval Aviation is also based here along with powerful elements of the PVO (National Air Defense).

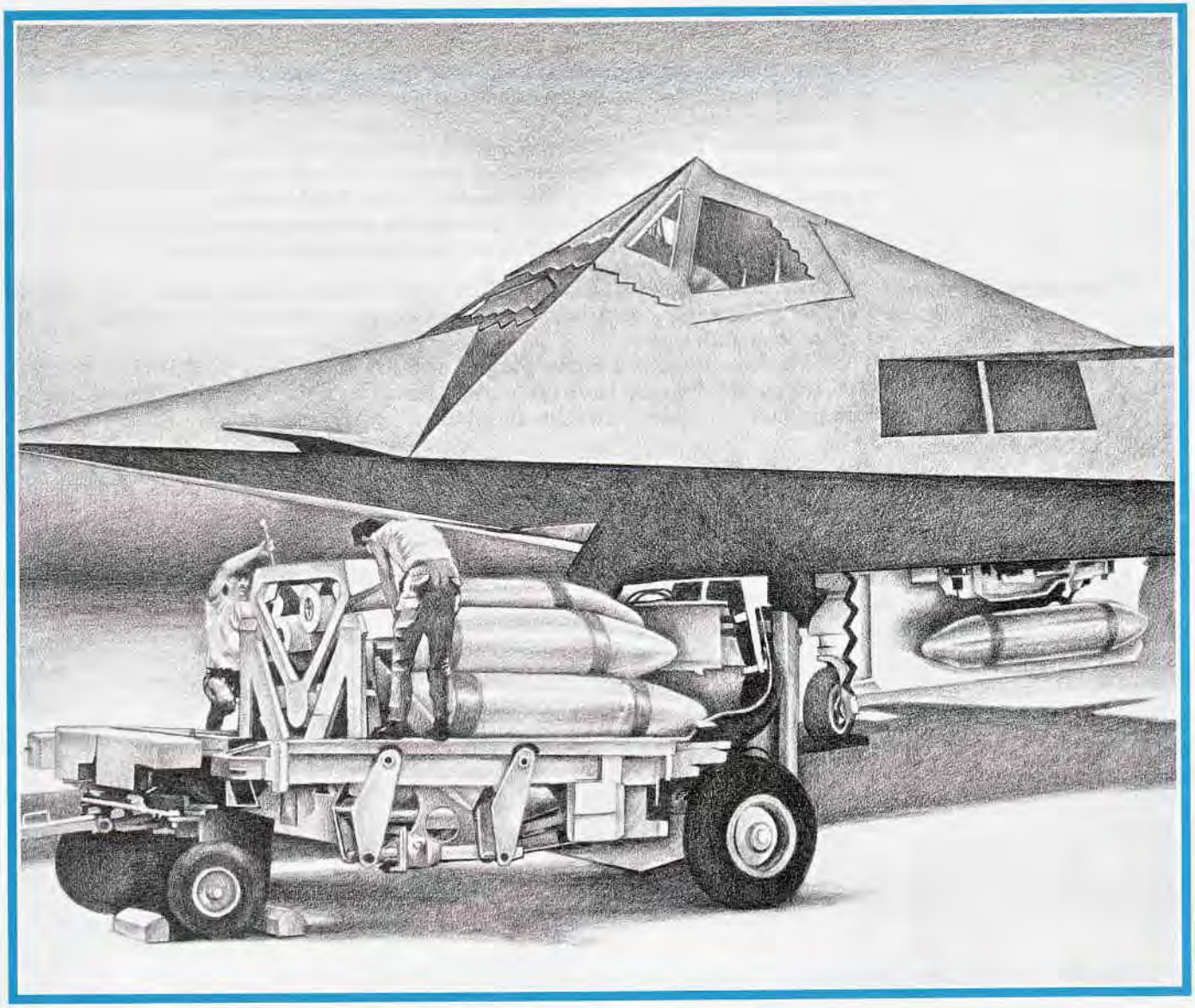
Poltavka: This is a smaller city used as a support for Vladivostok. A Long-range Phased Array Radar (LPAR) system that extends the defense umbrella far into the Sea of Japan is located here along with an airfield and SAM battery.

Nachodka: This small city is perhaps the southeastern-most city in the Soviet Union. Its airfield and SAM sites protect the approaches to Vladivostok.

Friendly Bases

Ch'unch'on (South Korea): This is one of South Korea's major cities. Located about 60 miles northeast of the capital at Seoul, it has one of the country's major USAF airbases in South Korea.

CVN Nimitz and Constellation at Sea: These huge 80,000-ton nuclear carriers are the the latest and most powerful aircraft carriers available. They now cruise the Sea of Japan in case the "Korean problem" should turn "hot."



5 ARMS AND EQUIPMENT

ORDNANCE AND WEAPONS DATA

Performance Characteristics

Qty	Weapon	Max Range	Max Speed	Guidance System	Attack Altitude	Attack Techniques
–	M61A1 20mm Cannon	6 km	—	Historical sight	0'	anticipation firing
4	AIM-9M "Sidewinder"	17 km	2,000 kts	IR-homing	500'+	fire-and-forget
3	AIM-120A AMRAAM	32 km	2,400 kts	Radar-homing	500'+	fire-and-forget
2	AGM-65D "Maverick"	32 km	700 kts	Thermal image	500'+	fire-and-forget
1	AGM-88A HARM	20 km	1,400 kts	Target-radar	500'+	fire-and-forget
2	Penguin-3 ASM	32 km	500 kts	IR-homing	500'+	fire-and-forget
1	AGM-84A "Harpoon"	60 km	500 kts	Radar-homing	500'+	fire-and-forget
2	GBU-12 Paveway	1+ km	glides	Laser-homing	500'	toss (level)
2	CBU-72 FAE	1+ km	glides	Laser-homing	500'	toss (level)
2	Mk 20 "Rockeye" II	1+ km	glides	Laser-homing	500'	toss (level)
2	Mk 20 "Rockeye"	0 km	retarded	none	500'	level
2	Durandal	0 km	retarded	none	500'	level
1	ISC B-1 minelets	0 km	retarded	none	500'	level
3	Mk 82-1 "Snakeye"	0 km	retarded	none	500'	level
2	Mk 35 IN cluster	0 km	retarded	none	500'	level
3	Mk 82-0 "Slick"	0 km	free fall	none	3,000'	level (dive)
2	Mk 122 "Fireye"	0 km	free fall	none	3,000'	level (dive)
1	special equipment	0 km	retarded	none	500'	level
1	135mm/IR cameras	~10 km	on plane	none	200'	level

Key to Performance Characteristics

Qty: The number of weapons of this type you can carry in one of your bay positions (you have 4 weapons positions). The M61A1 cannon is fixed in the nose and always available.

Weapon: The name of the weapon

Max Range: Maximum range at which the weapon can be launched or fired effectively. A 0 km range means the weapon is a free-fall or retarded bomb that must be dropped onto the target.

Max Speed: The speed at which the weapon reaches the target. This is given in knots so you can compare it with your own flight speed.

glides means the weapon 'flies' without power. Therefore your speed, at the time of launch, becomes the speed of the weapon.

retarded means the weapon is a retarded bomb that falls away behind your craft, decelerating as it drops. Some retarded weapons even open a parachute during their descent, to stabilize the fall and line up the warhead(s).

free fall means the weapon is a traditional free-fall bomb that arcs downward to the target.

Guidance System: The guidance system used to bring the weapon to bear on the target.

Attack Altitude: The recommended altitude for the typical attack method. The "500+" entry means any altitude above 500' is fine.

Attack Techniques: This references the appropriate attack technique. Techniques noted in parenthesis are alternate attack methods that are either more dangerous or more difficult to learn.

Key to F-117A Weapons Effectiveness

Target Type Abbreviations

ac: aircraft in flight.
hgr: airbase hangar, which at military airfields are hardened bunkers.
rwy: airbase runway.
pln: planes on airbase runways.
twr: airbase tower, including the tower radars and radios.
nuc: nuclear power plant and biological/chemical weapons plants.
brg: bridge over a river.
bld: buildings, including terrorist camps, offices, warehouses, homes, etc.
bnk: bunker, such as fixed army HQ sites, and palaces of dictators.
dep: depot of military fuel and supplies
msl: missile launcher, including both fixed and mobile.
sam: SAM radar station, usually near or among SAM missile launchers
par: LPAR ABM radar station
oth: OTH long-range radar station
plt: offshore oil platform
ref: oil refinery

tnk: oil tanks
wel: oil wells
Pen: underground submarine pens
shp: all ships, including cargo ships, warships, and surfaced submarines.

Results Abbreviations

The effectiveness of results is rated as follows:
– the weapon is useless against the target.
1 the weapon has almost no chance of doing damage to the target.
2 the weapon may do some damage to the target.
3 the weapon does poorly against the target.
4 the weapon is usually effective against the target.
5 the weapon is almost always effective against the target.
6 the weapon is very effective against the target.
7 the weapon was designed for use against this target type.

F-117A Weapons Effectiveness

Weapon	Airbases					Structures			Military			Radars			Oil			Nav		
	ac	hgr	rwy	pln	twr	nuc	brg	bld	bnk	dep	msl	sam	par	oth	plt	ref	tnk	wel	pen	shp
M61A1 20mm Cannon	4	-	-	4	4	-	-	4	-	4	4	2	2	2	4	4	4	4	-	3
AIM-9M "Sidewinder"	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AIM-120A AMRAAM	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AGM-65D "Maverick"	-	2	-	2	3	4	4	3	4	3	3	4	4	4	4	4	4	4	-	4
Penguin-3 ASM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
AGM-84A "Harpoon"	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
AGM-88A HARM	-	-	-	-	-	-	-	-	-	-	-	6	6	6	-	-	-	-	-	5
GBU-12 Paveway	-	4	1	2	4	5	5	4	5	4	4	5	5	5	4	4	4	4	-	3
CBU-72 FAE	-	4	-	-	6	5	-	6	5	-	-	-	-	-	4	-	-	-	5	2
Mk 20 "Rockeye" II	-	-	-	4	4	-	-	4	-	5	5	4	4	4	4	5	5	5	-	4
Mk 20 "Rockeye"	-	-	-	4	4	-	-	4	-	4	4	4	4	4	4	4	4	4	-	3
Durandal	-	-	7	-	-	1	2	-	1	-	-	-	-	-	-	-	-	-	-	-
ISC 5-1 minelets	-	-	6	-	3	-	-	3	-	2	3	-	-	-	-	3	3	3	-	-
Mk 82-1 "Snakeye"	-	-	1	4	4	-	-	4	-	4	-	2	2	2	-	4	4	4	-	-
Mk 35 IN cluster	-	1	-	6	4	-	-	4	-	6	6	3	3	3	6	6	6	6	-	3
Mk 82-0 "Slick"	-	3	1	3	4	1	1	4	1	4	2	3	3	3	3	4	4	4	-	3
Mk 122 "Fireye"	-	2	-	4	4	2	-	4	2	5	3	3	3	3	2	5	5	5	1	3

Air-to-Air Missiles (AAMs)

System Name	Nation or plane	Guidance System	Effective Range(km)	Max Speed	Maneuverability
Long-Range Radar-Homing AAMs					
AA-6 Acrid	MiG-25	SA Pulse	50	Mach 4	Poor
AA-7 Apex	MiG-23	SA Pulse	34	Mach 3	Poor
AA-9 Amos	MiG-31	SA Pulse	82	Mach 3.5	Fair
AIM-7E Sparrow	F-4, F-15, F-18	SA Pulse	44	Mach 3.7	Very Good
AA-10 Alamo	MiG-29, Su-27	Active Dop	64	Mach 3+	Good
AIM-120A AMRAAM	US	Active Dop	32	Mach 4	Very Good
Short-Range Infrared-Homing AAMs					
AA-2 Atoll	USSR	IR (1)	14	Mach 2.5	Very Good
AA-6 Acrid (IR)	MiG-25	IR (1)	50	Mach 4	Poor
AA-7 Apex (IR)	MiG-23	IR (1)	34	Mach 3	Fair
AIM-9H Sidewinder	Western	IR (1)	12	Mach 3+	Excellent
AA-8 Aphid	USSR	IR (2)	12	Mach 3	Excellent
AA-10 Alamo (IR)	MiG-29, Su-27	IR (2)	64	Mach 3+	Good
AIM-9M Sidewinder	US	IR (2)	17	Mach 3+	Excellent

Key to Air-to-Air Missiles (AAMs)

System Name: The name of the missile system.

Nation or Plane: The type of plane which carries the missile. If a specific plane is listed, only those planes carry that missile.

US: Any plane of the US Air Force, but not current or former US allies.

Western: Any plane of a western-allied nation, including former American allies such as Iran, or neutrals such as Sweden.

USSR: Any plane of a USSR-allied nation, including such Soviet allies as Libya, Finland, Iraq, East Germany, Czechoslovakia, Poland, etc.

Guidance System: The method used by the missile to find its target.

SA Pulse: Semi-Active Pulse radar. Requires the launching plane to continue to "paint" the target with radar until the missile hits.

Active Dop: Active Doppler radar. The missile has its own radar set, allowing the pilot to fire and forget. In addition, the missile's doppler radar is fooled by chaff only if the target plane runs perpendicular to the missile's course.

IR (1): First Generation IR-homing. The missile chases the hot engine exhaust only and is easily fooled by jammers and flares.

IR (2): Second Generation IR-homing. The missile homes on any hot part of a plane, including the nose, wings, and tail, as well as the engine exhausts. It can recover from jamming and continue seeking.

Effective Range (km): The maximum range (in kilometers) at which the missile can lock-on to a target.

Max Speed: The launching speed of the missile. Mach 1 is about 660 knots.

Maneuverability: The turning ability of the missile in flight.

Surface-to-Air Missiles (SAMs)

Name	Mounting	Search Guidance	Search Range(km)	Firing Guidance	Firing Range	Max Speed	Max Alt	Maneuver-ability
Long-Range Radar-Guided SAMs								
SA-2 Guideline	fixed	Poor pulse	200	BR pulse	125	Mach 3+	55,000'	Very poor
SA-4 Ganef	fixed/mobile	Poor pulse	100	SA pulse	70	Mach 2.5	75,000'	Poor
SA-5 Gammon	fixed	Poor pulse	350	BR pulse	150	Mach 3	95,000'	Poor
SA-6 Gainful	mobile	Poor pulse	80	SA pulse	30	Mach 2.8	60,000'	Fair
SA-8B Gecko	mobile	Fair pulse	125	SA pulse	65	Mach 2	25,000'	Good
SA-11 Gadfly	mobile	Fair pulse	200	SA pulse	100	Mach 2.5	45,000'	Good
Rapier	fixed/mobile	Good pulse	75	SA pulse	65	Mach 2+	24,000'	Very good
SA-12 Gladiator	mobile	Good Dop	290	SA+CG Dop	150	Mach 3+	70,000'	Fair
MIM-23B Hawk	fixed	Good Dop	175	SA pulse	125	Mach 1.5	52,000'	Good
SA-10 Grumble	fixed/mobile	Excellent Dop	320	SA+CG Dop	125	Mach 3	70,000'	Fair
SA-N-4	warship	Pulse	200	SA pulse	30	Mach 2	25,000'	Good
SA-N-6	warship	Dop	320	SA+CG Dop	125	Mach 3	70,000'	Fair
SA-N-7	warship	Dop	50-200	SA pulse	100	Mach 2.5	45,000'	Good
Short-Range IR/Visual-Guided SAMs								
SA-7B Grail	infantry	Eyesight	Eyesight	IR (1)	10	Mach 1.5	20,000'	Good
FIM-43A Redeye	infantry	Eyesight	Eyesight	IR (1)	7	Mach 1.5	10,000'	Very good
SA-9B Gaskin	mobile	Eyesight	Eyesight	IR (1)	30	Mach 1.5	20,000'	Very good
SA-14	infantry	Eyesight	Eyesight	IR (2)	16	Mach 1.5+	20,000'	Excellent
FIM-92A Stinger	infantry	Eyesight	Eyesight	IR (2)	10	Mach 2	20,000'	Excellent
SA-N-5	warship	Poor pulse	50-150	IR (1)	30	Mach 1.5	20,000'	Good
SA-13 Gopher	mobile	Poor pulse	125	IR (2)	65	Mach 1.5	30,000'	Very good
Tigercat	fixed	Poor pulse	65	Visual	30	Mach 1.5	12,000'	Good
Seacat	warship	Poor pulse	200	Visual	30	Mach 1.5	12,000'	Good

Key to Surface-to-Air Missiles (SAMs)

Name: The commonly used name of the system.

Mounting: How the system appears when seen.

Fixed: Fixed-site missile launchers. Positioned around a central radar station.

Mobile: Vehicle-mounted launchers and radar, usually parked in an irregular pattern.

Warship: Ship-borne system. The radar and missile launcher are mounted on a warship.

Infantry: Shoulder-launched SAM, carried by infantrymen.

Search Guidance: The type and quality of search radar used by the missile.

Dop: Doppler radar. It is most effective when you fly toward or away from it, least effective when you arc around it at a constant distance.

Pulse: Pulse radar. It is most effective when you fly sideways to it, least effective when you fly straight at it.

Search Range (km): The theoretical maximum range (in kilometers) of the search radar. However, against your F-117, radar performance is greatly reduced. The quality of the radar and local conditions determine its real, effective range.

Firing Guidance: The way the missile finds your aircraft. Pulse and Doppler radars have varying effectiveness depending on your flight path in relation to the missile (see search guidance, above, for details).

BR Pulse: Beam-Rider Pulse radar. The missile uses pulse radar guidance, with the radar receiver at the launching site; it cannot "burn through" jamming at close range.

SA Pulse: Semi-Active Pulse radar. The missile uses pulse radar guidance, with the receiver in the missile; it may "burn through" jamming at close range.

SA Dop: Semi-Active Doppler radar. The missile uses Doppler radar guidance, with the receiver in the missile; it can "burn through" jamming at close range.

SA+CG Dop: Semi-Active Doppler radar with Command Guidance. The missile uses Doppler radar guidance, with the receiver in the missile. It can "burn through" jamming at close range and can conduct multiple attacks.

IR (1): First Generation IR-homing. The missile seeks hot exhausts. It is very vulnerable to jamming and flares.

IR (2): Second Generation IR-homing. The missile seeks any hot surface, including nose, wing edges, tail, etc. It has logic circuits that help it recover from jamming or flares.

Visual: The missile is guided by a controller on the ground, who must watch your plane and react to your maneuvering.

Firing Range: Maximum range (in kilometers) at which the missile is fired.

Max Speed: Maximum speed in flight of the missile. Mach 1 is about 660 kts.

Max Alt: Maximum altitude the missile can reach.

Maneuverability: The turning ability of the missile in flight.

AIR-TO-AIR WEAPONS

While the Lockheed F-117A carries no air-to-air armament, the MicroProse version does.

F-117A AIR-TO-AIR WEAPONS

M61A1 20mm "Vulcan" Cannon

M61A1 20MM "VULCAN" CANNON

Very short-range general purpose gun.

Quantity:	1 fixed internally
Effective Range:	3 km
Maximum Range:	6 km
Attack Technique:	Tracking camera/laser historical gunsight

AIM-9M "Sidewinder"

AIM-9M "SIDEWINDER"

Short-range air-to-air missile with IR-homing.

Quantity on rack:	4
Guidance:	Second generation ("all aspect") IR-seeker
Effective Range:	17 km
Missile Speed:	Mach 3+
Maneuverability:	Excellent
Attack Technique:	Self-guided fire-and-forget

AIM-120A AMRAAM

AIM-120A AMRAAM

Medium-range air-to-air missile with active radar-homing.

Quantity on rack:	3
Guidance:	Active radar-homing (has its own radar in nose)
Effective Range:	32 km
Missile Speed:	Mach 4
Maneuverability:	Very good
Attack Technique:	Self-guided fire-and-forget

ENEMY CANNONS

M61A1 20mm "Vulcan" Cannon

M61A1 20MM "VULCAN" CANNON

Very short-range general purpose gun.

Nation of Manufacture:	USA
Effective Range:	3 km
Maximum Range:	6 km
Attack Technique:	Radar-predicting gunsight
Rate of Fire:	3000 rds/minute
Nationality:	Iranian Fighters

GSh-23 23mm Cannon

GSH-23 23MM CANNON

Very short-range general purpose gun.

Nation of Manufacture:	USSR
Effective Range:	3 km
Maximum Range:	6 km
Attack Technique:	Radar-predicting gunsight
Rate of Fire:	3000 rds/minute
Nationality:	Soviet-Built Fighters

ENEMY IR AAMS

AIM-9H "Sidewinder"

AIM-9H "SIDEWINDER"

Short-range air-to-air missile with IR-homing.

Nation of Manufacture:	USA
Effective Range:	12 km
Missile Speed:	Mach 3+
Maneuverability:	Excellent
Attack Technique:	Locks onto tail exhaust, then fire-and-forget
Nationality:	Iranian

AA-2 "Atoll"

AA-2 "ATOLL"

Short-range air-to-air missile with IR-homing.

Nation of Manufacture:	USSR
Guidance:	First generation IR-seeker
Effective Range:	14 km
Missile Speed:	Mach 2.5
Maneuverability:	Very good
Attack Technique:	Locks onto tail exhaust, then fire-and-forget
Nationality:	Soviet-built Fighters

AA-6 "Acrid" (IR)

AA-6 "ACRID" (IR)

Medium-range air-to-air missile with IR-homing.

Nation of Manufacture:	USSR
Guidance:	First generation IR-seeker
Effective Range:	50 km
Missile Speed:	Mach 4
Maneuverability:	Poor
Attack Technique:	Locks onto tail exhaust, then fire-and-forget
Nationality and Aircraft:	Soviet MiG-25

AA-7 "Apex" (IR)

AA-7 "APEX" (IR)

Medium-range air-to-air missile with IR-homing.

Nation of Manufacture:	USSR
Guidance:	First generation IR-seeker
Effective Range:	34 km
Missile Speed:	Mach 3
Maneuverability:	Fair
Attack Technique:	Locks onto tail exhaust, then fire-and-forget
Nationality and Aircraft:	Soviet MiG-23

AA-8 "Aphid"

AA-8 "APHID"

Short-range air-to-air missile with IR-homing.

Nation of Manufacture:	USSR
Guidance:	Early second generation IR-seeker
Effective Range:	12 km
Missile Speed:	Mach 3
Maneuverability:	Excellent
Attack Technique:	All-aspect lock on, then fire-and-forget
Nationality and Aircraft:	Soviet, most fighters

AA-10 "Alamo" (IR)

AA-10 "ALAMO" (IR)

Medium-range air-to-air missile with IR-homing.

Nation of Manufacture:	USSR
Guidance:	Second generation IR-seeker
Effective Range:	about 64 km
Missile Speed:	Mach 3+
Maneuverability:	Good
Attack Technique:	All-aspect lock on, then fire-and-forget
Nationality and Aircraft:	Soviet, most fighters

ENEMY RADAR AAMS

AIM-7E "Sparrow"

AIM-7E "SPARROW"

Medium-range air-to-air missile with semi-active radar-homing.

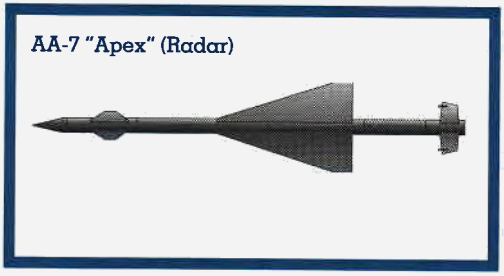
Nation of Manufacture:	USA
Guidance:	Semi-active radar-homing (requires radar guidance from plane)
Effective Range:	44 km
Missile Speed:	Mach 3.7
Maneuverability:	Very good
Attack Technique:	Semi-active radar-guided from launching aircraft
Nationality and Aircraft:	Iranian F-4s

AA-6 "Acrid" (Radar)

AA-6 "ACRID" (RADAR)

Long-range air-to-air missile with semi-active radar-homing.

Nation of Manufacture:	USSR
Guidance:	Semi-active radar-homing (requires radar guidance from plane)
Effective Range:	50 km
Missile Speed:	Mach 4
Maneuverability:	Poor
Attack Technique:	Semi-active radar-guided from launching aircraft
Nationality and Aircraft:	Soviet MiG-25s



AA-7 "APEX" (RADAR)

Medium-range air-to-air missile with semi-active radar-homing.

Nation of Manufacture:	USSR
Guidance:	Semi-active radar-homing (requires radar guidance from plane)
Effective Range:	34 km
Missile Speed:	Mach 3
Maneuverability:	Poor
Attack Technique:	Semi-active radar-guided from launching aircraft
Nationality and Aircraft:	Soviet and Warsaw Pact MiG-23s

AA-9 "AMOS"

Long-range air-to-air missile with semi-active radar-homing.

Nation of Manufacture:	USSR
Guidance:	Semi-active radar-homing (requires radar guidance from plane)
Effective Range:	82 km
Missile Speed:	Mach 3.5
Maneuverability:	Fair
Attack Technique:	Semi-active radar-guided from launching aircraft
Nationality and Aircraft:	Soviet MiG-31s

AA-10 "ALAMO"

Medium-range air-to-air missile with active radar-homing.

Nation of Manufacture:	USSR
Guidance:	Active radar-homing (has its own radar in nose)
Effective Range:	64 km
Missile Speed:	Mach 3+
Maneuverability:	Good
Attack Technique:	Active radar-homing independent of launching aircraft
Nationality and Aircraft:	Soviet MiG-29s and SU-27s

F-117A AIR-TO-GROUND WEAPONS

GUIDED MISSILES

AGM-88A HARM

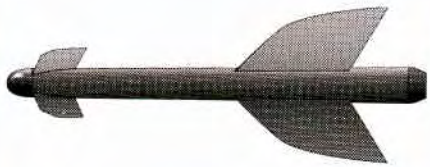
AGM-88A HARM

High speed Anti-Radiation Missile.

Quantity per bay:	1
Optimum Targets:	Ground radar stations
Acceptable Targets:	Warship radars
Effective Range:	20 kilometers
Max Speed:	Mach 2+
Attack Technique:	Air-to-ground fire-and-forget
Min Launch Altitude:	500'
Max Launch Altitude:	60,000'

Notes: America's most advanced anti-radar missile, the HARM can lock-on to hostile radars even if they change frequencies or switch off. US officials have hinted that it can home on radar components that are still warm, even if the set is turned off! The missile also has a "loiter" mode where it circles, waiting for a hostile radar to turn on. The "loiter" attack mode is not available to HARMs carried on the F-117A.

Penguin-3 ASM



PENGUIN-3 ASM

Medium-altitude infrared-homing anti-ship missile.

Quantity per bay:	2
Acceptable Targets:	Ships at sea
Effective Range:	32 kilometers
Max Speed:	Mach 0.8
Attack Technique:	Air-to-ground fire-and-forget launch against any warship
Min Launch Altitude:	500'
Max Launch Altitude:	40,000'

Notes: Designed in Norway, this modestly sized and priced missile flies to a designated point, then switches on an infrared homer that seeks the heat of a ship against the cool ocean background.

AGM-84A "Harpoon"

AGM-84A "HARPOON"

Sea-skimming radar- and inertial-guided anti-ship missile.

Quantity per bay:	1
Optimum Targets:	Ships at sea
Effective Range:	60 kilometers
Max Speed:	Mach 0.8
Attack Technique:	Air-to-ground fire-and-forget launch against any warship
Min Launch Altitude:	500'
Max Launch Altitude:	40,000'

Notes: America's standard anti-missile, the Harpoon is more powerful and harder to stop than the Penguin. It is launched under inertial guidance, flying at sea-skimming altitudes to avoid detection. At a designated point its radar is activated to find the target. It either pops up and dives onto the target, or flies straight in.

AGM-65D "Maverick"

AGM-65D "MAVERICK"

IR-imaging air-to-ground guided missile.

Quantity per bay:	2
Acceptable Targets:	Bridges, bunkers, radar sites, oil facilities, ships
Poor Targets:	Hangars, ground planes, buildings, depots, missile sites
Effective Range:	32 kilometers
Max Speed:	Mach 1+
Attack Technique:	Air-to-ground fire-and-forget launch
Min Launch Altitude:	500'
Max Launch Altitude:	40,000'

Notes: America's standard air-to-ground guided missile, the Maverick has had a wide variety of guidance systems. Originally, a video camera in the missile's nose stored an image of the target in the missile's "brain." Once in flight it steered itself toward the image. Later versions added zoom lenses, PAVE TACK lasers, and ultimately, a FLIR imaging system that can "see" through clouds, smoke, and night.

LASER-GUIDED BOMBS

GBU-12 Paveway

GBU-12 PAVEWAY

Laser-guided glide bomb.

Quantity per bay:	2
Acceptable Targets:	Almost any
Poor Targets:	Ships
Effective Range:	2 kilometers per 1K' of altitude
Max Speed:	Glide bomb
Attack Technique:	Toss bombing or level bombing
Toss Release Altitude:	500' and climb
Level Release Altitude:	2,000' and turn away

Notes: The GBU-12 is a standard in US inventory. Large fighter-bombers like the F-111 favor heavier 1,000 lb and 2,000 lb models (GBU 15s, for example, that F-111s used to destroy the oil pumping manifolds during the Iraqi War), but the F-117A must carry lighter munitions in its small bays. The PAVE TACK laser guidance system is probably the most accurate precision bombing system in the world.

CBU-72 FAE

CBU-72 FAE

Laser-guided triple fuel-air explosive bomb.

Quantity per bay:	2
Optimum Targets:	Buildings
Acceptable Targets:	Submarine pens, hangars, bunkers, oil platforms
Poor Targets:	Ships
Effective Range:	2 kilometers per 1K' of altitude
Max Speed:	Glide bomb
Attack Technique:	Toss bombing or level bombing
Toss Release Altitude:	500' and climb
Level Release Altitude:	2,000' and turn away

Notes: This weapon contains a mixture of three gases, which are released into the air, forming an explosive mixture. A delayed-action fuse ignites the mixture, causing the contaminated air to expand and burn. The sudden expansion sets off mines and flattens soft objects. (US warplanes dropped FAEs on Iraqi minefields during the Gulf War to render them less deadly, in preparation for the ground attack.)

Mk 20 "Rockeye" II

MK 20 "ROCKEYE" II

Laser-guided high-explosive cluster bomb.

Quantity per bay:	2
Acceptable Targets:	Almost anything
Effective Range:	2 kilometer per 1K' of altitude
Max Speed:	Glide bomb
Attack Technique:	Toss bombing or level bombing
Toss Release Altitude:	500' and climb
Level Release Altitude:	2,000' and turn away

Notes: This weapon marries a laser-guided glide-bomb system to a Mk 20 Rockeye cluster munition. The laser guidance allows for earlier release and greater bomblet release accuracy.

RETARDED BOMBS

Mk 20 "Rockeye"

MK 20 "ROCKEYE"

Retarded fragmentation cluster bomb.

Quantity per bay:	2
Acceptable Targets:	Most anything
Poor Targets:	Ships
Effective Range:	Nil
Max Speed:	Retarded bomb
Attack Technique:	Low-altitude level bombing
Min Release Altitude:	500'

Notes: This cluster bomb breaks open at a predesignated altitude, spinning out 247 shaped-charge bomblets that can destroy buildings, armored vehicles, and people. (The U.S. Navy discovered these bombs were enormously effective against small warships when a single cluster bomb wrecked a Libyan Nanuchka-class missile boat in 1986.)

Durandal Bomb

DURANDAL BOMB

Parachute-deployed runway-penetration bomb.

Quantity per bay:	2
Optimum Targets:	Runways
Poor Targets:	Bridges
Effective Range:	Nil
Max Speed:	Retarded bomb
Attack Technique:	Low-altitude level bombing
Min Release Altitude:	500'

Notes: This French-made weapon is the standard anti-runway weapon in the USAF arsenal. Durandal deploys a parachute, causing it to float nose-down over a runway. A rocket motor suddenly ignites, blasting the warhead straight down through the concrete, where it explodes. The result is a thoroughly ruined surface and tons of wreckage.

ISC B-1 Minelets

ISC B-1 MINELETS

Parachute-deployed minelet dispenser.

Quantity per bay:	1
Optimum Targets:	Runways
Poor Targets:	Buildings, depots, missile sites, oil facilities on land
Effective Range:	Nil
Max Speed:	Retarded bomb
Attack Technique:	Low-altitude level bombing
Min Release Altitude:	500'

Notes: This extremely new weapon dispenses a variety of small anti-personnel, anti-vehicle, and delayed fuse mines. Used on airfields, it prevents flight operations until cleared. Clearing the mines is complicated by the variety of types, as well as random delayed-fuse bombs, and magnetic fuses that ignite when metal gets too close to them.

Mk 82-1 "Snakeye"

MK 82-1 "SNAKEYE"

Retarded high-explosive "iron" bomb.

Quantity per bay:	3
Acceptable Targets:	Grounded planes, buildings, depots, oil facilities on land
Poor Targets:	Radar sites
Effective Range:	Nil
Max Speed:	Retarded bomb
Attack Technique:	Low-altitude level bombing
Min Release Altitude:	500'

Notes: The Snakeye is the standard vane-type retarder unit for many US bombs, here attached to the Mk 82 500 lb high-explosive bomb.

Mk 35 IN Cluster

MK 35 IN CLUSTER

Retarded incendiary cluster bomb.

Quantity per bay:	2
Optimum Targets:	Grounded planes, depots, missile sites, oil facilities
Acceptable Targets:	Buildings
Poor Targets:	Radar sites, ships
Effective Range:	Nil
Max Speed:	Retarded bomb
Attack Technique:	Low-altitude level bombing
Min Release Altitude:	500'

Notes: Similar to the Rockeye, but filled with 57 incendiary bomblets, this cluster bomb spreads bomblets over an area of several hundred yards. Each bomblet in turn spreads burning liquid wherever it lands, resulting in a wide-ranging, raging fire.

FREE-FALL BOMBS

Mk 82-0 "Slick"

Mk 122 "Fireye"

MK 82-0 "SLICK"

Free-fall high-explosive "iron" bomb.

Quantity per bay:	3
Acceptable Targets:	Buildings, depots, oil facilities on land
Poor Targets:	Almost anything else
Effective Range:	Nil
Max Speed:	Free-fall bomb
Attack Technique:	Level bombing or dive bombing
Level Release Altitude:	3,000'
Dive Release Altitude:	Dive from 8,000', release at 3,000'

Notes: A traditional 500 lb high explosive, virtually unchanged since WWII.

MK 122 "FIREYE"

Free-fall incendiary "fire" bomb.

Quantity per bay:	2
Acceptable Targets:	Grounded planes, buildings, depots, oil facilities on land
Poor Targets:	Hangars, bunkers, missile sites, radar sites, oil platforms, ships
Effective Range:	Nil
Max Speed:	Free-fall bomb
Attack Technique:	Level bombing or dive bombing
Level Release Altitude:	3,000'
Dive Release Altitude:	Dive from 8,000', release at 3,000'

Notes: This weapon contains incendiary liquid that spreads over a wide area and can flow into vents, grates, weapon slits, etc., making it effective against vehicles and fortifications as well as open-air targets.

OTHER EQUIPMENT

135mm/IR Camera

135MM/IR CAMERA

Visual and FLIR photographic reconnaissance camera.

Quantity per bay:	1
Targets:	Any
Effective Range:	Nil
Max Speed:	Remains internal
Attack Technique:	Level low-altitude photographic run
Photo Run Altitude:	200'

Notes: This pallet contains a 135mm high-resolution camera for use in visible light, and a second camera for infrared (IR) thermal photography. Both photographs are taken simultaneously, under pilot control and the pilot can view through either. When in use the F-117A's tracking camera is "frozen" into a pre-programmed position, allowing it to function as a viewer for the big 135mm lens.

SAM TECHNICAL SPECIFICATIONS

Radar Ratings: Pulse radar is generally less effective than Doppler, and obsolete radar of either type is greatly inferior to modern radar. As a result, modern Doppler radar is the most dangerous, while obsolete pulse radar is the least dangerous.

Ranges: The maximum firing range is often less than the maximum search range, due to the limited fuel carried by most missiles.

Guidance Systems: *Radar-guided* missiles, with or without command guidance, are confused by the ECM jammer unless they are very close. If they are close, chaff is needed instead. *Infrared-guided* missiles are confused by your IR jammer unless very close, where flares are used instead. A decoy is effective against both types of missiles.

Visually-guided missiles cannot be fooled, but are slow reacting, allowing you to outmaneuver them easily.

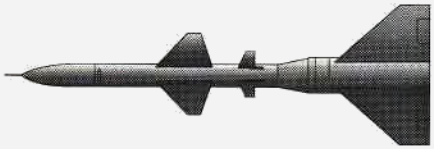
Maximum speed is a useful measure of whether you can outrun a missile, and how much reaction time you have after one is fired. Speeds of Mach 1 or 2 are considered to be slow by modern standards. Mach 3 or faster missiles are much more formidable opponents.

Maximum altitude is also a useful measure, since in some cases you can fly above the missile's ceiling.

Maneuverability indicates how easy it is to outmaneuver the missile. The less maneuverable the missile, the better your chance of turning perpendicular to its course and outmaneuvering it.

RADAR-GUIDED SAMS

SA-2 Guideline

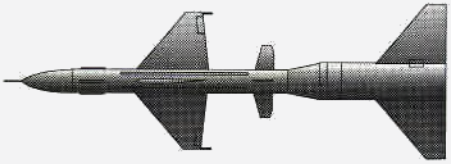


SA-2 GUIDELINE

Long-range, fixed-site, radar-homing SAM. Radar bunker with missile emplacements.

Search System:	Obsolete pulse radar
Max Search Range:	200 kilometers
Guidance System:	Obsolete pulse radar "beam rider"
Max Firing Range:	125 kilometers
Max Speed:	Mach 3+
Max Altitude:	55,000'
Maneuverability:	Very poor

SA-5 Gammon



SA-5 GAMMON

Long-range, fixed-site, radar-homing SAM. Radar bunker with missile emplacements.

Search System:	Obsolete pulse radar
Max Search Range:	350 kilometers
Guidance System:	Obsolete pulse radar "beam rider"
Max Firing Range:	150 kilometers
Max Speed:	Mach 3
Max Altitude:	95,000'
Maneuverability:	Poor

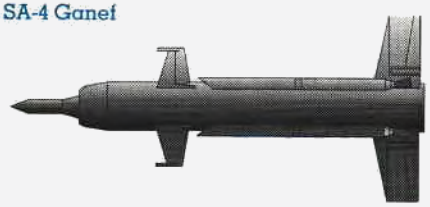
SA-10 Grumble

SA-10 GRUMBLE

Long-range, fixed-site or mobile, radar-homing SAM. Radar bunker or armored vehicle with missile emplacements or armored vehicle missile launchers.

Search System:	Phased-array Doppler radar
Max Search Range:	320 kilometers
Guidance System:	Modern Doppler radar and command guidance
Max Firing Range:	125 kilometers
Max Speed:	Mach 3
Max Altitude:	70,000'+
Maneuverability:	Fair

SA-4 Ganef



SA-4 GANEF

Medium-range, fixed-site or mobile, radar-homing SAM. Radar bunker with missile emplacements, or radar and launcher on tracked vehicles.

Search System:	Obsolete pulse radar
Max Search Range:	100 kilometers
Guidance System:	Obsolete pulse radar & semi-active radar-homing
Max Firing Range:	70 kilometers
Max Speed:	Mach 2.5
Max Altitude:	75,000'
Maneuverability:	Very poor

SA-12 Gladiator

no illustration available

SA-12 GLADIATOR

Medium-/long-range, fixed-site or mobile, radar-homing SAM. Temporary site with radar and missile launchers, or dispersed radar and launcher vehicles.

Search System:	Phased-array Doppler radar
Max Search Range:	290 kilometers
Guidance System:	Modern Doppler radar and command guidance
Max Firing Range:	150 kilometers
Max Speed:	Mach 3+
Max Altitude:	70,000'+
Maneuverability:	Fair

SA-6 Gainful

no illustration available

SA-6 GAINFUL

Medium-range, mobile, radar-homing SAM. Radar and launcher on tracked vehicles.

Search System:	Obsolete pulse radar
Max Search Range:	80 kilometers
Guidance System:	Obsolete pulse radar and command guidance
Max Firing Range:	30 kilometers
Max Speed:	Mach 2.8
Max Altitude:	60,000'
Maneuverability:	Fair

SA-8 Gecko

SA-8 GECKO

Medium-range, mobile, radar-homing SAM. Radar and launcher on a same vehicle.

Search System:	Modern pulse radar
Max Search Range:	125 kilometers
Guidance System:	Modern pulse radar, semi-active with video backup
Max Speed:	Mach 2
Max Firing Range:	65 kilometers
Max Altitude:	25,000'
Maneuverability:	Good

SA-11 Gadfly

SA-11 GADFLY

Medium-range, mobile, radar-homing SAM. Radar and launcher on same vehicle.

Search System:	Modern Doppler radar
Max Search Range:	200 kilometers
Guidance System:	Modern pulse radar, backup unknown
Max Firing Range:	100 kilometers
Max Speed:	Mach 2.5
Max Altitude:	45,000'
Maneuverability:	Good

MIM-23B Hawk

MIM-23B HAWK

Medium-range, fixed-site, radar-homing SAM. Radar bunker or trailer with missile launcher emplacements or trailers.

Search System:	Modern pulse radar
Max Search Range:	175 kilometers
Guidance System:	Modern pulse radar and command guidance
Max Firing Range:	125 kilometers
Max Speed:	Mach 1.5
Max Altitude:	52,000'
Maneuverability:	Good

Rapier

RAPIER

Short-range, fixed-site, visual/radar-homing SAM. Combined radar and launcher pedestal, or on tracked vehicle.

Search System:	Modern pulse radar
Max Search Range:	75 km
Guidance System:	Optical command guidance with semi-active pulse radar backup
Max Firing Range:	65 km
Max Speed:	Mach 2+
Max Altitude:	24,000'
Maneuverability:	Very good

SA-N-4

SA-N-4

Medium-range, area-defense naval SAM. Integral to warship.

Search System:	Depends on the ship, usually pulse radar
Max Search Range:	typically 100-200 km
Guidance System:	Modern pulse radar with video backup
Max Firing Range:	30 kilometers
Max Speed:	Mach 2
Max Altitude:	25,000'
Maneuverability:	Good

SA-N-6

SA-N-6

Medium-range, area-defense naval SAM. Integral to warship.

Search System:	Phased-array Doppler radar
Max Search Range:	300+ kilometers
Guidance System:	Modern Doppler radar and command guidance
Max Firing Range:	125 kilometers
Max Speed:	Mach 3
Max Altitude:	over 70,000'
Maneuverability:	Average

SA-N-7

SA-N-7

Medium-range, area-defense naval SAM. Integral to warship.

Search System:	Depends on ship, usually modern Doppler radar
Max Search Range:	Depends on the ship, 50-200 kilometers
Guidance System:	Modern pulse radar, backup unknown
Max Firing Range:	100 kilometers
Max Speed:	Mach 2.5
Max Altitude:	45,000'
Maneuverability:	Good

IR AND VISUAL SAMS

SA-7B Grail

SA-7B GRAIL

Short-range, shoulder-launched, IR-homing SAM. Carried by infantrymen or any light vehicle.

Search System:	Eyesight
Max Search Range:	Eyesight
Guidance System:	IR-homing (1st generation)
Max Firing Range:	10 kilometers
Max Speed:	Mach 1.5
Max Altitude:	20,000'+
Maneuverability:	Good

FIM-43A Redeye

FIM-43A REDEYE

Short-range, shoulder-launched, IR-homing SAM. Carried by infantrymen, or any light vehicle.

Search System:	Eyesight
Max Search Range:	Eyesight
Guidance System:	IR-homing (1st generation)
Max Firing Range:	no more than 7 kilometers
Max Speed:	Mach 1.5
Max Altitude:	About 10,000'
Maneuverability:	Very good

SA-14

no illustration available

SA-14

Short-range, shoulder-launched, IR-homing SAM. Carried by infantrymen or any light vehicle.

Search System:	Eyesight
Max Search Range:	Eyesight
Guidance System:	IR-homing (2nd generation all-aspect)
Max Firing Range:	About 16 kilometers
Max Speed:	Mach 1.5+
Max Altitude:	20,000'+
Maneuverability:	Excellent

FIM-92A Stinger

FIM-92A STINGER

Short-range, shoulder-launched, IR-homing SAM. Carried by infantrymen or any light vehicle.

Search System:	Eyesight
Max Search Range:	Eyesight
Guidance System:	IR-homing (2nd generation all-aspect)
Max Firing Range:	About 10 kilometers
Max Speed:	Mach 2
Max Altitude:	About 20,000'
Maneuverability:	Excellent

SA-9B Gaskin

SA-9B GASKIN

Short-range, vehicle-mounted, IR-homing SAM. Radar and launcher carried on same armored vehicle.

Search System:	Eyesight
Max Search Range:	Eyesight
Guidance System:	Pulse radar aiming and IR-homing
Max Firing Range:	30 kilometers
Max Speed:	Mach 1.5
Max Altitude:	20,000'
Maneuverability:	Very good

SA-13 Gopher

SA-13 GOPHER

Short-range, vehicle-mounted, IR-homing SAM. Radar and launcher carried on same armored vehicle.

Search System:	Obsolete pulse radars or eyesight
Max Search Range:	Visual or 30-60 kilometer pulse radar
Guidance System:	Pulse radar aiming and IR-homing
Max Firing Range:	65 kilometers
Max Speed:	Mach 1.5
Max Altitude:	30,000'
Maneuverability:	Very good

Tigercat

TIGERCAT

Short-range, fixed-site, visual SAM. Emplaced controller position; trailer launcher(s).

Search System:	Visual or obsolete pulse radar
Max Search Range:	Eyesight or 65 kilometer pulse radar
Guidance System:	Joystick (visual) command guidance
Max Firing Range:	30 kilometers
Max Speed:	Mach 1.5
Max Altitude:	12,000'
Maneuverability:	Good

SA-N-5

SA-N-5

Short-range, point defense, naval SAM. Integral to warship.

Search System:	Naval pulse radar of varying quality
Max Search Range:	Varies with ship, 50-150 kilometers
Guidance System:	IR-homing
Max Firing Range:	30 kilometers
Max Speed:	Mach 1.5
Max Altitude:	20,000'
Maneuverability:	Very good

Seacat on Vosper Mk 5 Frigates

SEACAT ON VOSPER MK 5 FRIGATES

Short-range, point defense, naval SAM. Integral to warship.

Search System:	Obsolete pulse radar
Max Search Range:	200 kilometers
Guidance System:	Joystick (visual) command guidance
Max Firing Range:	30 kilometers
Max Speed:	Mach 1.5
Max Altitude:	12,000'
Maneuverability:	Good

WARPLANES

KEY TO AIRCRAFT DATA

Roles

Fighter: A fighter plane specializes in air-to-air combat, where the objective is destroying enemy aircraft.

Interceptor : An interceptor is a fighter designed to fly long distances and attack distant enemy aircraft. Many interceptors are poor dogfighters.

Strike: A strike plane is designed to hit surface targets in enemy territory.

- *Close support strikes* are against enemy front-line troops.
- *Interdiction strikes* are against military targets in rear areas.
- *Deep strikes* attack enemy installations far behind the front line.
- *Attack* aircraft are designed to strike warships.

Bombers: Bombers are designed for interdiction, deep strike, and/or naval attack, as well as carrying nuclear weapons and/or reconnaissance gear.

Transports: Transports carry personnel and equipment. They are not designed to fight, and almost never carry any armament.

AEW&C: These planes carry powerful search radars and communications gear, designed to watch friendly and hostile aircraft while simultaneously controlling friendly air operations.

Mission Weight

This is the typical total weight of the plane, with fuel and weapons, at takeoff. If the plane can serve in both fighter and strike roles, the fighter weight is given. In a strike role a plane often carries 15-35% additional weight in bombs and AGMs.

Engines

The total thrust of an engine (on afterburners if available) is important. Airplanes with greater thrust than weight can fly "ballistically," a useful advantage in air combat. A high thrust/weight ratio is desired by all fighter pilots.

Range and Ceiling

Range is the approximate combat radius of a plane when loaded for action, but using only internal tanks (no extra fuel tanks). Ceiling is the maximum altitude of the plane, using afterburners if available.

Maximum Speed

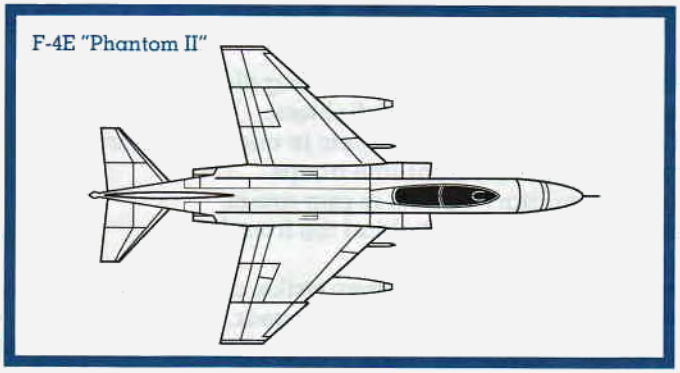
This is the plane's maximum speed at 36,000', an important benchmark altitude, because above it Mach 1 is 573 knots. Although this speed is important, the optimum turning speed for most aircraft is Mach 0.75 to 0.90; higher speeds are good only for chasing or escaping from opponents, and quick dashes in enemy airspace.

Armament

Often weapons pylons can be fitted to carry various bombs or lightweight missiles. The number of pylons need not limit the number of ordnance items.

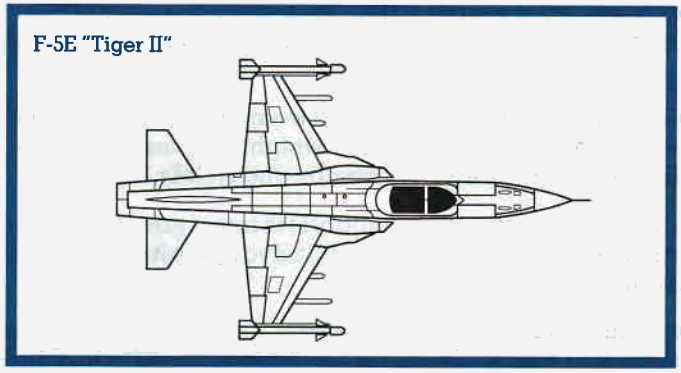
Radar Quality

As a stealth pilot, you are naturally interested in the range and quality of enemy airborne search radar. These refer to air-to-air search radars only.



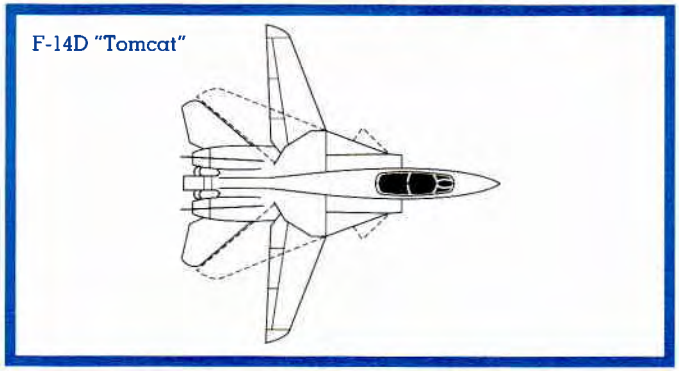
F-4E "PHANTOM II"

Designer:	McDonnell Douglas, USA
Role:	Two-seat fighter and strike fighter
Weight:	27 tons
Engine(s):	Two GE J79-17 turbojets; 35,800 lbs thrust
Range:	830 kilometers
Ceiling:	58,750'
Max Speed:	1260 kts
Armament:	20mm cannon, 4 missile recesses, 5 weapon pylons
Radar Quality:	Fair quality and range pulse radar



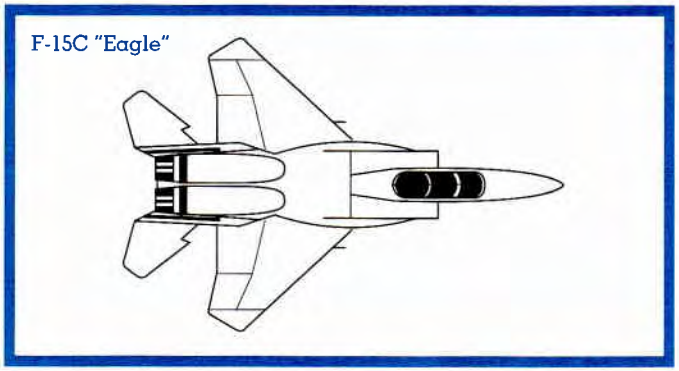
F-5E "TIGER II"

Designer:	Northrop, USA
Role:	Single-seat fighter and strike fighter
Weight:	12 tons
Engine(s):	Two GE J85-GE-21B turbojets; 10,000 lbs thrust
Range:	220 kilometers
Ceiling:	51,000'
Max Speed:	950 kts
Armament:	Two 20mm cannon, 5 weapon pylons
Radar Quality:	Poor quality and range pulse radar



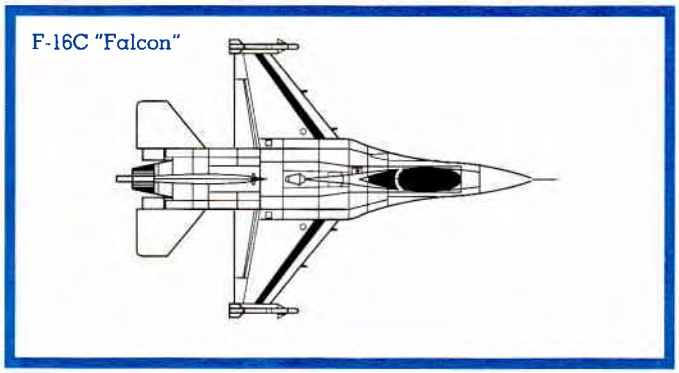
F-14D "TOMCAT"

Designer:	Grumman, USA
Role:	Two-seat fighter and interceptor
Weight:	35 tons
Engine(s):	two GE F110-400 turbofans; 54-58,000 lbs thrust
Range:	1280 kilometers
Ceiling:	56,000'+
Max Speed:	1350 kts with TF30, higher with F110
Armament:	20mm cannon, 4 weapons pallets, 2 weapon pylons
Radar Quality:	Excellent range, high quality Doppler radar



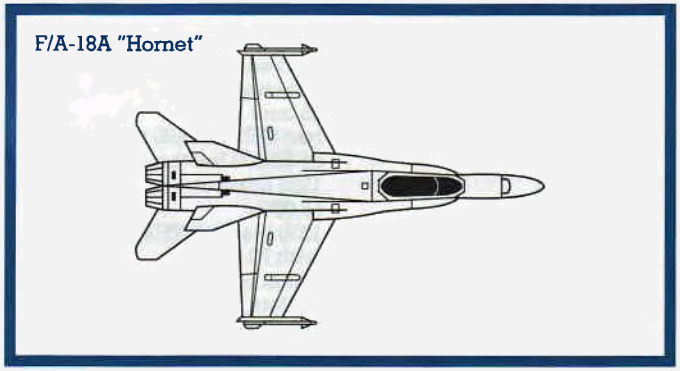
F-15C "EAGLE"

Designer:	McDonnell Douglas, USA
Role:	Single-seat fighter
Weight:	22 tons
Engine(s):	Two Pratt and Whitney F100-100 turbofans; 47,660 lbs thrust
Range:	1200 kilometers
Ceiling:	63,000'
Max Speed:	1260 kts or greater
Armament:	20mm cannon, 4 missile ejectors, 4 weapon pylons, 2 FAST pallet points
Radar Quality:	Medium-range, high quality Doppler radar



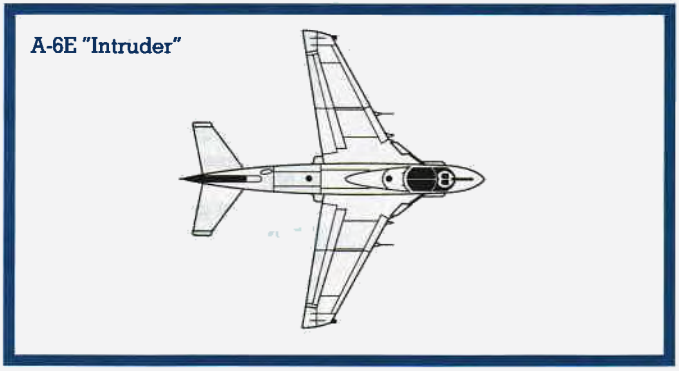
F-16C "FALCON"

Designer:	General Dynamics, USA
Role:	Single-seat fighter and strike fighter
Weight:	12.5 tons
Engine(s):	One Pratt and Whitney F100-200 turbofan; 23,830 lbs thrust
Range:	540 kilometers
Ceiling:	50,000'+
Max Speed:	1190 kts
Armament:	20mm cannon, 7 weapon pylons
Radar Quality:	Medium-range, high-quality Doppler radar



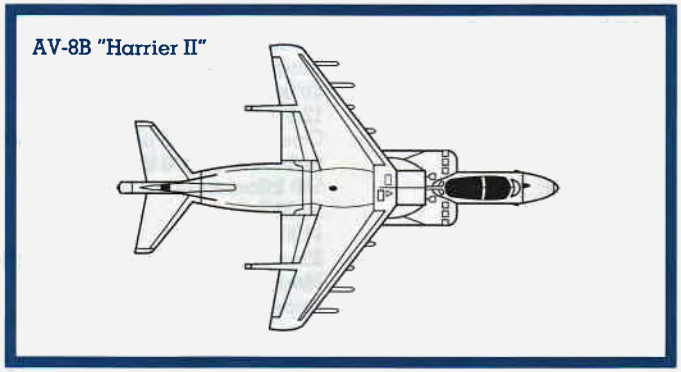
F/A-18A "HORNET"

Designer:	McDonnell Douglas/ Northrop, USA
Role:	Single-seat fighter and strike fighter
Weight:	18 tons
Engine(s):	Two GE F404-400 turbofans; 32,000 lbs thrust
Range:	740 kilometers
Ceiling:	50,000'
Max Speed:	1050 kts
Armament:	20mm cannon, 9 weapon pylons
Radar Quality:	Medium-range, high quality Doppler radar



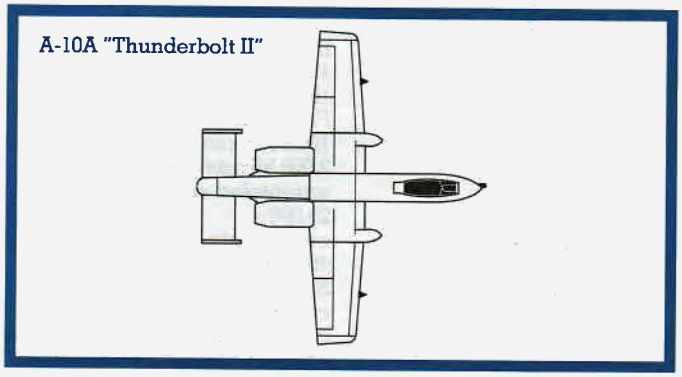
A-6E "INTRUDER"

Designer:	Grumman, USA
Role:	Two-seat attack and interdiction bomber
Weight:	13 tons
Engine(s):	Two Pratt & Whitney J52-8A turbojets; 18,600 lbs thrust
Range:	870 kilometers
Ceiling:	44,600'
Max Speed:	540 kts
Armament:	5 weapon pylons
Radar Quality:	Poor, but superb air-to-ground weapons radars



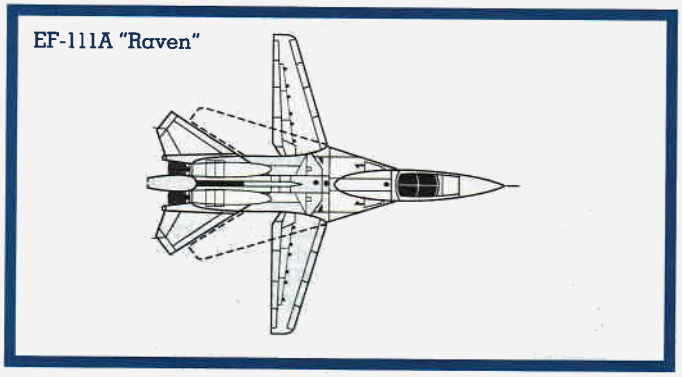
AV-8B "HARRIER II"

Designer:	British Aerospace, UK and McDonnell Douglas, USA
Role:	Single-seat S/VTOL fighter and strike fighter
Weight:	15 tons STOVL, 10 tons VTOL
Engine(s):	One Rolls Royce/Pegasus 11-21E 22,000 lbs vectored thrust
Range:	240 kilometers
Ceiling:	55,000'
Max Speed:	520 kts
Armament:	25mm cannon, 7 weapon pylons
Radar Quality:	Poor, target acquisition is usually visual



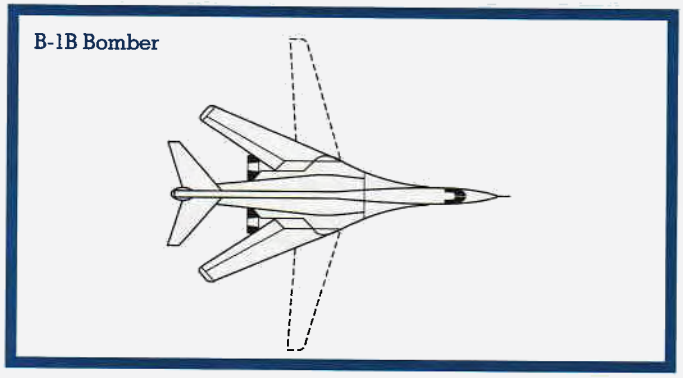
A-10A "THUNDERBOLT II"

Designer:	Fairchild Republic, USA
Role:	Single-seat close ground support aircraft
Weight:	20 tons
Engine(s):	Two GE TF34-100 turbofans; 18,130 lbs thrust
Range:	960 kilometers
Ceiling:	probably under 40,000'
Max Speed:	Unknown, probably less than 370 kts
Armament:	7-barrel 30mm cannon, 11 weapon pylons
Radar Quality:	Poor, air-to-ground avionics quite basic



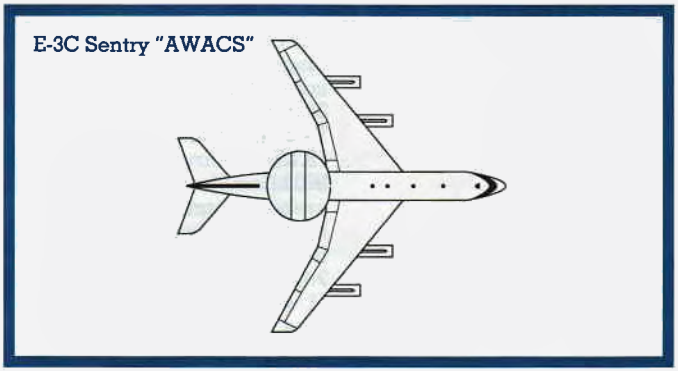
EF-111A "RAVEN"

Designer:	General Dynamics, USA
Role:	Two-seat electronic warfare escort
Weight:	43.5 tons
Engine(s):	Two Pratt & Whitney TF30-3 turbofans; 37,000 lbs thrust
Range:	1,900 kilometers
Ceiling:	54,700'
Max Speed:	1020 kts
Armament:	ALQ-99E electronic warfare system, no other weapons
Radar Quality:	Medium/long-range, high quality pulse and Doppler



B-1B BOMBER

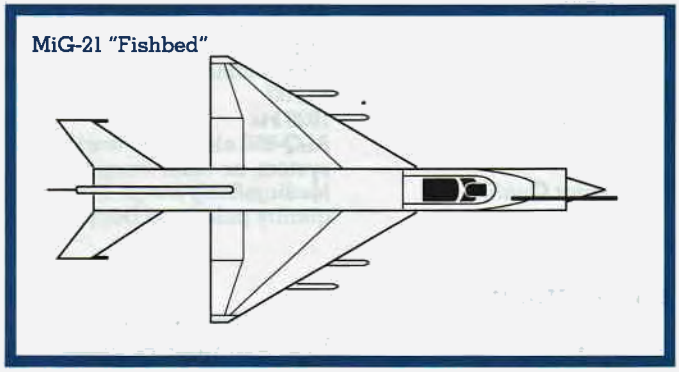
Designer:	Rockwell International, USA
Role:	Four-man strategic bomber
Weight:	225 tons with internal load only
Engine(s):	Four GE F101-102 turbofans; 120 lbs thrust
Range:	5,900 kilometers
Ceiling:	Unknown, probably under 50,000'
Max Speed:	725 kts
Armament:	37.5 ton capacity bomb bay, 29.5 tons on external mounts
Radar Quality:	Medium-range, high quality Doppler radar



E-3C SENTRY "AWACS"

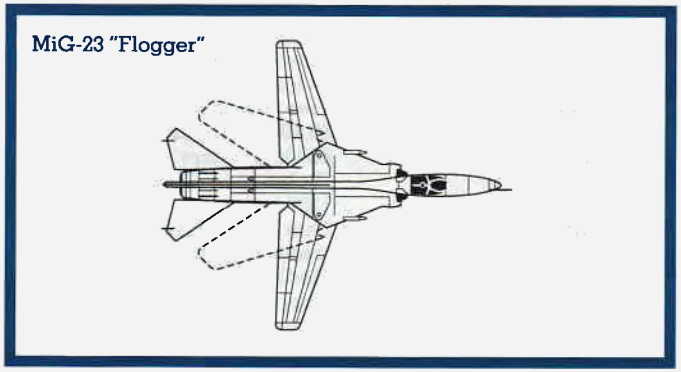
Designer:	Boeing, USA
Role:	15 to 17-man AEW&C
Weight:	162.5 tons
Engine(s):	Four Pratt & Whitney TF33-100/100A turbofans; 84,000 lbs thrust
Range:	3,000 kilometers (11 hours unrefueled endurance)
Ceiling:	29,000'+
Cruise Speed:	over 350 kts
Maximum Speed:	460 kts
Armament:	Surveillance radar, communications, air traffic control, and electronic defenses; weapon pylons may be added.
Radar Quality:	Excellent range and quality radars.

SOVIET-BUILT WARPLANES



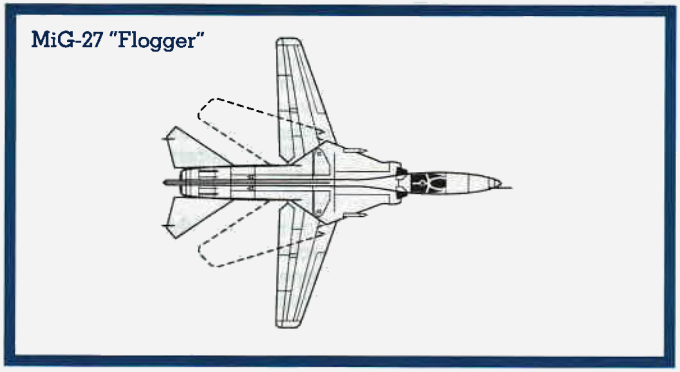
MIG-21 "FISHBED"

Designer:	Mikoyan-Gurevich, USSR
Role:	Single-seat fighter
Weight:	9 tons
Engine(s):	One Tumansky R-11F2S-300 turbofan;14,550 lbs thrust
Range:	630 kilometers
Ceiling:	59,000' (often only 50,000')
Max Speed:	1220 kts
Armament:	Two 23mm cannon, 4 weapon pylons, 1 fuel tank pylon
Radar Quality:	Very short-range, low quality pulse radar



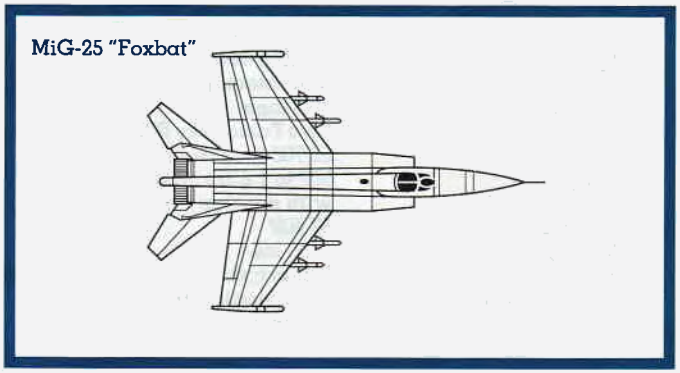
MIG-23 "FLOGGER"

Designer:	Mikoyan-Gurevich, USSR
Role:	Single-seat fighter
Weight:	16 tons
Engine(s):	One Tumansky R-29B turbofan; 27,500 lbs thrust
Range:	900 kilometers
Ceiling:	61,000'
Max Speed:	1190 kts
Armament:	Two 23mm cannon, 4 weapon pylons, 1 fuel tank pylon
Radar Quality:	Very poor, short-range range pulse radar



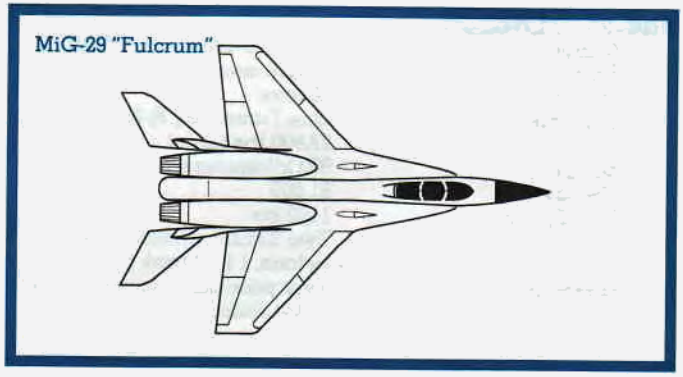
MIG-27 "FLOGGER"

Designer:	Mikoyan-Gurevich, USSR
Role:	Single-seat strike fighter
Weight:	22 tons
Engine(s):	One Tumansky R-29 turbofan; 25,353 lbs thrust
Range:	400 kilometers
Ceiling:	52,500'
Max Speed:	925 kts
Armament:	One 23mm cannon, 5 weapon pylons, 2 bomb racks
Radar Quality:	Very poor, very short-range pulse radar



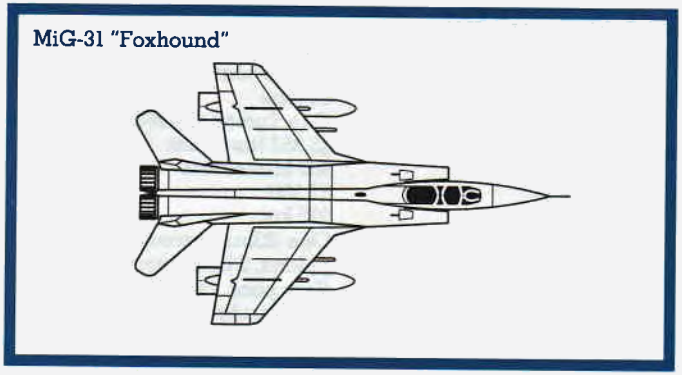
MIG-25 "FOXBAT"

Designer:	Mikoyan-Gurevich, USSR
Role:	Single-seat interceptor
Weight:	40 tons
Engine(s):	Two Tumansky R-31 turbofans; 48,500 lbs thrust
Range:	1,100 kilometers
Ceiling:	80,000'
Max Speed:	1860 kts
Armament:	4 weapon pylons
Radar Quality:	Medium quality, medium-range pulse radar



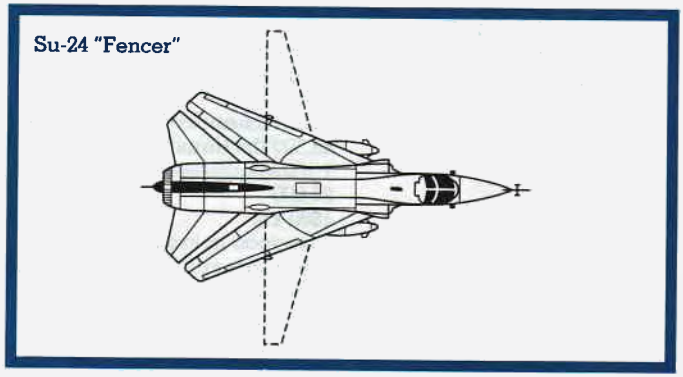
MIG-29 "FULCRUM"

Designer:	Mikoyan-Gurevich, USSR
Role:	Single-seat fighter
Weight:	18 tons
Engine(s):	Two Tumansky R-33D turbofans; 36,600 lbs thrust
Range:	650 kilometers
Ceiling:	Probably 55-65,000'
Max Speed:	1260 kts
Armament:	One multi-barrel cannon, 6 weapon pylons
Radar Quality:	Medium quality and range Doppler radar



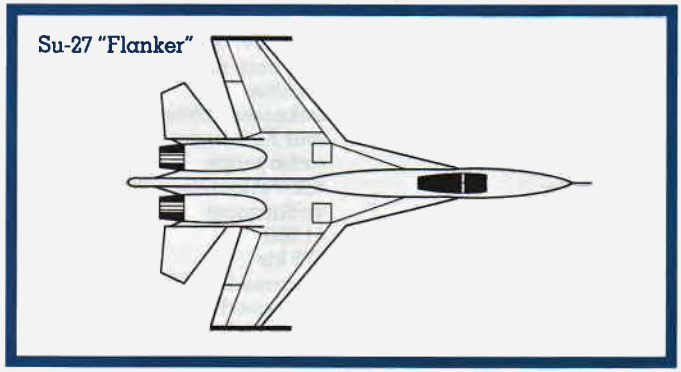
MIG-31 "FOXHOUND"

Designer:	Mikoyan-Gurevich, USSR
Role:	Single-seat interceptor
Weight:	45 tons
Engine(s):	Two turbofans or turbojets, estimated thrust 50-60,000 lbs
Range:	1,500 kilometers
Ceiling:	75,500'
Max Speed:	1400 kts
Armament:	Cannon possible, 4 missile recesses, 4 weapon pylons
Radar Quality:	Superior quality and range Doppler radar



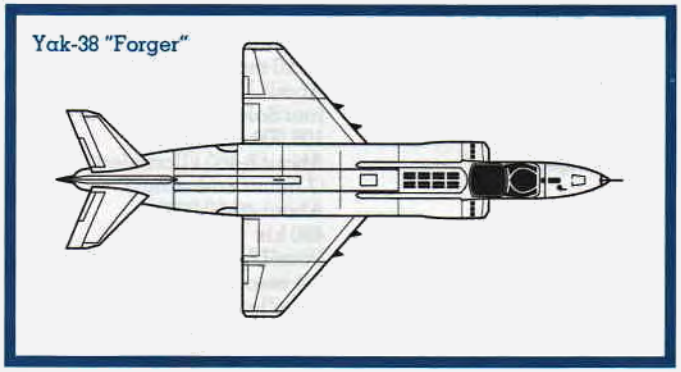
SU-24 "FENCER"

Designer:	Sukhoi, USSR
Role:	Double-seat strike fighter and interceptor
Weight:	43.5 tons
Engine(s):	Two Tumansky R-29B turbofans; 50,700 lbs thrust
Range:	300 to 1,800 kilometers (varies with mission profile and load)
Ceiling:	57,400'
Max Speed:	1400 kts
Armament:	23mm cannon, 8 weapon pylons
Radar Quality:	Nil, avionics designed purely for air-to-ground role



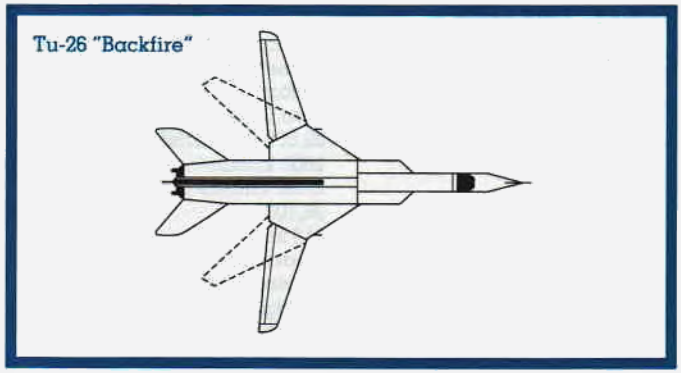
SU-27 "FLANKER"

Designer:	Sukhoi, USSR
Role:	Single-seat fighter
Weight:	25 tons
Engine(s):	Two unknown turbojets; estimated 60,000 lbs thrust
Range:	1,150 kilometers
Ceiling:	Unknown, probably 60,000' or more
Max Speed:	1350 kts
Armament:	Probably a cannon, 6 weapon pylons
Radar Quality:	Above average quality and range Doppler radar



YAK-38 "FORGER"

Designer:	Yakovlev, USSR
Role:	Single-seat fighter
Weight:	12 tons
Engine(s):	One Lyulka AL-21 vectored-thrust turbojet; 17,985 lbs thrust, plus two Koliesov liftjet engines
Range:	370 kilometers
Ceiling:	39,370'
Max Speed:	550 kts
Armament:	4 weapon pylons
Radar Quality:	Poor quality and range pulse radar



TU-26 "BACKFIRE"

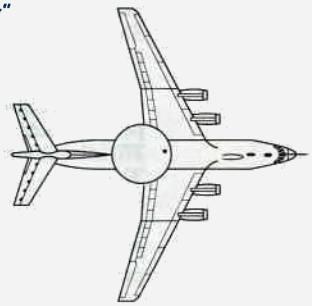
Designer:	Tupolev, USSR
Role:	Four-man bomber
Weight:	61 tons
Engine(s):	Two upgraded Kuznetsov NK-144 turbofans; 88,180 lbs thrust
Range:	5,500 kilometers
Ceiling:	55,000'
Max Speed:	970 kts
Armament:	Three heavy air-to-surface missiles or 13 tons of bombs
Radar Quality:	Fair, with excellent air-surface avionics

Tu-95D "Bear"

TU-95D "BEAR"

Designer:	Tupolev, USSR
Role:	7-12 man reconnaissance bomber
Weight:	unknown, about 145-165 tons
Engine(s):	four Kuznetsov NK-12MV turbo props
Range:	8,250 kilometers (7 hours endurance)
Ceiling:	41,000'
Max Speed:	475 kts
Armament:	Unarmed
Radar Quality:	Very good long-range pulse radars

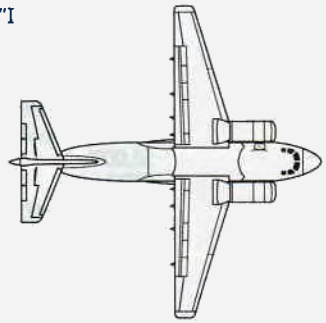
Il-76 "Mainstay"



IL-76 "MAINSTAY"

Designer:	Ilyushin, USSR
Role:	15-20 man AEW&C
Weight:	About 150 tons
Engine(s):	four Soloview D-30KP turbofans; 106,000 lbs thrust
Range:	About 6,400 kilometers (7 hours endurance)
Ceiling:	About 40-50,000'
Max Speed:	460 kts
Armament:	Possibly twin 23mm tail cannon, 2-4 weapon pylons
Radar Quality:	Excellent long-range Doppler radars

An-72 "Coaler"I



AN-72 "COALER"

Designer:	Antonov, USSR
Role:	Three-seat air transport
Weight:	28 tons
Engine(s):	Two Lotarev D-36 turbofans; 28,660 lbs thrust
Range:	1000 kilometers (max cargo) to 3,800 kilometers (no cargo)
Ceiling:	36,100'
Max Speed:	410 kts
Armament:	Unarmed; can carry 32 passengers or 11 tons cargo
Radar Quality:	Navigational only

APPENDIX

KEY CONTROLS SUMMARY

Controller	Joystick, mouse, arrow keys, or numeric keypad
Selector	joystick button 1, left mouse button, or return key

Action desired	Joystick	Cursor Keys	keypad
pitch down	forward	up-arrow	8
roll right	right	right-arrow	6
roll left	left	left-arrow	4
pitch up	back	down-arrow	2
dive right	forward/right	—	9
dive left	forward/left	—	7
climb right	back/right	—	3
climb left	back/left	—	1
stick sensitivity	Ins key (tiny, small, and medium stick movement)		
max stick movement	fast double-press of the key		

Throttle

Maximum power	Shift +
Increase throttle	=
Decrease throttle	–
No power	Shift –

Weapons Controls

Select Weapon	space bar
Fire Weapon	Return/Enter or joystick button 2
Fire Cannon	Backspace or joystick button 1

Defenses

Drop Flare	1
Drop Chaff	2
IR Jammer on/off	3
ECM on/off	4
Drop Decoy	5

Equipment Controls

Gear up/down	6
Autopilot on/off	7
Bay open/closed	8
Flaps in/out	9
Brakes on/off	0
Eject	Shift F10

Display Controls	HUD Modes	F2
	HUD De-clutter	V
	Maps	F3
	Day/Night HUD	F4
	Ordnance	F5
	FLIR On/Off	F6
	ILS On/Off	F9
	Mission Orders	F10
Tracking Camera Controls (right MFD)	Cam Ahead	/
	Cam Rear	>
	Cam Right	<
	Cam Left	M
	Designate New Target	N
	Select Target	B
INS (Inertial Navigation System)	Select Waypoint	F7
	Change Waypoint	F8
	Reset Waypoint	Shift F8
	Last Waypoint	PgUp*
	Next Waypoint	PgDn*
	Move Waypoint Up	Up-arrow or numeric keypad 8*
	Move Waypoint Down	Down-arrow or numeric keypad 2*
	Move Waypoint Left	Left-arrow or numeric keypad 4*
	Move Waypoint Right	Right-arrow or numeric keypad 6*
	* shift if not using joystick	
From-the-Cockpit Viewing	Cockpit View	F1
	View Ahead	Shift /
	View Rear	Shift >
	View Left	Shift <
	View Right	Shift M
Out-of-Plane Viewing	Slot View	Shift F1
	Chase Plane	Shift F2
	Side View	Shift F3
	Missile View	Shift F4
	Tactical View	Shift F5
	Inverse Tactical view	Shift F6

View Control Keys

Zoom view	Z
UnZoom view	X
View Angle view	C

Other Controls

Accel Time	Shift Z
Norm Time	Shift X
Pause	Alt/P
UnPause	Any Key
"Boss" hide game	Alt/B
Quit	Alt/Q
Resupply (training)	Alt/R
Volume Adjust	Alt/V cycles through all 4 levels sound level 3 = all sounds sound level 2 = all sounds except engine background noise sound level 1 = firing and explosions only (no warning sounds) sound level 0 = no sound
Detail Adjust	Alt/D cycles through all 4 levels detail level 3 = exceptional detail (for average 386 and above) detail level 2 = moderate detail (for slow 386 and fast 286) detail level 1 = limited detail (for average 286) detail level 0 = limited detail (foranything else)

Special Controls

Go to Training (Alt/T): Tapping this key converts your current mission into a training mission. This means that henceforth enemy weapons do no damage, and that Resupply (Alt/R) is now available. A mission is coverted to training it cannot be converted back. Note that you score nothing for a training mission.

Teleport (Alt/cursor keys): These keys function *only* in training. Tapping the key "teleports" your aircraft in that direction. The distance you're "teleported" varies with the current Zoom/UnZoom scale of the satellite map.

Day/Night (Alt/N): This key functions *only* in training. Tapping it will switch the current time of day from night to day, or day to night. Once this key is used, time ceases to pass, so that it will be permanently day or night for the duration of the mission.

Resupply (Alt/R): This key functions only in training. Tapping it will re-fill your fuel tanks and weapon bays.

DISPLAY COLORS SUMMARY

HUD Colors	Black Rectangle	Ineffective weapon (day)
	Maroon Rectangle	Ineffective weapon (night)
	White Rectangle	Effective weapon
	White Oval	Effective weapon, locked on target
	Red Oval	Highly effective weapon, locked on target
EMV Scale Colors	Red Bar	Enemy Ground Radar
	Pink Bar	Enemy Ground Radar — poor detection
	Yellow Bar	Enemy Ground Radar — good detection
	Light Blue Bar	Enemy Aircraft Radar
	White Bar	Enemy Aircraft Radar — good detection
Satellite Map (Left MFD)	Flashing White Dot	Your aircraft
	Red Dot	Other aircraft
	Black Dot	Ground Radar
	Yellow Dot	Missile
	Dotted Line	Pulse Radar (the color matches EMV colors)
	Solid Line	Doppler Radar (the color matches EMV colors)
Tactical Display (Left MFD)	Gray squares	16 km grid
	Green radar dish	Ground Radar
	Blue boat	Warship Radar
	Solid gray rectangle	Airfield
	Red crossed circle	Other ground targets
	Blue airplane	Your F-117A / other friendly aircraft
	Gray outline	Decoy
	White dots	Chaff
	Red/Yellow burst	Flare
	Yellow plane	Enemy plane — higher altitude
	Light red plane	Enemy plane — similar altitude
	Dark red plane	Enemy plane — lower altitude
	Yellow line	Radar-guided Missile
	Red line	IR-guided Missile
	White line	Visually guided Missile
	Flashing item	Your objective
	Gray-boxed item	Current target
	Color-boxed item	Source of enemy radar signal
INS Waypoints Fuel Bar	Black region	Fuel consumed
	White region	Fuel for flight to current waypoint
	Blue regions	Fuel for flight to other waypoints
	Green region	Reserve Fuel

GLOSSARY OF ABBREVIATIONS

AAA: Anti-Aircraft Artillery (also called "Triple-A")
AAM: Air-to-Air Missile
AEW&C: Airborne Early Warning and Control
AEWS: Airborne Early Warning System
AFC: Air Force Cross
AFV: Armored Fighting Vehicle
AGM: Air-to-Ground Missile
AIR: Air-to-Air HUD mode
AM: Airman's Medal
AMRAAM: Advanced Medium Range Air-to-Air Missile
AOA: Angle of Attack
AV: Avionics damage light
AWACS: Airborne Warning and Control System
BAOR: British Army Of the Rhine
BD: Bay Door damage light
CMOH: Congressional Medal of Honor
DFC: Distinguished Flying Cross
DLIR: Downward-Looking Infrared
EAR: Enemy Airborne Radar
ECM: Electronic Counter Measures
EGR: Enemy Ground Radar
EMV: Electromagnetic Visibility
ENG: Engine damage light
ETA: Estimated time of arrival
FC: Flight Control damage light
FIRE: Fire Control damage light
FLIR: Forward-Looking Infrared
FUEL: Fuel Tanks damage light
GND: Air-to-Ground
HARM: High Speed Anti-Radiation
HUD: Heads-Up Display
ILS: Instrument Landing System
INS: Inertial Navigation System
IR: Incoming IR-guided missile warning light
IR: Infrared
IRST: Infrared Search and Track
JAM: Jammers damage light
km: Kilometer
kts: Knots
LADAR: Laser Detection and Ranging
LPAR: Long-range Phased Array Radar
MFD: Multi-Function Display
MTI: Moving Target Indication
MW: Missile Warning damage light
NAV: Navigation HUD mode
ORD: Mission Orders (right MFD)
OTH: Over the Horizon
PLO: Palestine Liberation Organization
RAD: Incoming Radar-guided missile warning light
RAM: Radar-Absorbent Material
RCS: Radar Cross Section
ROE: Rules of Engagement
SAM: Surface-to-Air Missile
SS: Silver Star
TAC: Tactical Display (left MFD)
TRAK: Radar Tracking warning light
VVI: Vertical Velocity Indicator
WPN: Weapons Display (right MFD)

DESIGNERS' NOTES

Background

F-117A Stealth Fighter 2.0 is the result of lots and lots of people working closely together over a long period of time. It really goes all the way back to 1987 when the first game on the topic was done.

Project Stealth Fighter (for the Commodore 64) was the first effort at a stealth game, and it worked remarkably well given its limited 8-bit, 1 MHz environment – Arnold Hendrick and Jim Synoski had set the stage for the next try at a stealth game.

When Sid Meier and Andy Hollis teamed up to do the same game for a 16-bit IBM machine, a large team was quickly assembled to work on what we knew would be a great game. Four and a half man years later, when MicroProse finally released *F-19 Stealth Fighter* for the IBM in the fall of 1988, the US Air Force finally unveiled its much-rumored stealth fighter, the F-117A.

We thought *F-19* would be a winner because it was the most realistic combat flight game to date for the commercial marketplace, but we had no idea of the magnitude of its success. It sold LOTS of copies fast and won just about every conceivable award in the first year it was on the shelves. It was proclaimed "...possibly the best computer game ever made..." The Software Publisher's Association voted it the best game of the year, and the accolades go on and on. Even now it continues to be one of our best-selling titles.

The Air Force had managed to keep the look of the F-117A a secret for nearly 10 years, fooling everyone, including various model makers, about the shape and the name of their stealth plane. As soon as we got a good look at the F-117A, we knew that sooner or later, we'd update *F-19* to match the look of that aircraft.

In the fall of 1990, MicroProse president, Bill Stealey suggested the time had come for us to do it, and we had until the summer of 1991.

Design Team

Since 1988, MicroProse has done four new games using state-of-the-art 3-D technology. Andy Hollis came out with *F-15 Strike Eagle II*, for the fall of 1989, which used the same core system as *F-19* but pushed the boundaries farther and faster. In 1990, he used a related 3-D system to produce *Lightspeed*. In both these products the 3-D was improved and modified to render more colorful, faster code. Meanwhile, Scott Spanburg had developed a different but related system, first for *M1 Tank Platoon*, then in the following year for *Knights of the Sky*. So we've gained lots of experience with 3-D systems, and it is fair to say that the 3-D system you see in *F-117A* is the product of all the 3-D work that MicroProse has done since 1988.

Lead programmer Joe Hellesen was given the unenviable task of taking a great game, *F-19*, and improving it. We were able to enlist Max Remington (3-D artist for virtually all of MicroProse's games) to do the new objects we needed. Bruce Shelley was charged with overseeing the development of the new worlds that would have to be

constructed, and Bruce Milligan (a recently hired game designer) was charged with constructing them. Veteran computer artists Kim Biscoe and Barbara Bents were brought on-board to provide art for opening and closing screens, and Ed Fletcher, a new hot-shot addition to MPS Labs, was brought on to do the front and end game programming.

From the outset, Joe and I agreed not to tamper with the basic gameplay—*F-19* was a real winner which had enjoyed phenomenal success, the basic gameplay is solid... "if it ain't broke don't fix it." We decided that, given time constraints, the best course was to concentrate on graphics to see if we could make it more realistic, fun and set a new standard for future flight sims in terms of graphic presentation of the world in which you fly.

Already, we had a system that allowed a great deal of detail but we wanted to enhance it, make it more believable, more colorful. The original game had been done with 16-color 3-D worlds (at that time 16-color EGA was pushing the limits of the technology), so the first step was to adapt the game to 256-color graphics. This meant a lot of work for Max and Joe. All the objects had to be recolored, and in some cases rebuilt to accommodate 256-color graphics.

To make sure players have plenty of areas in which to fly, we included all four worlds from the old *F-19*, and added five more — two from *F-15 II* and three new ones.

The night world took on new significance because the real F-117A never flies combat sorties during the day. Joe and Kim came up with a striking night horizon. Then we added lights to the ground objects which switch on an off according to where you are (enemy or friendly territory), the level of tension, and what time of day it is. Next, we added a sky that lightens and darkens dynamically according to the time of day. Finally, we added the FLIR camera view, partly because it was "cool" and partly out of necessity: in the deepest, darkest night, it is imperative to use the FLIR so you can tell what you're looking at. These combine to give a very strong feeling of realism.

To go with these additions, we also needed a real-looking F-117 aircraft. Max spent several long weekends building the most complex object ever to appear in a home computer game, and Joe and Andy came up with a way to make all those surfaces and lines sort correctly.

During the development period, US forces were involved in a war in Iraq and Kuwait which showed just how effective precision bombing can be. Joe immediately began to work on a new view through the tracking camera – one that would show the "real" world outside your aircraft, like the video tape shown at briefings during the war. He linked this view to the nose view of the Maverick missile, because this weapon actually has a camera in its nose. (Other weapons that have nose cameras, like the GBU-15s that F-111's knocked out the pumping manifolds at Sea Island, are not represented in the game because they are probably too heavy for the F-117A).

The front and end of the game were completely redesigned to make it easier to navigate through options and to give a chance for some beautiful 256-color graphics to adorn your CRT. We added a feature that allows you (if you're the type) to quickly generate a bunch of missions until you get one you really want. Also, for those of you who want to know what it might be like to fly the real F-117, we included the "Lockheed F-117A" option that essentially cuts out some of the capabilities to make it more like the real plane.

There are a lot of other enhancements: a more intelligent and realistic cockpit, improved enemy AI, new targets, new missions, and on and on.

For those of you that have enjoyed the original *F-19*, we hope you'll like this one even more. For those who are playing our Stealth Fighter game for the first time, hold on to your seats and get ready for an experience of a lifetime.

CREDITS

IBM Programming	Joe Hellesen and Ed Fletcher with David McKibbin, Gregg Kreafle, and Andy Hollis
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