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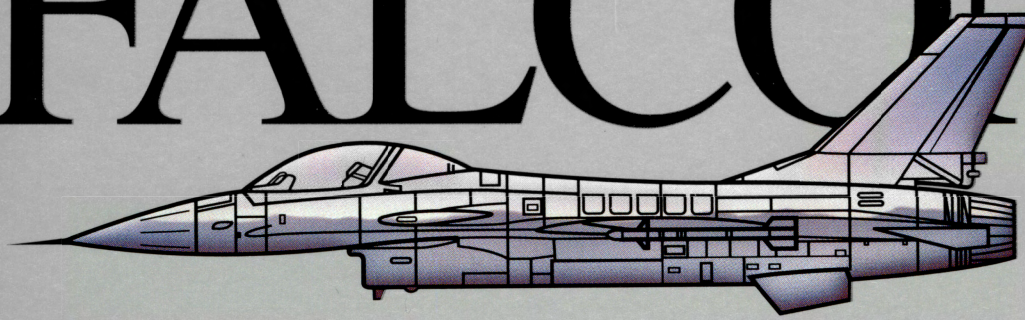

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IBM FLIGHT MANUAL

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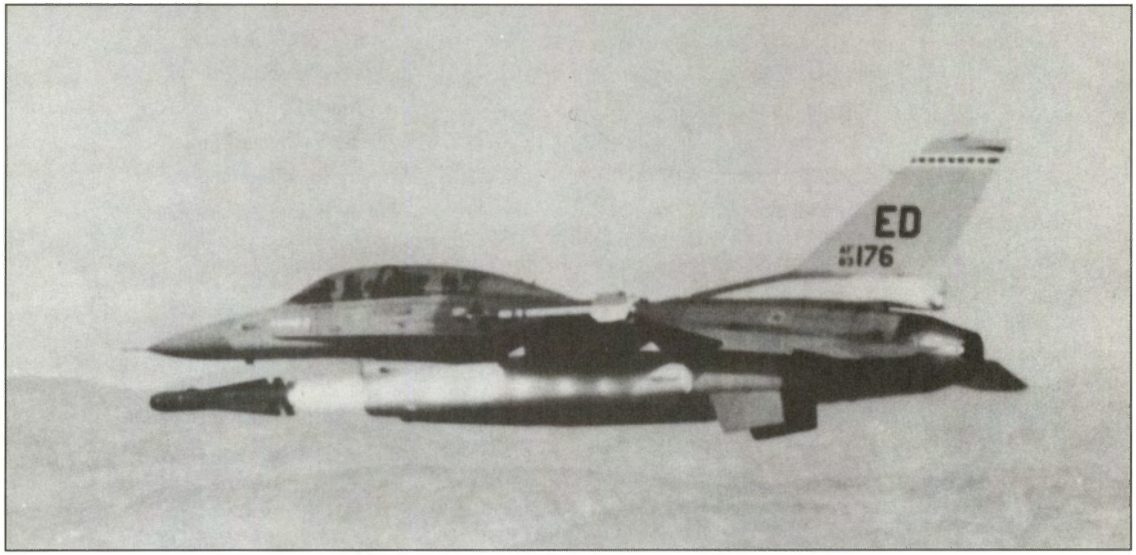

FLIGHT MANUAL

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Foreword: Operation Desert Storm

Many of us are extremely proud of how well Coalition forces did in the Gulf War. Their success is a tribute not only to the technology but to the training and professionalism of our armed forces. For the first time in 47 years, the nations of the world stood side by side to thwart aggression. Men and women were willing to fight for a cause that was not entirely their own in order to preserve another nation's sovereignty. Yet, as full of pride and patriotism as we are, we must also never forget the bitter cost of war and the need for a better peace.

As successful as the world has been in repelling force with force, it has not yet demonstrated its ability to promote world peace and harmony. The world came together to defeat a nation through the use of war. It spent over 40 billion dollars and committed hundreds of thousands of troops to that effort.

We won the war, but are we losing the peace? What are all the nations in the Gulf War doing now to promote lasting peace? When will leaders and nations set aside their individual pride and come to the table to attempt to iron out their differences and create a new peace in the Middle East?

The Middle East has been a place of conflict for over 4,500 years. Each nation is proud. Each person is willing to sacrifice his or her life for a just cause. The problems and solutions to peace and prosperity for all in the Middle East are complex, but the reason for harmony is clear: life is too special to waste. With each passing generation, each nation has an opportunity to create a better place to live. No nation can afford to lose its most important asset: its children. Each child is potentially a builder, a scientist, an engineer, a teacher, a doctor, a leader. War robs a nation of its future, for in the end there are no true winners in war. The only thing that separates the victors from the vanquished is the degree of loss.

Each nation has a responsibility to make peace a higher priority than war. The industrial countries of the world can no longer afford to blindly arm Third World nations. This is not only a dangerous and destabilizing practice, but it also robs Third World nations of the funds they need to help feed their hungry, educate their children, care for their elderly, build the resources for self-sufficiency, protect their individual cultures and preserve their right of self-determination.

Unlike *Falcon 3.0,* real war is not a game. No matter how right our government was, or how wrong the leadership of Iraq was, hundreds of thousands of lives were lost or permanently scarred for a cause that the soldiers and citizens of Iraq did not fully comprehend. The waste of lives, as well as the damage that will take decades to repair, cannot be ignored.

We designed this simulation to teach and educate us about what we ask our young men and women to commit to when we ask them to fight. We must respect those whom we ask to make the greatest sacrifice of all. *Falcon 3.0* attempts to recreate the realities of battle and thus was designed as a simulation, not as a video game. It is not our purpose to glorify or trivialize war.

Unfortunately, war is still a reality. We hope you will use this product to gain a better understanding of the dangers our pilots face and the complexity of the systems they must master. We hope you also understand that war is not a game you can simply reset or play again. In war, every truck, tank, plane or building that is destroyed costs human lives.

Soldiers and pilots understand this. We ask a lot from our servicemen and servicewomen. Use this product with respect and keep in mind the differences between fantasy and reality.

We salute all of the men and women of the armed forces across the world for their sacrifices and their willingness to defend and fight for their countries. We pray that their efforts will not be forgotten or wasted and hope that the leaders of the world will create a better existence for mankind. We look forward to the day when our children will join with other children of the world to celebrate our diversity instead of fearing it, a day when men and women help build a greater place with each other instead of at the expense of one another, a day when war is a forgotten word.

In the end, all of us, regardless of race, religion or nationality, have the same desires: to live productive lives and to give our children the ability to pursue their dreams in a world of peace.

Gilman Louie
CEO/Chairman
Sphere, Inc.
September 12, 1991

SECTION

INTRODUCTION

Introduction

Strapped into your seat, you scan the Iraqi landscape for bogeys. Nothing. Martyrs' Bridge ought to be easy to take out. Suddenly, a high-pitched warning screeches at you. Your radar lights up like Times Square on the First. "2 bogeys at 11, 30 miles," you radio to your wingman, almost shouting. "Roger, moving to intercept," he responds. A quick check of the threat indicator shows they haven't spotted you yet since they're not breaking off. You and your wingie break combat spread, swing wide and try to pince them from the rear. Just before you attack, they catch your radar and break off. "Get 'em!" you yell, firing off a burst of rounds at the leader as he zips by while your wingie takes off after the other bandit.

Getting a closer look, your heart leaps into your throat as you notice that these planes are fast and lethal MiG-29s. Muttering sighs of relief that their radar didn't spot you first, you break hard after the leader. He pulls up into a roll, and you follow keeping your energy high, then break down just after he makes his descent. Dead in your sights, you select and arm a Sidewinder, then fire it in his direction. Like he knew it was coming, the MiG dives fast to avoid the missile, dumping flares, and then pulls up hard. Your shallow dive catches him with his energy depleted, so you switch to guns and lay into him. Flames erupt from his engine and flak rains from his wounded bird. Spiraling downward toward the Tigris, the MiG pilot ejects just before his plane shatters like a used firecracker. The other MiG sees his comrade go down and bugs out towards Baghdad. During this time your wingman got shot up and a dirty smear on his tail says that he's got one helluva fuel leak. "I'm a dot," your wingie yells, pulling back and heading for home. "Roger," you reply. Only four more miles to that bridge. Gotta go for it.

You drop to 2,000 feet to avoid radar — then home in on the bridge. "If those Iraqi tanks get there before me, Army's gonna have my head." Two miles to target, approaching visual. Martyrs' Bridge comes into range, and you click to your GBU. Target lock, FIRE! The bomb glides through the air and slams into the center of the bridge, turning it into a hulk of twisted metal. As you wing around and head for home, you're already thinking ahead to your next assignment...

Welcome to the world of *Falcon 3.0*, the most complete and accurate flight simulator on the market today. Strap yourself in and prepare for combat!

About *Falcon 3.0*

Falcon 3.0 is first and foremost a simulator of the F-16 Fighting Falcon — a dogfighting aircraft with the additional capability of air-to-ground bombing. It is not only one of the most maneuverable (and inexpensive) planes in the United States' arsenal of aircraft, but it's also a favorite of experienced combat pilots. *Falcon 3.0* has been designed to provide the most authentic simulation of air combat possible on your computer.

Inside *Falcon 3.0* are actually three games in one: the Instant Action mode for the novice flight-sim pilot, the Red Flag training ground/mission editor where budding pilots can prepare for combat, and the Campaign mode in which you take the part of a squadron commander and lead your pilots to victory or defeat on one of three real-world battlefields.

Instant Action is designed for the novice pilot, or the player who is interested in "mixing it up" without a lot of complexity. All you've got in this mode is your F-16 and lots of enemies. Instant Action can also serve as basic training for the simulation; you can learn how to fly and observe the characteristics of the various enemy aircraft. You will be scored based on the number of air and ground targets destroyed and the accuracy of the weapons you fired. Instant Action is fully described following this introduction in **Section II: Instant Action**.

One feature of Red Flag is the set of training lessons described in **Section V: Air Combat School**. These lessons will lead you through the operation of your F-16, from basic flight to air combat manuevers. They also cover the operation of the aircraft's avionic and weapon systems. Another feature of Red Flag is the mission editor which allows you to create your own missions involving a great variety of air and ground forces.

The Campaign is the heart of *Falcon 3.0*. In the Campaign, you play the role of a squadron commander in one of three theaters of conflict: Panama, Israel or Kuwait. You assign the pilots of your squadron to various missions to achieve victory. You also take the role of the lead pilot on all missions; your skills determine the outcome of every mission and eventually the outcome of the war. The computer controls your wingmen and the overall course of the conflict. The progress of the campaign is strongly influenced by your success or failure on the battlefield, so no two campaigns will ever be exactly alike. Descriptions of the three theaters can be found in **Section XIII: Theaters of Conflict**.

In addition to the three major modes of play described above, there are a number of other features in *Falcon 3.0:* ACMI (Air Combat Maneuvering Instrumentation), which allows you to record and review mission action, a Configuration section for customizing game features, and a Communications mode that allows you to battle your friends head-to-head using modem or a direct connection.

How to approach this manual

Don't worry about the length of this book — by no means do you need to read it all to experience the thrill of *Falcon 3.0*. While a lot of the manual describes how to play the game, not every section needs to be tackled at once. Also, some sections of the manual contain history and reference articles that you can read at any time. These sections add to your understanding of the game, but are not required reading for getting started.

Before continuing with this manual, you should open the **Release Notes and Communications Handbook** (included in your *Falcon 3.0* box) and read the Installation and Loading procedures. That handbook will explain where to find the Install program and how it operates. It will tell you how to load the game and configure your system to utilize expanded memory (EMS). The remainder contains detailed instructions on how to use the communications section of *Falcon 3.0* and how to contact our customer support department.

Next, you should turn to **Section III: War Room,** which gives a brief overview of *Falcon 3.0's* interface and describes how to get to the various areas of the game. From the War Room, you can choose to fly around in Instant Action **(Section II)**, to change some of the hardware or software options for the game **(Section IX)**, or to edit one of your squadrons **(Section IV)**. After setting up a squadron, you can either go on a training mission **(Section V)** or begin a new campaign **(Section VII)**.

Once you've had some flight experience, you can tackle **Section XI: Aerodynamics and G Forces** to learn about the basic physics of flight. You can also read an actual F-16 pilot's observations on dogfighting techniques in **Section XII: Advanced Fighter Tactics**, if you feel the need to brush up on your dogfighting skills.

SECTION

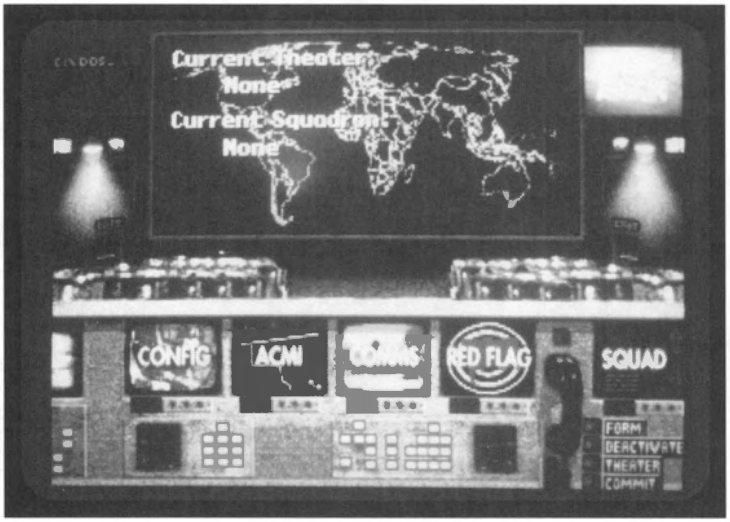
II

INSTANT ACTION

Instant Action

Instant Action puts you into the air immediately. No setup, no required objectives, no hassle — just straight piloting.

If you haven't already installed *Falcon 3.0,* install it according to the directions in the **Release Notes and Communications Handbook.** To enter Instant Action, load *Falcon 3.0* according to the instructions. You will see an introductory sequence followed by the title screen and game credits.



Welcome to the War Room

The screen which follows is the War Room. Using the keyboard or mouse, you can go to other sections of the game by selecting one of the various monitors in the War Room.

If you have gone to the Configuration area before, go there now, select the Beginner button and return. If you want to adjust the settings to make it more difficult or more realistic, please see **Section IX: Configuration** for full instructions.

If you have never gone to the Configuration screen before, don't worry; you'll automatically start at the Beginner setting.

Selecting the large screen at the upper left of the War Room exits you to DOS; selecting the large monitor at the upper right launches you straight into Instant Action.

Zero to 450 in six seconds

After some video animations, you will find yourself airborne, cruising at 450 knots directly over an enemy ground installation.

Start fighting — you're on your own, with unlimited fuel, weapons and time. Every radar contact is hostile, every dot on the horizon is the enemy, and everything on the ground wants you shot down. The goal is simple: see how long you can last and how many of them you can take with you before you buy the farm.

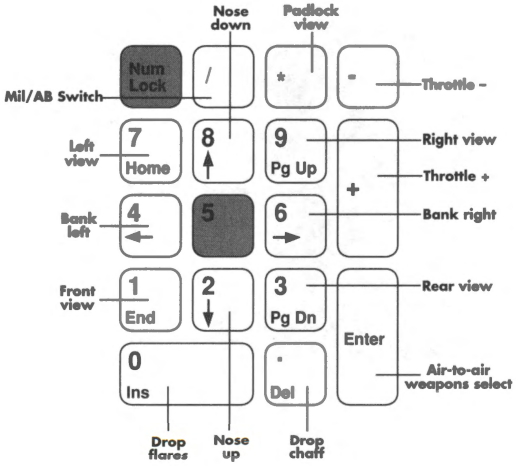
Time out!

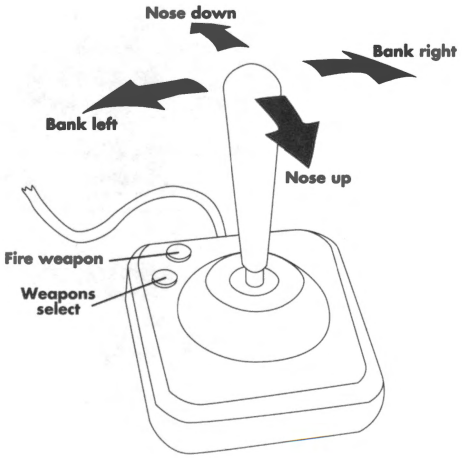
The game can be paused by pressing [P]. A paused game can be restarted the same way.

Pressing [Esc] will also halt the game as well as bring up the menu bar. A number of options are available through the various menu selections; these are fully discussed at the end of **Section VIII: Flight**. Return to play by pulling down the FILE menu and selecting Return to Game.

Controlling the plane

A full keyboard diagram is printed on the **Quick Reference Card**, but here are the basics.

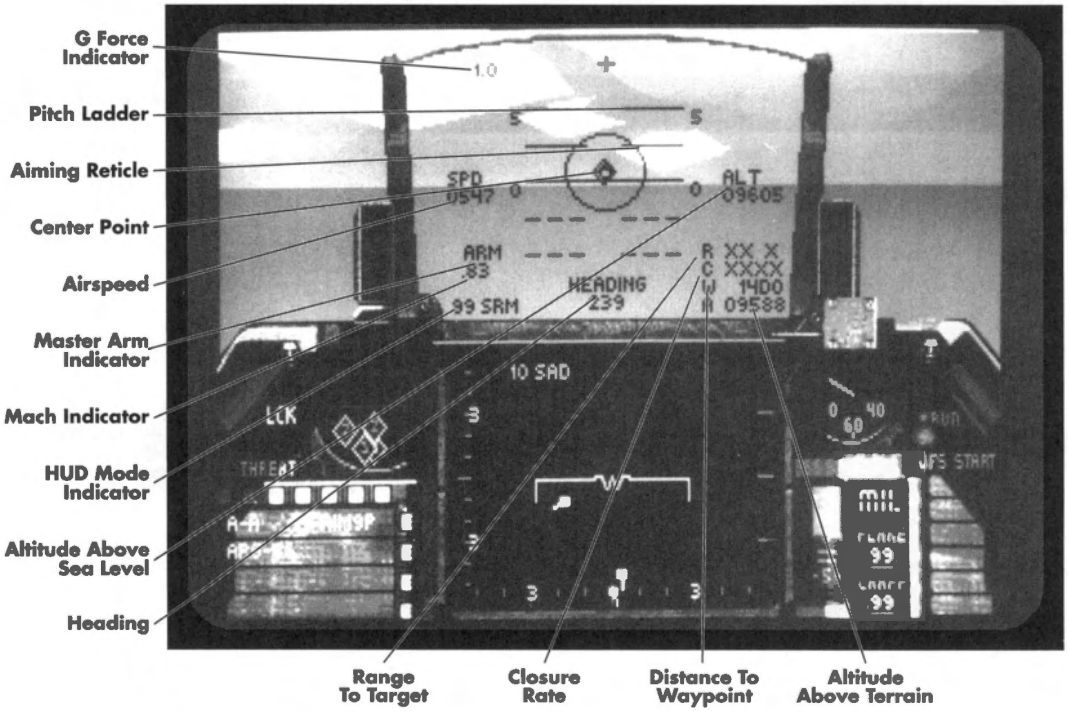




To bank left or right, just push the stick to that side. Pull back on the stick to climb, and push forward on the stick to dive. Pull back and bank simultaneously to turn tighter. If you are using the keyboard, the arrow keys take the place of the stick.

Control the throttle with [+] and [–]. Watch the RPM Indicator on the right side of the cockpit as you increase and decrease the power; for dogfighting, 60–80% power is optimum. But if you need to extend or are just plain out of airspeed, kick in the afterburners with [/]. When you first fire the 'burners, you will see "AB1" displayed in the MIL/AB Indicator, next to the RPM Indicator. This means you are in the first stage of afterburner. Use [<] and [>] to scale through the five afterburner stages. Shut down the afterburners with [/].

The Head-Up Display (HUD)



Pause the game for a moment. Now look at the center of your screen, where all the green writing is. The area within this metal frame is the HUD.

The symbols

The tiny circle in the center is the Center Point; its purpose is to help keep the pilot's attention focused in chaotic situations.

The larger circle around the Center Point is the Aiming Reticle. In general, any target within the aiming reticle has a good chance of being hit, assuming it is in range and you are locked on. Within the Aiming Reticle, a number of different targeting aids may appear. These will be discussed later.

Overlaid on the Aiming Reticle is the Pitch Ladder, a wide band of lines with numbers next to them. The lines are parallel to the horizon, and the numbers at either end indicate the plane's pitch in degrees. Zero degrees is parallel to the ground, 90 degrees is pointing straight up, and -90 degrees is pointing straight down.

At the top of the HUD is the plus sign. If an air-to-air target is within visual range, a line will extend from the plus sign in the direction of the selected target.

The figures

Centered in the bottom of the HUD is your current heading in degrees, where 000 is due north, 090 is due east, 180 is due south, and 270 is due west. Next to the heading will be the Waypoint Caret which tells you which way to turn to head to your next waypoint. For example, if the heading read "270>", you should bank to the right to reach your next waypoint. When you are heading directly towards your waypoint, the Waypoint Caret will read ">xxx<."

Next to the heading, in the lower right-hand corner of the HUD, are four numbers. The top one is the range to the current target in feet. The next is the closure rate — your speed relative to the target. If your closure rate is positive, then you are approaching your target at that speed (in knots). If it is negative, then your target is pulling away at that rate. The third number is the distance to the next waypoint. The bottom number is your altitude above terrain, which shows how high above the dirt you are.

Above the range figure, at the middle of the right-hand side of the HUD, is your altitude in feet. This is how high above sea level you are — not how far above terrain your plane is.

At the top left of the HUD is a number indicating how many Gs you are pulling and whether they are negative or positive. This is only of concern if you are playing with Redout/Blackout active (see **Section IX: Configuration**).

The number displayed below the G readout, about the midpoint of the left side of the HUD, is your airspeed in knots.

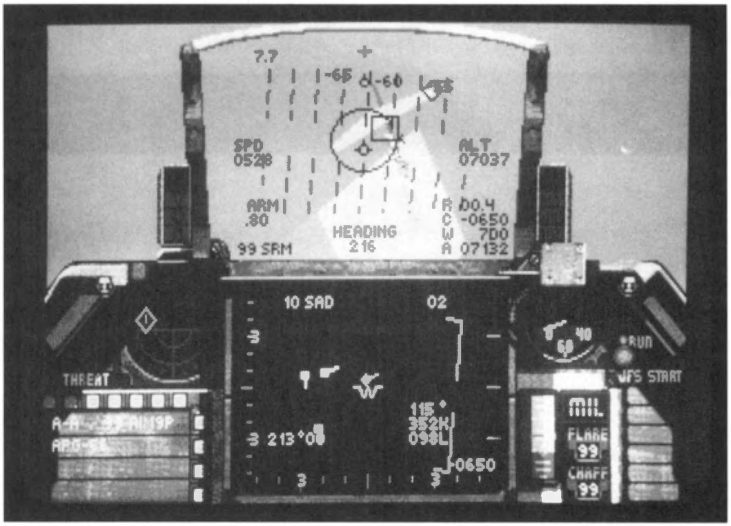
Below that is the Master Arm Indicator, which should display the word "ARM." This simply means your weapons are armed.

Just below the Master Arm Indicator is a number with a decimal point. This is your speed in Mach numbers; 1.0 is equal to the speed of sound, 2.0 is twice the speed of sound, and so on.

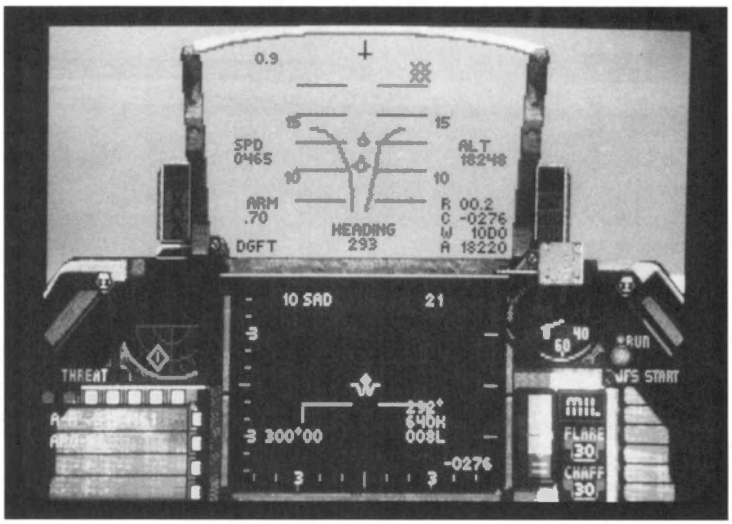
Below the Mach indicator is the number "99" followed by a three- or four-letter code. The number "99" indicates that you have unlimited armament; the letter code indicates what HUD mode you are in. The HUD mode automatically changes when a new weapons system is selected. The various modes (CCIP, DGFT, ILS, SRM, STRF and so on) are explained in detail in **Section VIII: Flight**.

How to shoot

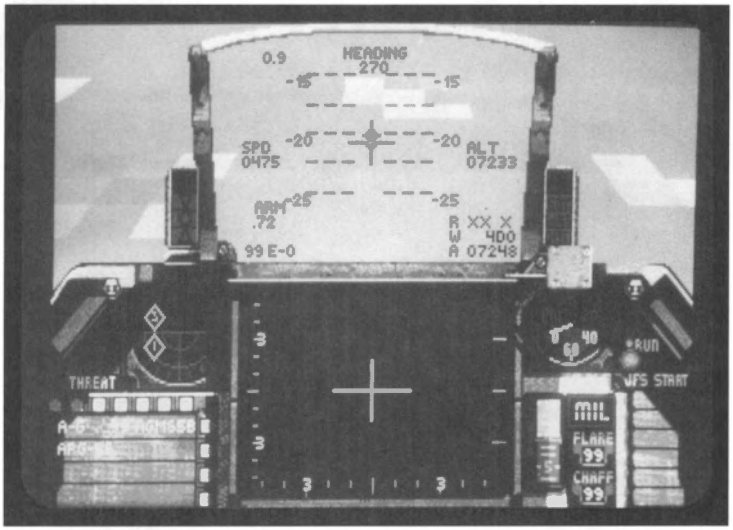
The Stores Control Panel in the lower left-hand corner of your Front View shows what weapons mode you are in, either "A-A" (Air-to-Air) or "A-G" (Air-to-Ground). If you are in A-A mode, pressing [Backspace] will switch to A-G; in A-G mode, pressing [Enter] will switch to A-A. The panel also shows which weapons system is currently active. In A-G mode, [Backspace] will cycle through the various air-to-ground weapons. If you are in A-A mode, cycle through the air-to-air weapons by pressing [Enter].



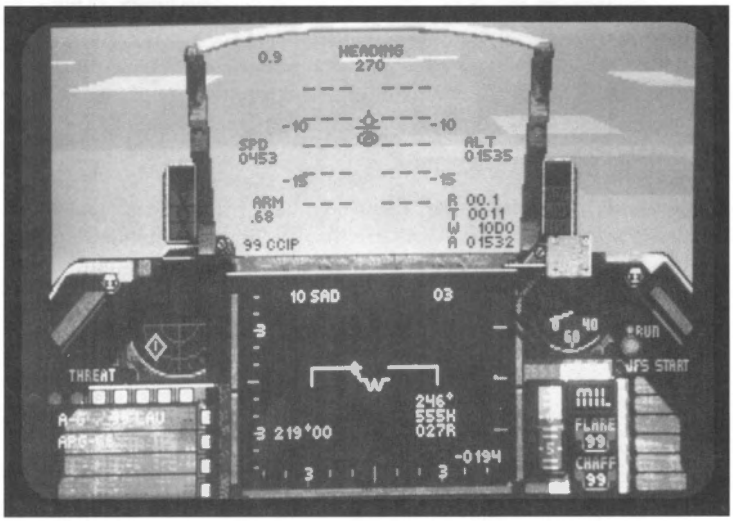
In A-A mode with any of the missiles selected, there will be a diamond within the Aiming Reticle. This shows where the missile is seeking. When an enemy enters the Aiming Reticle and is within visual range the missile will automatically lock on, and the Aiming Reticle will flash as long as the lock is maintained. Hit [Spacebar] to fire the missile.



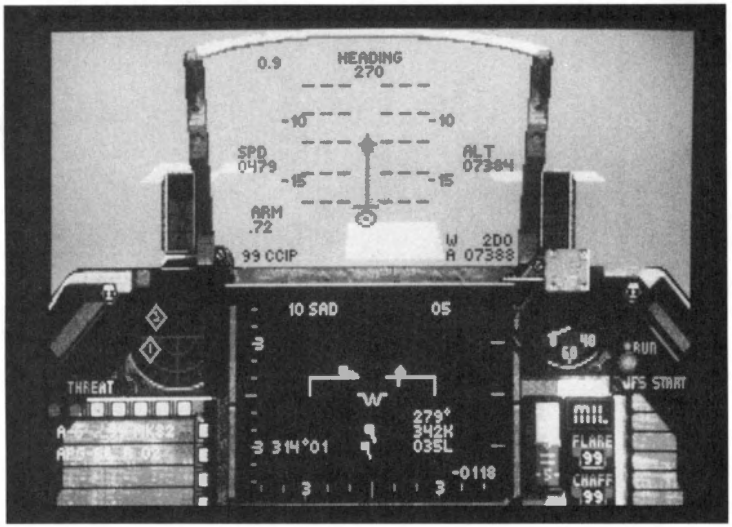
In A-A mode with the M61A1 gun active, a pair of lines will appear within the Aiming Reticle. As you maneuver, these lines will curve and sweep up or down, forming what is known as the Funnel. The point of the funnel, where the two lines meet, is where shells from the gun will arrive. A good rule of thumb for ranging and accuracy: if both of the target's wingtips touch the sides of the funnel, it is within range and likely to be hit. Hit [Spacebar] to fire.



In A-G mode with AGM-65Bs, AGM-65Ds or GBU-15s selected, cross hairs will appear in the middle of the Aiming Reticle. When a target enters the Aiming Reticle, the cross hairs will automatically lock on and follow the target. Press Spacebar to fire.



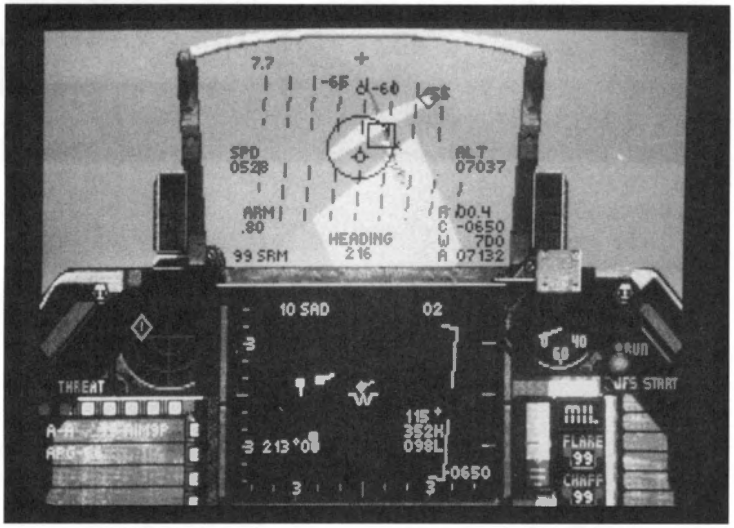
In A-G mode with LAUs or with the gun selected, the bombsight (a targeting dot with a circle around it) will appear near the Center Point. When the dot is on the target, press Spacebar to fire.



With all other A-G weapons, weapons delivery requires two actions: designating the target and release of the weapon. A bombsight similar to that used for the gun and LAU rockets will appear with a line extending upwards from the targeting dot. When the target is in the targeting circle at the base of the line, hit [Spacebar] once. This designates the target, identifying it for the on-board bombing computer. If you continue flying over the target, the computer will automatically release the bomb at the correct time to strike the target you selected. Or, if you want, you can release it yourself by pressing [Spacebar] any time after designating. Pressing [Spacebar] twice quickly will release a bomb immediately.

The radar

Below the HUD is the Radar/Electro-Optical (REO) Display. This is where the various radar and weapons guidance systems display their information. There are two REO Display modes; one is for air-to-air combat, and one is for air-to-ground.



In air-to-air mode, your plane's position will be in the center of the REO display. Any plane above the center will be in front of you, and any plane below the REO's center will be behind you. The long green line across the center is called the waterline, and shows your roll (your plane's left-right tilt in relationship to the ground). The ends of the waterline bend toward the ground to aid in orientation.

In the upper left corner is a number followed by the letters "SAD" (Situation Awareness Display). The number shows the scale of the display. The number "20," for example, means that it is 20 miles from the top of the display to the waterline. The scale will automatically change as necessary.

In the upper right corner of the REO Display is a two-digit number. This is the enemy's altitude in thousands of feet.

Near the lower right corner of the A-A REO Display are three numbers. The top one is the target's heading in degrees, the middle one is the target's airspeed in knots, and the bottom one is the aspect angle to the target. Aspect angle is covered in **Section V: Air Combat School** and in **Section XII: Advanced Fighter Tactics**.

In the very bottom of the right side is the closure rate, which is also displayed in the HUD.

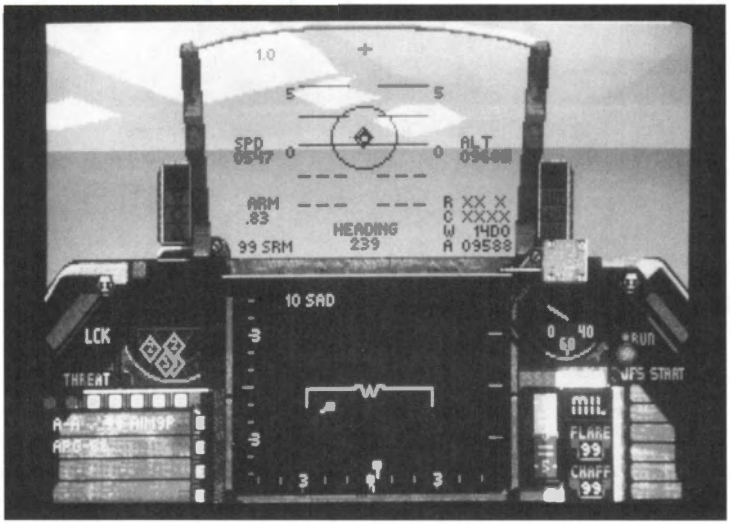
If you have any radar contacts, they will be shown on your REO Display. The target you are tracking will show up as a diamond; any other contacts will be displayed as squares. The color of the square or diamond indicates the contact's relative altitude as compared to your own:

- Orange targets are more than 3,000 feet below you.
- White targets are within 3,000 feet of you in altitude.
- Blue targets are over 3,000 feet above you.

The line extending outward behind each radar contact shows the contact's direction of travel. To track a different target, press [T].

In air-to-ground mode, Maverick missiles and GBUs use the REO to display a video picture from their target acquisition sensors. When you have selected either of these weapons, the REO will display a set of cross hairs and video of any targets picked up by the sensor.

Using the Threat Warning System



The circular screen to the left of the REO Disclay is the Threat Warning Indicator. Any enemy with active radar will show up as a blip on this screen. The screen is divided by two lines. Anything above the horizontal line is in front of your plane, and everything below the line is behind you. The shape of the blip indicates what is emitting the radar signals: diamonds are enemy aircraft, large squares are enemy surface-to-air missiles, and small squares are air-to-air missiles in flight. The numbers inside the blips indicate the type of radar being used (which is not important in Instant Action).

To the left of the Threat Indicator is the Threat Warning Panel. If enemy radar locks onto you, the "LCK" light will come on; if a missile is launched at you, the "LNH" light will warn you.

Have a look around

There are many different views to choose from to help you see your adversaries and your position. Select these views by pressing the number keys [1] through [0] or [End], [PgDn], [Home], and [PgUp] ([1], [3], [7] and [9] on the numeric keypad).

In all five outside views, [F1] will zoom in, [F2] will zoom out and [F3] and [F4] will rotate the image.

Pressing [1] switches to Satellite View, which shows your plane from above.

Select Ground View, which shows your plane from below, by pressing [2].

The Wingman View, chosen by pressing [7], is not active because you are on your own in Instant Action.

Switch to Track View by pressing [9]. This shows your plane from behind if no enemies are in view. If enemies are in sight, the view will always keep the target and your plane visible at the same time.

The Chase View also shows your plane from behind, but as if the camera were chasing you — it lags behind your maneuvers slightly, whereas the tracking view does not. Pressing [0] (zero) activates the chase plane view.

The Left View from the cockpit is chosen by selecting [Home] ([7] on the numeric keypad) or [4]. Switch to a Right View by pressing [PgUp] ([9] on the numeric keypad) or [6]. Check your six, or Rear View, by pressing [PgDn] ([3] on the numeric keypad) or [5].

Return to the Front View by pressing [End] ([1] on the numeric keypad) or [3].

Scoring

Instant Action is the only part of the game in which a score is kept in *Falcon 3.0*. The score for destroying any air or ground target is determined by the difficulty of the feat. The skill, the aircraft, and the weapons of a defeated pilot all add up to determine the point value of a dogfight victory. In addition, the presence of multiple bogeys in the area will increase the value of both air and ground targets. Although you have been given unlimited weapons, every missile fired and every bomb dropped subtracts from your point total. Then, your base score will be multiplied based on your realism setting in the Configuration area. So, if you want a high score, don't waste your weapons. This is good practice for the campaign anyway, since every weapon will be precious at the higher levels of realism. Good luck and watch your six!

SECTION III

WAR ROOM

Before reading this section of the manual, be sure you have installed Falcon 3.0 *and loaded the program. Complete instructions for installation and loading can be found in the* **Release Notes and Communications Handbook** *included in your* Falcon 3.0 *box. In addition, you should have read the first few sections of the handbook which explain how to use the keyboard and mouse on the interface controls.*

While reading the manual, there may be times where you will find an unfamiliar word. If this occurs, you can refer to the Glossary/Abbreviation part of **Section XV: Reference** *at the back of this manual.*

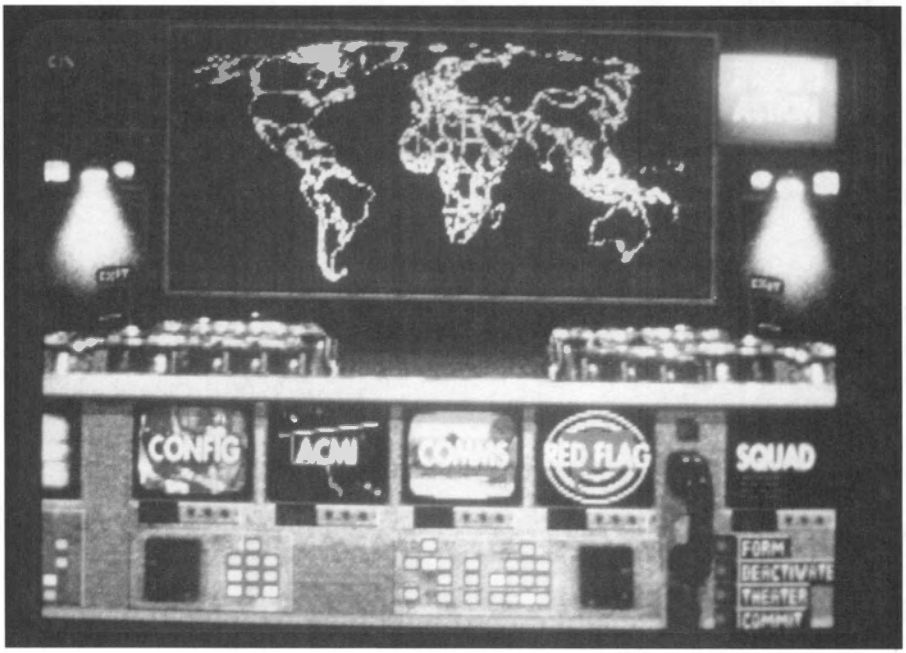
War Room introduction

After you have loaded *Falcon 3.0* and progressed through the intro screens, you arrive at the War Room. The War Room is the main menu for *Falcon 3.0*. Here, you can enter any of the other major areas of the program: Instant Action, Configuration, ACMI, or Communications. In addition, you can remove or create a squadron and place that squadron in the Red Flag training area or into a full-blown campaign.

Whenever you exit from any section of the game (Campaign, Red Flag, Instant Action, etc.), you will return to this screen.

War Room operations

The War Room is arranged into three major sections: the World Map, the Squadron Manipulation area and the TV Monitors. When the red light next to a particular section is illuminated, you can select that section. If the light is not lit, you may need to do something else first before you can enter the area.



World Map

The World Map displays textual information about your current squadron and theater. It also shows the geographical area where your campaign is located. If you have a squadron selected and that squadron is assigned to a theater, the world map will display a small box on the map which shows where that theater can be found.

Squadron manipulation

The lower right-hand corner of the screen is where you select, delete or create a squadron for use in a campaign or the Red Flag training grounds. Before you can start a campaign or enter Red Flag, you need to choose/create a squadron.

Squadrons are the basic unit in *Falcon 3.0*. Although you as an individual pilot fly a single F-16, the rest of the aircraft on your flight are flown by other (computer-controlled) pilots. Squadrons are the equivalent of "saved games" in *Falcon 3.0*. You can have up to six (6) squadrons active at any given time.

Following are the squadron-based options you can choose from the War Room (each of them is located in the lower-right hand corner):

FORM button

This button is used when you want to create a new squadron from scratch. Before the first time you form a squadron, the information on the World Map will indicate that you have no squadron or theater selected. When you select the FORM button, you can then choose your squadron's patch using the the arrows in the SQUAD monitor.

This button will be lit if there are fewer than six squadrons already created.

SQUAD (Squadron) monitor

After selecting the FORM button, up and down arrows will appear in this monitor. To choose an insignia, select the green arrows to scroll through your choices. Each insignia comes with its own squadron name attached. When you find an insignia you like, simply select it. You are now ready to choose a theater or enter the Red Flag training area.

This button will be lit if you have previously created a squadron. You can cycle through this monitor to view the available squadrons until you find the one you want.

DEACTIVATE button

This button is used to remove a squadron from active duty. When you click this button, the currently displayed squadron insignia (as well all the pilots and their statistics therein) will be deleted — never to be seen again! If you select this button, you will be prompted as to whether or not you want to continue with the operation.

This button will be lit if there is a squadron already selected from the SQUAD monitor.

WARNING: As mentioned above, this option will delete ALL records about the current squadron, including pilots, statistics and the like. Use this option with extreme caution.

THEATER button

Once you have chosen a squadron to command, you can select a theater for your campaign by using this button. Each time you select the THEATER button, a box will appear on the World Map indicating the geographical area of the current theater. Keep selecting this button until you have picked the theater you want to fly in.

If you choose a new theater for a squadron already engaged in a campaign, all information about that campaign will be lost and your squadron will restart with the new theater. To make sure that you don't accidentally erase an existing campaign, you will be prompted to continue your action.

This button will be lit if there is a squadron already selected from the SQUAD monitor.

COMMIT button

Now that you've chosen a new squadron and a theater, you can start up a campaign by selecting the COMMIT button. This will bring you to the War Update screen (see **Section VII: Campaign** for more information).

In addition, if you have a previous squadron in an existing campaign, selecting this button will bring you to the exact point you were when you last exited the campaign.

This button will be lit if there is a squadron and theater already selected.

Telephone

Selecting the telephone to the left of the SQUAD monitor will bring you to the Squadron Ready Room. Here, you can edit pilot names and faces, view the top pilots in your squadron, or transfer pilots to another squadron. Complete details on this room can be found in the next section, **Section IV: Squadron Ready Room**.

This button will be lit if there is a squadron already selected from the SQUAD monitor.

TV monitors

When selected, each of the TV monitors in the War Room will bring you to a different area of *Falcon 3.0*. A description and location of all the monitors follows.

INSTANT ACTION monitor

You can enter Instant Action by selecting the monitor in the upper right-hand corner of the screen. This area of the program is designed to get you in the air to mix it up right away. It is also a useful training tool for learning the various weapons systems and their operations. The Instant Action area is fully explained in the previous section, **Section II: Instant Action**.

You can choose this monitor at any time. Instant Action is totally independent from your squadrons, so you don't need to choose a squadron before selecting this monitor.

CONFIG (Configuration) monitor

The Configuration area is accessed by selecting the first monitor from the left at the bottom of the screen. Here, you can adjust a number of options to customize the game. Some of the things you can manipulate are: flight control input device, EMS settings, sound options, and the difficulty level variables of the game. A number of factors comprise each difficulty level, and you have the option to change any or all of them. These items include such factors as collisions, flight model, enemy logic and a host of others. The Configuration area can be found in **Section IX: Configuration**.

You can choose this monitor at any time.

ACMI monitor

You can access the ACMI area by choosing the second monitor from the left at the bottom of the screen. The Air Combat Maneuvering Instrumentation (ACMI) area allows you to review your missions from two different perspectives after their completion. First, you can view the actions of your plane using a VCR-like interface. You then can view how you accomplished an objective from a number of different views and display speeds. Second, you have the option to see a particular portion of your flight from a tactical perspective. Here, you will see every plane involved in the engagement in a wireframe view from any angle and can follow the course of every missile fired. A description of how ACMI operates can be found in **Section X: ACMI**.

You can choose this monitor at any time.

COMMS (Communications) monitor

To go to the Communications area, select the third monitor from the left at the bottom of the screen. In the Communications area, two or more players can dogfight head-to-head via mode or direct-connect. For an added challenge, you can coordinate on joint missions in a Campaign or an individual Red Flag mission. Communications are described in the **Release Notes and Communications Handbook**.

Before this monitor can become active, you need to choose a pilot from the Squadron Ready Room. See **Section IV: Squadron Ready Room** and the **Release Notes and Communications Handbook** for more details.

RED FLAG monitor

The fourth monitor from the left is how to enter the Red Flag area. The Red Flag area is designed both to be a training ground where new pilots learn air-to-air and air-to ground mission skills, and a testing area for tactics against a number of opponents and targets. You can choose among a number of preset training missions, or you can design your own mission against a variety of different enemy planes and ground targets. All of this takes place in the Nevada desert and is described in the **Section VI: Red Flag**. The training part of Red Flag is described in **Part V: Air Combat School**.

This button will be lit if there is a squadron already selected from the SQUAD monitor.

Exit to DOS

The monitor in the upper left-hand corner will exit you to DOS. This is the quickest way to end the game from the War Room. If you aren't in this room, you can easily exit to DOS without returning here by pressing Alt X.

Before you begin...

If you want to change how you control your plane (keyboard or joystick), your difficulty characteristics or sound options, you might want to go to the Configuration section before play. In this area, simply make your choices and then select DONE to exit. For more information, see **Section IX: Configuration**.

SECTION

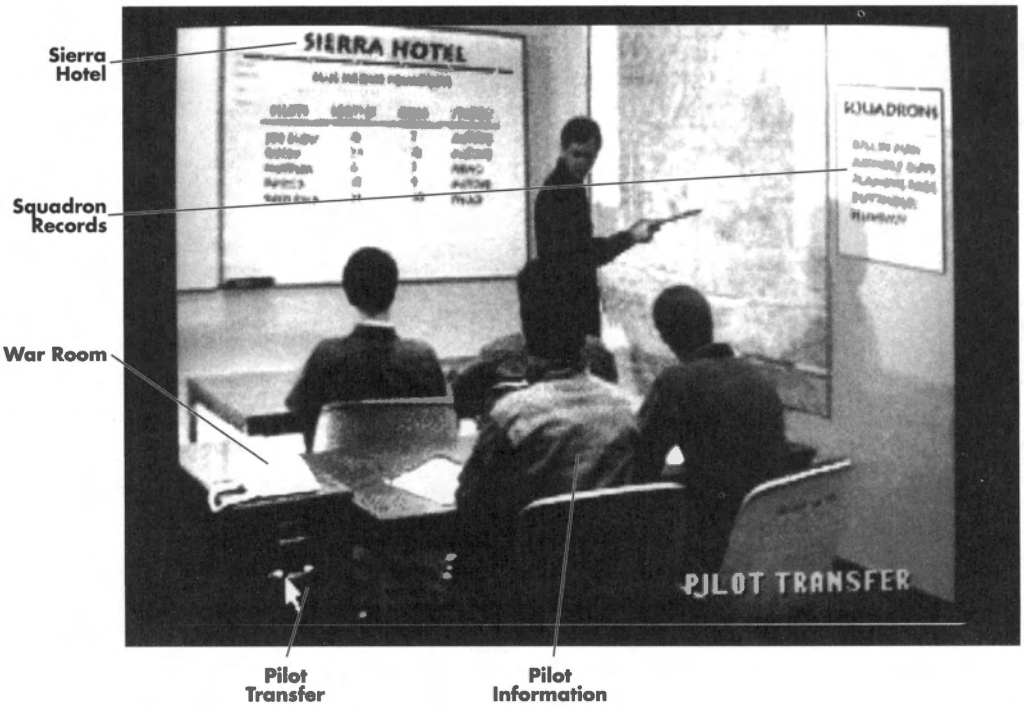
IV

SQUADRON READY ROOM

Squadron Ready Room introduction

The Squadron Ready Room is where you can view all the important information about your currently selected squadron. To arrive at this room, you need to have chosen a squadron and then selected the telephone from the War Room. Here, you can view your squadron's best pilots in Sierra Hotel and check out the current statistics for your individual pilots and complete squadron. You can also transfer pilots from one squadron to another and select a pilot to fly using *Falcon 3.0's* communications mode.

There are four areas in the Squadron Ready Room: Sierra Hotel, Pilot Information, Squadron Records and Pilot Transfer. To exit the room and return to the War Room, select the telephone on the file cabinet.



Sierra Hotel

To view the best pilots in your squadron, select the large whiteboard on the upper left side of the room. The Sierra Hotel displays the list of outstanding pilots in your squadron for everyone to admire. From left to right, these are the things shown on the whiteboard:

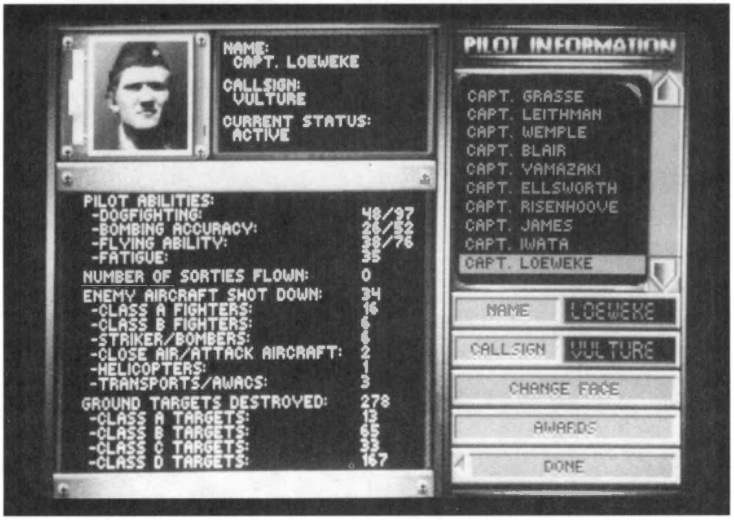
Pilot
This is the name of your ace pilot. Pilots will be listed in order of recognition, from top to bottom.

Sorties
The number of sorties is how many missions your pilot has flown. Each time a pilot goes out on a mission, his sortie total increases.

Kills
This is the number of confirmed kills that pilot has accumulated to date. Confirmed kills include any downed enemy aircraft (fighters, bombers, transports, helicopters, etc.) that have been seen by a witness other than the pilot himself.

Status
A pilot's status can be one of the following things: Active (currently in the squadron and ready to fly), MIA (Missing In Action — when a pilot is shot down and falls into enemy hands), Killed (killed in action), Back in x (this is the number of days in the campaign before this pilot can return to active duty).

Pilot Information
To view an individual pilot's performance record, select the lower left-hand pilot next to the file cabinet. The Pilot Information screen will display a number of things about a particular pilot and will also allow you to change his name, face and callsign.



To choose a pilot to view, simply select a name from the monitor in the upper right corner of the screen. Information on the pilot will be displayed below his name, face and callsign.

Pilot abilities

Every pilot has four ability scores, and each of them has a range from 1–100, where 1 is the lowest score and 100 is the highest score. For Dogfighting, Bombing Accuracy and Flying Ability, the first number is the current state of the pilot, while the second number is the maximum ability score for that statistic.

A pilot's ability score can be increased above his maximum by training and successful missions. Ability scores can be temporarily decreased by the amount of Fatigue a pilot is suffering from. All the ability scores are described below:

Dogfighting: This skill represents the level of applied BFM (Basic Fighter Maneuvers) and ACM (Air Combat Maneuvers) that a pilot can utilize in a combat environment. This includes overall situational awareness and having an "instinct" of what an enemy aircraft might do next.

Bombing Accuracy: The Bombing Accuracy ability represents the degree of skill a particular pilot has with for bombing both moving and stationary targets. In addition, this skill also represents the amount of intelligence the pilot has in recognizing enemy from allied targets and the precise point to release a bomb so that it will cause the most structural damage on a building, bridge, etc.

Flying Ability: Flying Ability differs from the Dogfighting skill because the former is represented by non-dogfight flying accuracy only. Avoiding radar and SAMs, flying at high speeds at low altitudes, flying close over rolling landscape, etc. fall under the Flying Ability rating. A pilot with high Flying Ability will understand the proper way to fly into a target area just under the radar or fool radar using radar-avoidance tactics.

Fatigue: The Fatigue skill represents the amount of physical and emotional stress/endurance a pilot can endure. The lower the Fatigue ability, the less effective he will be in performing his combat duties. Degradation of the Fatigue ability is based directly on how many sorties an individual pilot has flown. Each time a pilot flies on a mission, his Fatigue skill goes down. However, if a pilot sits out a possible mission, he will regain Fatigue points due to rest.

When the Fatigue skill decreases, the other skills decrease as well. This simulates how repeated exposure to combat is draining on a pilot's faculties.

Number of sorties flown

This is the number of sorties (missions) flown by that pilot.

Enemy aircraft shot down

This number indicates how many confirmed kills that pilot has accumulated. Every aircraft in the game has been put into a category which can be found in the Technical Specifications portion of **Section XV: Reference**. These categories are described in brief below:

Class A Fighters: Fighter aircraft that are equal or above equal to an F-16 in capability. Examples: Su-27, MiG-29 and Mirage F1.

Class B Fighters: Fighter aircraft that are below an F-16 in capability. Examples: MiG-21, MiG-23 and Mirage III.

Striker/Bombers: Strike aircraft or pure bombers. Examples: Tu-22 and Su-24.

Close Air/Attack Aircraft: Close Air Support (CAS) or Fighter/Attack aircraft. Examples: Su-25 and Tornado.

Helicopters: Military attack or reconnaissance helicopters. Examples: Mi-24 and SA 342.

Transports/AWACS: Transport/cargo aircraft or AWACS search aircraft. Examples: IL-76 and AN-12.

Ground targets destroyed

This is the number of ground targets that pilot has destroyed. The four categories indicates the degree of difficulty it takes to destroy that target. These categories are discussed below:

Class A Target: A target that requires pinpoint bombing or that may shoot back. Examples: bunkers and SAM sites.

Class B Target: A hard target that requires a heavy bomb load to destroy. Examples: runways and bridges.

Class C Target: A target that requires a medium-sized bomb or missile to destroy. Examples: medium-sized buildings and tanks.

Class D Target: A soft target that can be destroyed with a cluster bomb or small iron bombs. Examples: infantry, jeeps and trucks.

Button selections

Following are the buttons on the right side of the Pilot Information screen:

Pilot roster: To view the statistics of a particular pilot, highlight the pilot's name on the video monitor.

Name: Use this button to change the name of the currently selected pilot. A name can be up to 12 letters long.

Callsign: Use this button to change the callsign of the current pilot. A callsign can be up to 15 letters long. Any radio messages you receive from this pilot in combat will use the callsign rather than the name.

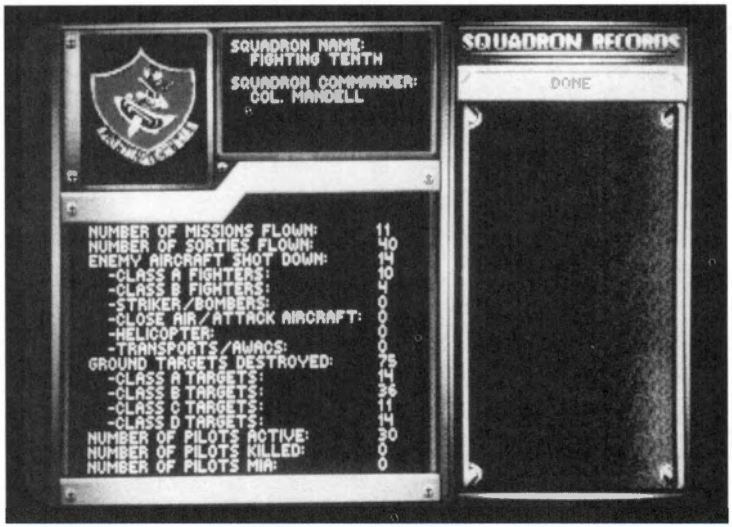
Change Face: Use this button to cycle through the available faces for the current pilot.

Awards: This button will change the left side of the screen to display any awards the pilot has received. Awards are given to deserving pilots who have excelled in combat. To redisplay the pilot information, select the Information button (which replaced the Awards button in the menu).

Done: Select this button when you are ready to return to the Squadron Ready Room.

Squadron Records

To look at your squadron's statistics, select the small whiteboard on the upper right side of the room. The Squadron Records board contains most of the same information as the Pilot Information screen, but on a a squadron level.



The left-hand side of the screen displays the squadron's insignia, name and Squadron Commander. Just below these are the combined records of all the pilots in that squadron. These are listed (in brief) below:

Number of missions flown

This is the number of missions run by that squadron. It will include all theaters the squadron has ever taken part in. This number, however, will never exceed the sortie count. One mission may have more than one aircraft flying; each aircraft is counted towards the sortie count. For example, if a mission has eight aircraft on it, there will be eight sorties on that one mission.

Number of sorties flown

This is the combined number of sorties flown by all the pilots in that squadron.

Enemy aircraft shot down

This number totals all the enemy aircraft downed by the pilots in that squadron. Each of the enemy aircraft categories is described in the Pilot Information section.

Ground targets destroyed

This number totals all the ground targets destroyed by the pilots in that squadron. Each of the ground target categories is described in the Pilot Information section.

Number of pilots active

When a squadron is formed, you will have 30 pilots on your roster. You may lose some due to casualties or fatigue. You can regain pilots when replacements arrive in a campaign. This number indicates how many are ready for active duty.

Number of pilots killed

This indicates the number of pilots killed in action (KIA), whether by enemy gunfire or pilot error.

Number of pilots MIA

This indicates the number of pilots missing in action (MIA). A pilot becomes MIA after ejecting behind enemy lines and not being rescued.

Pilot Transfer

To transfer a pilot from one squadron to another or to select him for Communications mode (described in the **Release Notes and Communications Handbook**), select the file cabinet. This brings you to the Pilot Transfer screen.

The left-hand side of this screen displays one of the other squadrons in the game, while the monitor on the right-hand side displays the pilots in your squadron. To transfer a pilot from your squadron to the other squadron, first select a name from the monitor on the right. Then select a name from the list on the left-hand side. The two names will then change places.

Pilot roster: The pilots in the monitor on the right-hand side are the pilots in *your* squadron.

Squadron: This button will change the squadron on the left-hand side to another of the squadrons in the game. If you haven't created any other squadrons, this button will be grayed out.

Pilot Information: You need to select a pilot from your squadron before choosing this button. Selecting this button will bring you to the Pilot Information screen described earlier. The only difference is that when you select Done from that screen, you will return to the Pilot Transfer screen.

Comms.: Before selecting this button, you need to choose a pilot from your roster. This is the pilot you will bringing into the communications part of *Falcon 3.0*. After you select this button, you will be transferred to the Communications Setup screen to set up your communications session. See the **Release Notes and Communications Handbook** for more details on communications.

Done: This button will return you to the Squadron Ready Room.

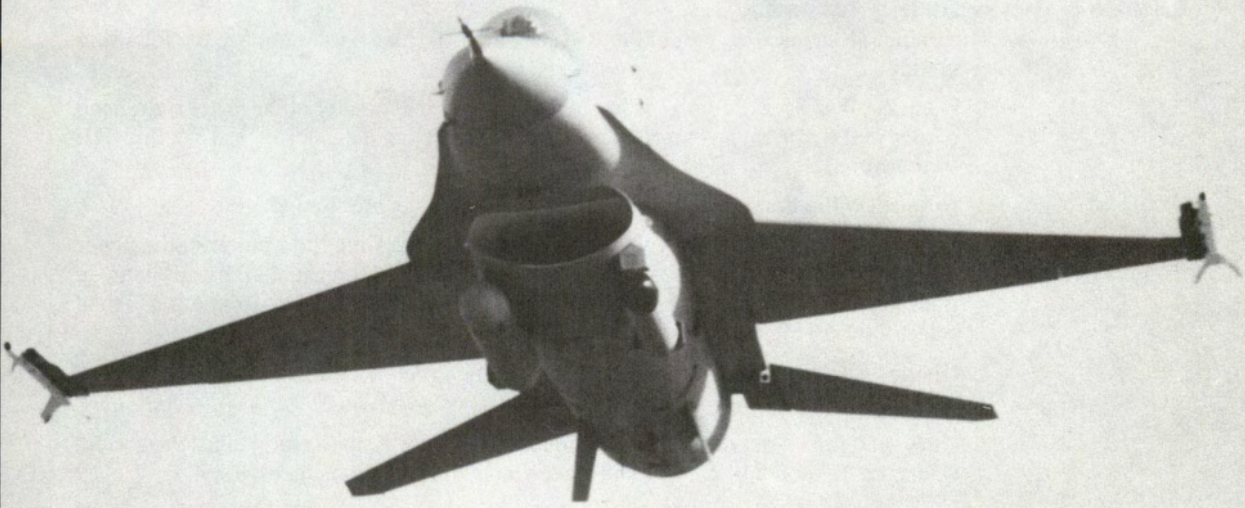
War Room

Select the phone on the file cabinet to return to the War Room.

SECTION

V

AIR COMBAT SCHOOL



Air Combat School introduction

Welcome to Air Combat School. Here, you'll learn everything you ever wanted to know about your F-16 Fighting Falcon. Each lesson is designed to teach you one or two key aspects of flying or fighting. Once you've finished your training, you'll have the knowledge and experience to mix it up with the best of them. Even if you already know how to fly, these lessons will teach you important specifics to survive in a combat environment.

There are a couple of things to remember before we begin:

1. *Work through the lessons by the numbers.*

Each lesson has been planned to take advantage of items learned in previous lessons. This way, you can build on your knowledge without getting confused or lost. When learning a lesson, keep working on it until you are successful, and then proceed to the next lesson.

2. *Always fly these lessons in Intermediate skill level.*

To change your skill level to Intermediate, you'll need to go to the Configuration area. This will ensure that your F-16's instrumentation will operate as described in the lessons.

1. From the War Room, select the first monitor on the left at the bottom of the screen.
2. When the Difficulty Levels screen appears, choose "Intermediate" from the Skill Level heading on the left-hand side of the screen.
3. When that light illuminates, choose "Done" from the upper right-hand corner of the screen.

For more information on the Configuration area, see **Section IX: Configuration**.

Loading the training lessons

The training lessons are a part of the Red Flag area. To load a mission, use the following procedure:

1. From the War Room, choose a squadron to fly from the monitor in the lower right-hand corner of the screen. For more information on selecting a squadron, see **Section III: War Room**.
2. Now select the first monitor to the left of the phone to enter Red Flag.
3. On the next screen, choose your training lesson by scrolling the window in the upper right-hand corner of the screen. Once you've highlighted the name of the mission you want to run (e.g., LESSON1, LESSON2, etc.), select the Load Mission button. Then, select the F-16 Pilots button.
4. Hit the Enter key to pass through the F-16 Pilots screen. This will bring you to the F-16 Armament screen.
5. Now, read the lesson description in the manual. When you are ready to try the lesson, select the Takeoff button. This will place you in the cockpit of your F-16.
6. After the mission is over, select the Red Flag Control button from the Debriefing screen to bring you back to the Red Flag Control screen.

Training lesson breakdown

Following is a description of the various missions in this section:

Lesson 1: Takeoff and Flight. This lesson teaches you how to takeoff and the basics of flying your F-16.

Lesson 2: Head-Up Display and G Forces. Here, you learn the basic features of the Head-Up Display (HUD). You'll also learn about positive and negative G forces.

Lesson 3: View Manipulation. All the outside and inside views (except Padlock View) are described and taught here.

Lesson 4: Landing. This covers how to land using the Instrument Landing System (ILS), its corresponding HUD mode and how to use the Angle of Attack (AOA) System.

Review 1: Takeoff–Landing. This review covers the first four lessons, from takeoff to landing.

Lesson 5: Weapons Selection and Situation Awareness Mode (SAM) Radar. This lesson teaches the basics of weapon selection and firing as well as a basic knowledge of the Radar/Electro-Optical (REO) display.

Lesson 6: Air-to-Air Weapons Delivery. This lesson instructs you on how to read your air-to-air HUD modes and how to fire your weapons effectively.

Lesson 7: Air-to-Ground Weapons Delivery. Similar to Lesson 6, this lesson teaches how to use all the air-to-ground weapons by describing the A-G HUD modes.

Lesson 8: Padlock View. This is an entire lesson on how to use the 360° Padlock View. You will learn how to read all the displays and control your aircraft to gain a superior position on your enemy.

Review 2: A-A/A-G Engagement. This complete mission covers all of Lessons 1–8: takeoff, air-to-air dogfight against a variety of enemy aircraft, air-to-ground destruction of a nuclear power plant and landing at your home airfield.

General briefing

So, you want to learn how to fly? Everything you need to know comes from me. The name's Mike Barstow, and I'm your instructor for these sessions. You can call me Mike or by my handle, "Threepoint." I'll explain that one later. Listen to me, and you'll do fine. Don't listen and your bird may get foxtrot uniform in the sky, if you know what I mean.

There are a couple of things you need to know before you grab the stick and go hog wild. First of all, be gentle with the plane. She doesn't require much prodding to do what you want, so there's no need to go slamming your stick back and forth when making a turn. Ease into it. Second and most important is listen carefully to what I say. Hey, it may sound obvious, but the easiest way to learn is through me. I'm not going to steer you wrong, so you don't have to worry.

Anyway, enough of all that. Got your equipment ready? Helmet? Skull cap? G suit? Parachute? Ok, let's go.

Overview: Lessons 1–4

These first four lessons are designed with the novice in mind. Even you hotshots out there that don't think you need this stuff should go through these. Why, you ask? Because every jet handles differently, and the F-16A is no exception.

Lessons 1–4 will teach you all the fundamentals of the F-16: how to read the instruments, the head-up display (HUD), controlling your bird's flight, all the different views, and last but not least, the two most important parts of flight, takeoff and landing. After these lessons are finished, you'll be able to do all these things and more.

Lesson 1: Takeoff and Flight

One of the most dangerous activities in today's modern fighter jet is the takeoff. It appears so easy that it lures inexperienced pilots into a false sense of security. Don't let that scare you — if you've got the proper training (like I'm going to give you), takeoffs will be almost automatic. Just let ol' Mike guide you through it. No problems.

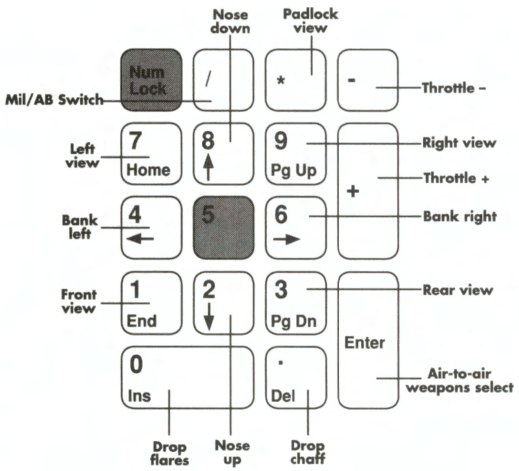
This lesson will cover how to use your plane's directional control (the "stick"), throttle and afterburners, autopilot and a couple other features. So go ahead, hit the Takeoff button so we can begin.

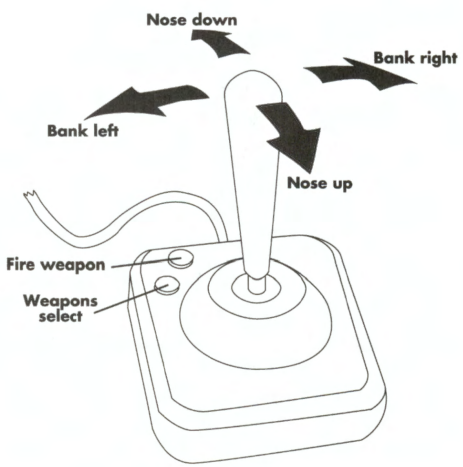
Before you begin

The first thing you'll see is the front view out of your cockpit. Don't be overwhelmed by the ton of dials and stuff in front of you. We'll get to it all in due time. The first two things you want to concentrate on are the directional control and the throttle.

The stick

The directional controller in your F-16 is simply called the "stick." You use it for controlling the plane's pitch and roll (up, down, left and right movements). It's the single most important piece of equipment on your plane, because without it, you can't fly.





For the sake of simplicity, I'm going to assume you're using a keyboard or a joystick for flying around. If you have a different type of controller (two joysticks or a ThrustMaster), check **Section VIII: Flight** for complete flying instructions. The keyboard and joystick controls are fairly simple (see diagram on previous page).

When you get in the air, don't be yanking around on the stick. It doesn't require much effort to turn your bird, so be gentle.

Climbing and diving

Pulling back on the stick makes your plane climb (gain altitude), while pushing the stick forward makes your plane dive (nose toward the ground).

Banking left and right

If you push the stick to the left or right, you begin a gradual turn. To increase the speed of your turn, push the stick to one side or another while pulling back on the stick.

RPM Indicator and throttle control

The first dial you will have to know about is the RPM Indicator. You can find it at the far right of the cockpit. Currently it is at 0, meaning you haven't started the engine yet. You can increase your RPMs by pressing the [+] key and decrease them by pressing the [-] key. The maximum amount of throttle you should apply without releasing the wheel brakes is about 60%.

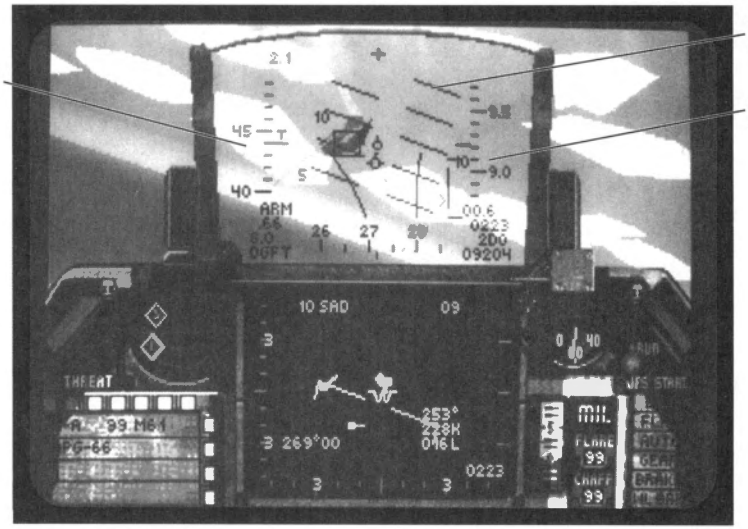
In addition to your standard thrust (known as Mil Power), you also have a five-stage afterburner for extra acceleration. To engage the afterburner, press the [/] key. (Note the indicator just below the RPM Indicator changes from "MIL" to "AB".) To increase the afterburner stages (and thus increase your speed), press [>]. To decrease a stage, press [<]. Since the afterburner uses a ton of fuel, you should generally only use it for takeoffs and to outrun the enemy.

Takeoff

Now that you're familiar with the stick and throttle controls, it's time to take off. First off, check out the upper middle screen with the green letters and numbers. This is your Head-Up Display, better known as the HUD. The HUD shows you all the necessary information about your F-16 and its weapons. For takeoff, we're only interested in three of the items — the rest will be covered in the next lesson.

The Head-Up Display

Look to the left side of the HUD. This is the Airspeed Scale, and it tells you how fast your aircraft is going. In the middle of the HUD is a series of horizontal bars called the Pitch Ladder. This shows you your current angle of climb (or dive). On the far right side of the HUD is the Altitude Scale which shows your current altitude in thousands of feet.



Start 'er up

Go ahead and engage the engine by pressing and holding the [+] key until the indicator reaches about 60%. Now kick in the afterburners [/] and watch the Airspeed Scale. Just after it reaches 15 (150 knots), ease the stick back gently to about 10° on the Pitch Ladder. Don't let your speed go beyond 20 (200 knots), or you'll burn your tires clean off.

Landing gear

Right after you get in the air, be sure to raise your landing gear by pressing the [G] key. Flying around with your landing gear up at speeds over 300 knots will cause permanent damage to your aircraft as well as hamper your maneuverability in the air. You can tell that your gear has been raised because the Wheel Status Light will go out on the right side of the cockpit and all lights will go out on your AR/NWS (Air Refuel/Nose Wheel Steering System) Light just to the right of the HUD.

Now that you've raised your gear, look at the Pitch Ladder. Keep it at 20°–30° until your Altitude Scale reaches 8.0 (8,000 feet). Now, level off by pushing forward on the stick until the Pitch Ladder is at 0°, and then turn off your afterburner by pressing [/]. Congrats, you're in the air!

Fly around

Now that you're up in the sky, fly around a bit to get used to your plane. Make nice, gentle movements on the stick, and keep an eye on your Altitude Scale. If it drops below 2,000 feet, level out and then gain a little more altitude.

Pause key

If you think your plane is going out of control or you accidentally hit some unfamiliar key, you can press [P] to pause your aircraft in mid-flight. Now you can stop, take a breather, and figure out where you are or what you just did. When you are ready to continue flying, just press [P] again.

Speed brakes and flaps

If you want to temporarily reduce speed without reducing the amount of thrust on your engine, you can toggle the speed brakes on or off with the [B] key. You can use your flaps ([F]) to help slow you down when landing. However, make sure you don't lower your flaps at speeds over 400 kts, or you'll shear them right off. Keep flying around until you feel comfortable with the controls, and then we'll talk about the autopilot.

Autopilot

The computerized autopilot is used in a number of ways, but is primarily designed so that you can follow your pre-designed route in and out of your mission area. It will also follow enemy planes in an attempt to get behind them in a dogfight.

To engage the autopilot, press the [A] key. You can now watch as the plane will level, fly to a point north of your airbase, then return to land. Before the plane returns to your home airfield, press the [\] key. This will bring up the HUD mode for the Instrument Landing System (ILS). Watch the horizontal and vertical bars as they line up in a cross. I'll give you all the details about the ILS HUD in Lesson 4, when I teach you how to land.

Accelerated mode

When you're in autopilot, you can hold down the [Tab] key to speed up your flight. The accelerated mode will increase actions in the outside world by a factor of 4x. You can also lock accelerated mode by pressing [Shift][Tab]. Don't try accelerated mode unless you're in autopilot, or you'll smack into the ground so fast it'll make your head swim.

On the ground

Once you've landed and your plane has come to a stop, engage the wheel brakes by pressing the [W] key. You always need to set the wheel brakes when you stop on the runway. Now, activate the menu bar by pressing [Esc], and select End Mission from the FILE menu. You've just completed your first lesso, and are well on your way to becoming "ace of the base."

Lesson 1 review:

In this lesson, you learned the following:

- Stick controls
- Throttle and afterburner controls
- Wheel brakes
- Raising the landing gear
- Pause key
- Speed brakes and flaps
- HUD basics: Airspeed Scale, Pitch Ladder and Altitude Scale
- Autopilot
- Accelerated mode
- Menu Bar (End Mission)

Next lesson, you'll learn everything you ever wanted to know about your HUD, and then some.

Lesson 2: The Head-Up Display (HUD)

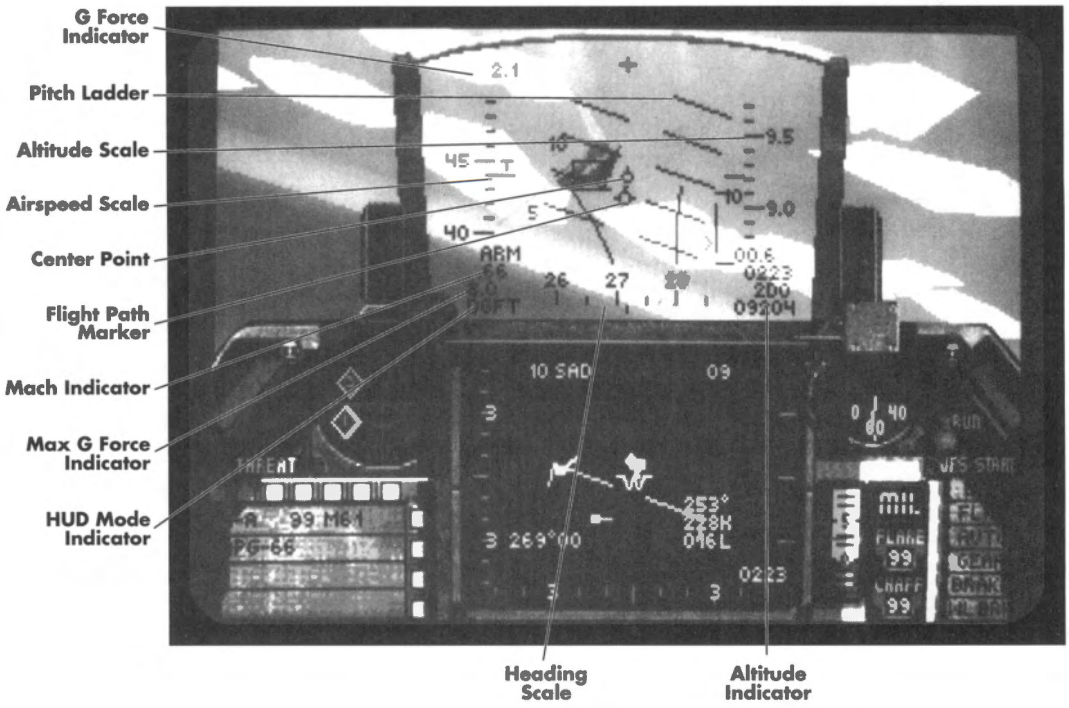
Your HUD is the most important instrument in your plane (actually, it's a combination of instruments all wrapped up in one) and is essential to flying. It contains vital information relating to your F-16's airspeed, altitude, heading and weapons information. If your HUD gets knocked out in combat, you're up sierra creek without a paddle.

This short lesson will teach you all the basics about your HUD and how to toggle between different HUD modes. We'll talk about specifics HUD modes and how to use your weapons in Lessons 5–7.

Before you begin

You're going to start out with your plane on the runway. Don't worry about controlling the plane for now; simply prepare to put your plane in autopilot, and then watch the read-outs.

Below is a diagram of where everything on the HUD is. You should refer to this whenever necessary when I'm describing this stuff.



Takeoff

In this lesson, don't bother to take off manually. Instead put the plane in autopilot ([A]) and watch the HUD. You learned about your Airspeed Scale, Pitch Ladder and Altitude Scale in the previous lesson, but let's go over them once again.

Airspeed Scale

Located on the far left-hand side of the HUD, the Airspeed Scale measures your plane's current true airspeed (TAS) in knots. You can read this scale by looking at the hash mark with the "T" above it. True airspeed is adjusted for error based on altitude and air density.

Altitude Scale

The Altitude Scale is located on the far right-hand side of the HUD. It measures your current altitude *above sea level* in thousands of feet. The hash mark in the middle of the scale is where you should read your altitude.

Pitch Ladder

The Pitch Ladder (the horizontal bars in the center of your HUD) shows your current degree of climb or dive. If you are climbing, these bars will be solid. If you are diving, these bars will be dashed.

Major HUD features

In addition to the Airspeed Scale, Altitude Scale and Pitch Ladder, there are a number of other features of the F-16's HUD. I won't explain every little feature, because some of them relate only to specific HUD modes. I'll talk about those in later lessons.

Don't worry about memorizing all these instruments at once; just familiarize yourself with them for now.

Heading Scale

This scale shows your F-16's heading. The Heading Scale will be along the bottom of all air-to-air HUD modes and at the top of all air-to-ground HUD modes. In this scale, 0° is north, 90° is east, 180° is south and 270° is west. You read the current heading by looking at the hash mark in the lower middle of the Heading Scale.

You'll also notice a small upside-down "v" moving around the bottom of the scale. That's the Waypoint Caret and shows you the direction of the next "waypoint" on your flight route. When you plan out a mission, each point where you change direction or where you plan to take an action is called a waypoint.

Flight Path Marker

The Flight Path Marker is used to show changes in your flight direction. When you pull back on the stick, the Flight Path Marker will move to show you which direction you are heading. If you let go of the stick, the Flight Path Marker will slowly drift back to the center of the HUD.

Center Point

The Center Point is located in the exact middle of most HUD modes and is used with the Flight Path Marker as a reference for which direction your plane's nose is pointing. If you are not moving the stick, the Flight Path Marker will be positioned directly over the Center Point.

HUD Mode Indicator

This display is located as the last line in the lower left-hand corner of the HUD. It's used to show which weapon system (and corresponding HUD mode) is currently selected on your aircraft. We'll discuss this in depth when we talk about specific HUD modes in later lessons.

G Force Indicator

The G Force Indicator (located just above the Airspeed Scale) measures the current amount of Gs your plane is currently pulling. Gs are the amount of gravity acting on you and your plane at any one time. At 9 Gs, blood flows away from your head and you begin to blackout. In addition, if you do -3 Gs (nosing your plane down, for example) too much blood flows to your head and you will begin to redout. Basically, if you start to blackout or redout, ease off the stick until your vision comes back in focus. More info on blackouts and redouts is in **Section XI: Aerodynamics and G Forces**.

Max G Force Indicator

You can find this display in the lower left-hand corner of the HUD, just above the Weapon Indicator (the second line from the bottom). This shows the maximum amount of Gs you have pulled since you stepped into the aircraft.

Mach Indicator

This display (the third line from the bottom in the lower left-hand corner) shows your airspeed as a percentage of the speed of sound. The speed of sound is Mach 1.0.

Altitude Indicator

The bottom number in the lower right-hand corner of the HUD displays your current altitude *above ground level* (AGL). This differs from the Altitude Scale, because the Altitude Indicator shows altitude above your current terrain, while the Altitude Scale shows altitude *above sea level.*

Cruising around

When the plane levels off at 14,000 feet, take your plane off autopilot (with the [A] key). Kick in your afterburners ([/]) and increase the staging (hit the [>] key twice) so that the display below the RPM Indicator reads "AB3." This is a good time for your first lesson in G forces.

Positive and negative Gs

I hate negative Gs. All pilots hate negative Gs. You will learn to hate negative Gs. Negative Gs are the most uncomfortable thing a pilot can experience because you get a feeling like your stomach is flying up through your mouth. Also, the pressure on your head feels like an 800-pound gorilla is giving you a headlock. Let's go ahead and push some negative Gs, so you can see what it feels like and not do it again, ok?

Right now, you're probably flying at about 630 knots (kts). Now push the nose down. See that! You start to redout almost immediately. This is G Force Lesson Number One: avoid negative Gs whenever possible. Let's try this experiment again, but this time we'll pull positive Gs to execute the same maneuver.

Level the plane out (either manually or by autopilot until the plane levels). Once level, turn off your autopilot if you had it engaged. Now, we'll execute the same dive, but pulling positive Gs instead of negative. Bank your plane to the left until the plane turns upside-down and then pull back on the stick. Dive down for a while and then bank to the right and pull

back on the stick until you level out. See how much easier that was? Not to mention that you are able to make the same maneuver in a shorter time. Your plane is three times more maneuverable in positive Gs than it is in negative Gs.

Landing

Ok, now that you've had your G force lesson, it's time to land. Just like you did in Lesson 1, turn on the ILS HUD mode (the \ key) and then engage the autopilot. After landing, turn on your wheel brakes (W). Now, go to the menu bar (Esc) and then select End Mission from the FILE menu. There you go.

Lesson 2 review:

In this lesson, you learned about the following items on the HUD:

- Heading Scale and Waypoint Caret
- HUD Mode Indicator
- G Force Indicator
- Max G Force Indicator
- Mach Indicator
- Altitude Indicator

In addition you learned the basics of G forces:

- Redout
- Blackout
- Positive and negative Gs

Next lesson, you'll learn about all the different inside and outside views. I'll also explain the best and worst times to use each of these views. Anyway, on to the next lesson.

Lesson 3: View Manipulation

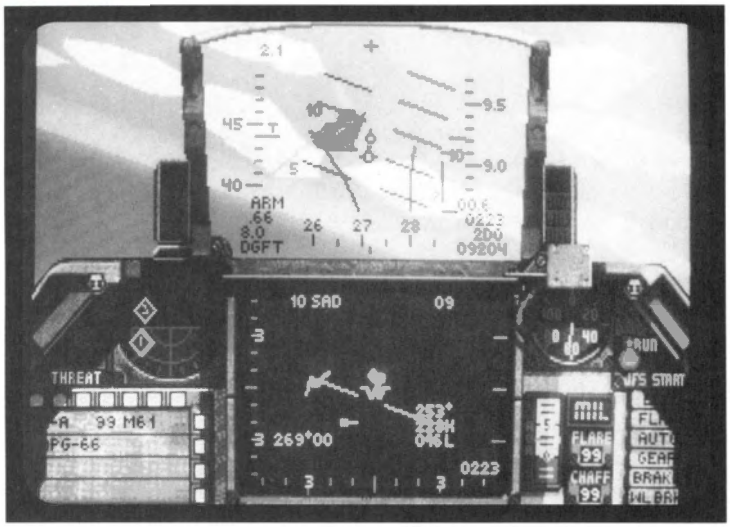
Ok, there are a number of different ways to see your F-16. Some of them take the perspective from inside the cockpit, while some look at your plane from the outside. There is also a view to see the path of your missile and another to watch that missile from your target's point of view. Finally, there is a view that you can use to watch your wingman's actions.

In this lesson I'm going to teach you when to use certain views to your best advantage in both combat and non-combat situations. And, yes, there are times that you absolutely shouldn't use a particular view. I'll talk about those as well.

In the plane

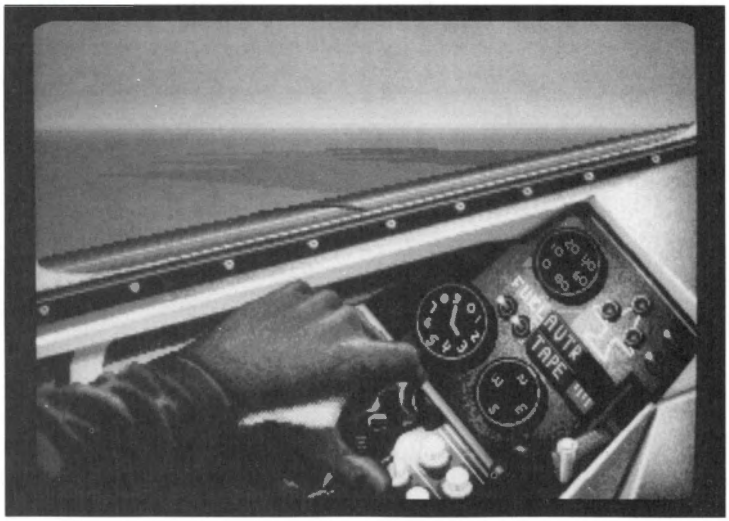
Here you are, back in your plane on the runway. Before you take off, let's take a look through your inside views and I'll tell you what you are seeing.

Front View



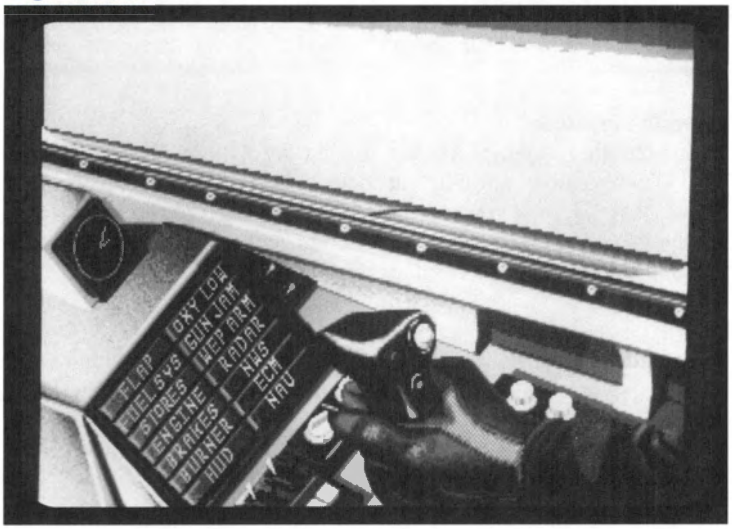
This is the old, familiar view from the last two lessons. It's the most useful of the views because it contains a number of vital instruments including the HUD, Radar and Threat Warning Indicator. You can press [3] (or [1] on the numeric keypad) to look out the Front View.

Left View



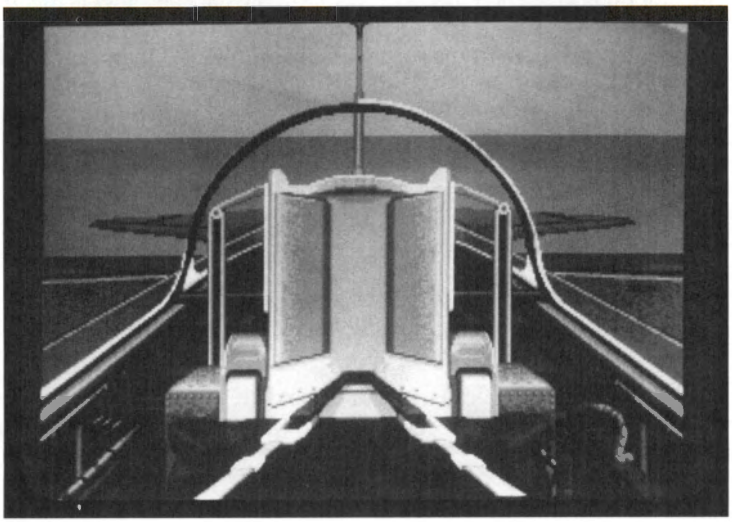
Press the [4] key (or [7] on the numeric keypad) to look out the left side of your cockpit. The Left View gives you access to a number of instruments, including the Fuel Indicator, Landing Gear Lights, AVTR Status Light and Tape Indicator, IFF Light, Backup Airspeed Indicator and the Compass. This view is useful for checking out these instruments, but isn't very good in combat situations.

Right View



Press the [6] key (or [9] on the numeric keypad) to look out the right side of your cockpit. Here you'll see a clock displaying the current mission time and your Caution Light Panel. The caution lights are used to indicate damage to your plane. If you hear a frantic high-pitched tone or a warning voice, you better look here to find out what's wrong. As with the Left View, this view isn't good in combat.

Rear View



This doesn't show you any instruments, but it's useful to look out for enemy planes that might be sneaking up on you. You can also use it for checking up on your wingmen. Press [5] (or [3] on the numeric keypad) to look behind you.

Up View

This simulates you looking straight up from your chair. It's somewhat useful if you are inverted or when you're in air combat and observing an enemy plane. Press the [U] key to look up.

Cockpit scrolling

If you press the [Scroll Lock] key when using any of the inside views (except the Up View), you will look either up or down in that cockpit view. Change to the Front View (the [3] key) and press the [Scroll Lock] key. See how it works? Each of the inside views has independent scrolling, so you can choose to look up or down. This scrolling feature makes the inside views more useful for air combat.

Outside views

Most of the outside views are fun to fly in but are extremely poor for combat. If it's a combat situation, switch back to Front View, Track View or Padlock View. I'll explain Padlock View in Lesson 8.

Just to let you know, all the outside view keys can be found on the top row of the keyboard.

Track View

The first major outside view is Track View. Right now you'll see a fixed view from a camera directly behind your aircraft. If your plane rolls, the camera will roll with you. When you get in combat, you'll see your plane and any plane you've locked onto (including your wingman). This makes it really easy to track an opponent. Switch to this view now by pressing the [9] key.

View Status Box

The first thing you'll notice about any one of the outside views is that box at the bottom of the screen. This is the View Status Box, and it shows you current info about your view. Everything's pretty self-explanatory except the "Zoom" Indicator. Let's go over this now.

Zoom keys

When you're in an outside view, you can zoom in and out on your bird to see it from closer or farther away. Press [F1] to zoom in and [F2] to zoom out. Notice that when you press these keys, the Zoom Indicator will increase or decrease. The max zoom level is 15 and the minimum is 1. Go ahead and set it up for zoom level 5.

Rotate keys

In any of the outside views, you can rotate around your plane horizontally or vertically. Rotate clockwise by pressing and holding the [F3] key. If you want to go back the other way (counter-clockwise), hold the [F4] key down.

To circle your plane vertically, press and hold the [Shift] and [F3] keys down together. If you want to rotate the other direction, hold down the [Shift] and [F4] keys together.

Finally, if you want a finer rotation on your views, hold down the [Ctrl] key with any of the above combinations.

If you got lost or if you're looking at your plane at a really weird angle, hit the [3] key to get back to the Front View. Then select whatever outside view you want.

Takeoff

Well, after all that you're ready to take off. From the Track View, pan around your aircraft, so you are looking at its side. Now, go ahead and use your autopilot ([A]) for takeoff. This way, you get a great view of your bird as it streaks off the runway.

Once the plane levels off (at about 10,000 feet), take your plane off autopilot ([A]) and we'll start up on some of the other outside views.

Satellite and Ground Views

These two views are almost identical. The Satellite View ([1]) looks at your plane from directly overhead, while the Ground View ([2]) checks out your plane from directly below. You can also use the Rotate and Zoom keys on these views to see your plane from various angles. By the way, in case you didn't figure it out already, these two views are really lousy in combat.

Wingman View

In case you haven't noticed, you've got a wingman on this flight. If you go to the Track View, you can pan around and see him. (He'll probably be right behind you.) If you want to take a look at things from his perspective, hit the [7] key. Now you can rotate around him and watch your own plane.

Rotate around in this view until you are looking at your own plane. Now, roll out and watch what happens. Your wingie will lag behind a bit, then follow your plane. Hit [A] to go back to autopilot.

The best time to use Wingman View is just before a combat situation when you are sending him out to execute a particular maneuver. For more information on executing maneuvers with your wingman, see the Tactics part of **Section XII: Advanced Fighter Tactics**.

Chase View

(By the way, this is one of my faves.) Hitting the [0] (zero) key brings up the Chase View. This gives you the angle from directly behind your plane like in Track View, but watch what happens if you nose your bird down.

Take your plane off autopilot ([A]) then go ahead and push down on the stick. There will be a slight lag, then the view will follow your plane. Fly around a bit and watch the results. This is a great view when flying around, but just like most of the outside views, it's really crummy to dogfight in.

Missile, Enemy and Target Views

These three views are used only when you're shooting at someone or something. The [Q] key toggles between these views, and you can use the Rotate and Zoom keys on these views.

The Missile View follows the path of a fired missile, while the Enemy View shows you the point of view from a targeted enemy plane or ground target. The Target View is behind air-to-air targets; see **Section VIII: Flight** for more details on all these views.

Padlock View

This view will be covered in depth in Lesson 8, but I'll go into briefly here. Basically, what you've got is a 360° inside-the-cockpit view. Here, you can padlock (keep your eyes fixed) on your enemy at all times. As an enemy plane shoots past your F-16, your eyes will never leave that plane. With this view, you have a much better chance of defeating your enemy.

You can hit [8] (or [*] on the numeric keypad) to see the Padlock View. There won't be anything there right now except your wingman, but you can see how it works.

Landing

Ok, now go back to the Track View ([9]) and hit [A] to have your bird finish its route and land. Set your wheel brakes and then go ahead and End Mission like you did in the previous two lessons.

Lesson 3 review:

In this lesson, you learned about the following inside views:

- Front View
- Left View
- Right View
- Rear View
- Up View
- Cockpit scrolling

You also learned about outside views:

- View Status Box
- Track View
- Satellite and Ground Views
- Wingman View
- Chase View
- Missile, Enemy and Target Views

Finally, you learned how to manipulate your outside views:

- Rotate keys
- Zoom keys

In the last lesson of this section, you will finally learn how to land. You've seen it on autopilot, now live the adventure!

Lesson 4: Landing

And you thought taking off was hard! A bad takeoff can end your trip real early, but you never live down the embarrassment of a crash landing. Don't worry, though: by the time you run through this lesson a few times, you'll be landing in your sleep.

This lesson will cover the "racetrack" method of landing — the ILS HUD mode, the angle of attack (AOA) system, using the rudder, and what should you do if you have to abort.

Before you begin

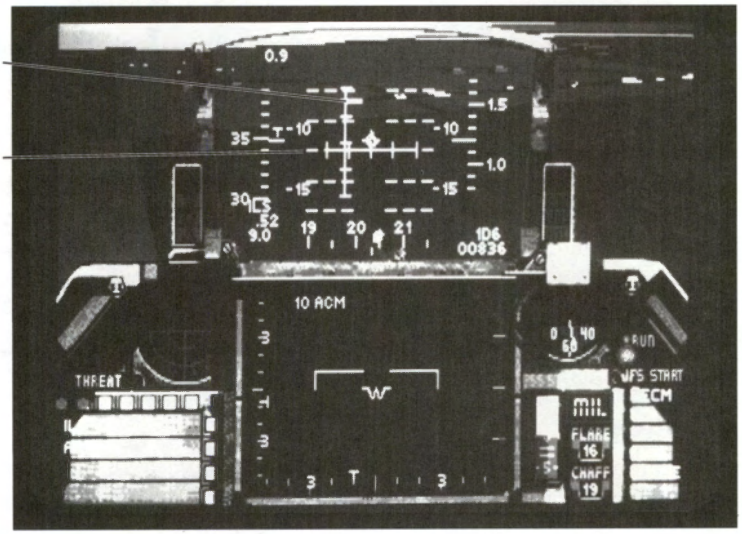
In order to land using your Instrument Landing System (ILS), you need to approach a runway that broadcasts ILS signals. At Nellis, there is only one airbase that is set up to broadcast ILS signals, but each campaign theater may have multiple airbases equipped with this system.

This is the first lesson that you're going to start out in the air. Don't worry, you've got a little "play" time before you have to worry about landing. Your plane is going to start due north of the runway at 8,000 feet, about eight or so miles out. Keep your hands off the controls for now, so I can explain a few things first.

The two main instruments designed to help you land are the ILS HUD mode and the AOA System. Both systems help you line up for that perfect approach angle.

Instrument Landing System (ILS) HUD mode

First thing you want to do before approaching your home airstrip is engage the ILS HUD mode. Do so now by pressing the [\] key; then press the [P] key to pause. Now the circle in your HUD will be replaced by notched horizontal and vertical bars. Your goal when landing is to align these bars so that they form a perfect cross. These two bars are the Glide Slope Deviation (GSD) Bar and the Localizer Deviation (LD) Bar.



LD Bar

The LD Bar measures your offset from the center of the runway. You want to align the vertical bar so that its center is in the middle of the HUD. If the LD Bar is to the right of center, you need to bank right. If it's to the left of center, you need to bank left.

GSD Bar

The GSD Bar measures your vertical angle to the runway. When the middle of the LD Bar is in the center of the HUD, you're approaching the runway at a proper angle. If the GSD Bar is above the center of the HUD, you are coming in too low. On the other hand, if it's below the center point, you're not low enough.

ILS HUD mode examples

Following are a couple of examples of what you might see when using your ILS HUD. First off, I'll give you the examples and then I'll explain how to correct the problem.

Angle of Attack (AOA) System

The AOA System consists of two indicators: the AOA Indexer and the AOA Indicator. Both indicators are used to display your aircraft's angle of attack. The main difference between the two is that the AOA Indexer shows it with a series of lights while the AOA Indicator uses a numerical scale. I'll go into the merits of both below.

AOA Indexer

The AOA Indexer is located just to the left of the HUD and basically illuminates one of three lights. These lights won't come on until you engage the ILS HUD mode. A perfect angle of attack/landing approach is when the center circle is lit.

If the top caret is on, it means that your AOA is too high because your airspeed is too low. To correct this, increase your airspeed by adding power or nosing your bird down or to a proper angle.

If the bottom caret is on, it means that your AOA is too low because your airspeed is too high. You should nose your plane up a little or use your speed brakes or flaps to bleed off airspeed until the center AOA light comes on.

AOA Indicator

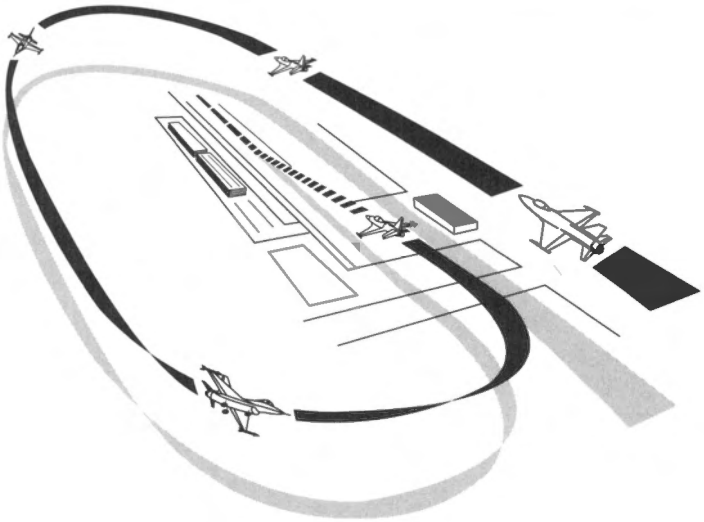
The AOA Indicator is located just to the right of the REO Display and immediately below the RPM Indicator. You can use this to judge your AOA for landing or when you are in combat. This indicator works in conjunction with the AOA Indexer to assist you in landing.

This indicator color-codes your AOA—light blue if you have a positive AOA, red if you have a negative AOA. A perfect AOA for landing is between positive 10–13°. If your AOA is above 13°, the top caret on the AOA Indexer will light up. If your AOA is below 10°, the bottom caret on the AOA Indexer will turn on.

Using all these things

You're probably saying to yourself, "Great, Mike, you've told us how these things work, but how do they **work?**" Don't worry, I'm getting to that.

Before you unpause the game to release your plane, make sure that you understand the concepts I explained above. If you read it again and still don't get it, you can either take a look at the landing portion of **Section VIII: Flight** or follow along with my walkthrough. Perhaps at the end of the lesson, you will get a better grasp of what I'm saying.



Heading

First off, you need to be facing your runway. It's important to note that your ILS HUD mode won't tell you if you are facing the wrong direction, so you need to know the direction of your runway. (For example, you could have the GSD and LD Scales lined up with perfect AOA, but you might be flying perpendicular to your runway.)

Take your aircraft off pause by pressing the [P] key and start to line up your bird with the approaching runway. In this lesson, you start out eight miles due north of the airfield, with a heading of due south. You can find out how far away you are from the runway by looking at the lower right-hand corner of the HUD. The Waypoint Indicator will show the number of miles to the next waypoint (which is your airfield) followed by the letter "D" and then a "2" representing the waypoint number. Also, take a look at the Waypoint Caret on the Heading Scale to help you align yourself to your airstrip.

Your landing approach heading should be somewhere around 180°. (Check the Heading Scale to see if that's true.) Don't worry about your AOA for now; just make sure you're facing that runway.

First runway approach

As you approach the airstrip, keep a close eye on the Waypoint Caret to make sure that you're heading the right direction. You'll also want to reduce your speed to about 400 kts and begin to descend at a rate of 1,000 feet/mile. Play around with the angle of descent until you feel comfortable with it, but it should be somewhere around -7°.

One key thing to remember is that most runways are aligned to the compass points, 0°, 90°, 180° and 270°. When you get within visual range of the end of a runway, you can see a number at the beginning of that runway. That's the angle you need to be heading for a straight approach (either 0, 9, 18 or 27 for the above four compass points).

Five miles to base

When you reach the five mile marker, you should be at about 5,000 feet. Now, you want to drop your airspeed to about 350 kts for your initial approach. Keep descending at 1,000 feet/mile until you reach about 2,000 feet.

Two miles to base

At the two mile marker, you should be somewhere around 2,000 feet altitude. It doesn't matter if you're a little high or low; just be sure to keep it at about 2,000 feet. You should get a visual sighting of the runway about now, so you're going to want to descend and line up parallel with the runway you want to land on.

Parallel the runway

Once you're lined up with the runway, you should be at about 400 feet or so above it. Keep this altitude as you fly over the runway. When you're past the runway, you want to start making a gentle 180° left turn and keep turning until you're flying back the way you came. You'll want to keep your airspeed at around 250 knots when you're making your turn.

Return approach

On this downward leg, you'll want to remain about 300–400 feet and about 250 knots. Now's the time to drop your landing gear ([G]). You'll notice that the top and bottom lights of your AR/NWS Status Indicator have lit up and your Wheel Status Light has turned on. Since

dropping the gear causes drag on your aircraft, increase throttle to keep your airspeed at about 250 kts.

Go ahead and check your Left View to see where the airstrip is. You should remain parallel to your runway at all times. Switch back to the Front View when you've aligned with the runway.

Second runway approach

When you get about two to three miles past the end of the runway, you'll want to make your second 180° turn to the left. If you keep the same angle of turn that you used in your first turn, you should be perfectly aligned when your 180 is finished. This should put you about a two or three miles away from the runway, lined up with it. Pause the game now and read on for a bit.

Angle of attack

Once you are heading the right direction, you're going to need to get those horizontal and vertical bars to form a cross. If they're not already, start to wrangle them into position. Only worry about one of the scales at a time. If your GSD Bar is below the center of the HUD, nose down. If it's above, pull up. Same goes for the LD Bar. If it's to the left of center, move left and vice versa.

While you're watching the ILS bars, keep an eye on the AOA system. Remember, it should be between 10°–13°. When you have a perfect AOA, the center light in the AOA Indexer will light up.

Airspeed

If you manage to get the two scales to form a cross but can't seem to get a perfect AOA, you are probably going in too fast or too slow. Check your AOA Indexer to see which of the two reasons it is. Adjust your airspeed so that you're coming in at about 250 kts.

Using the rudder

Once you get under 450 kts, you can use the rudder pedals on your F-16 to help fine tune your horizontal movement when lining up with the runway. Simply hold down the [[ ] key to apply left rudder or the [ ]] key to apply right rudder. This will slide your plane gently to one side or the other on your approach. Unpause the game now, and try to get your AOA aligned. Keep "riding the beam" as you approach the runway.

Aborting

This is where nerves come into play. If for some reason, you aren't approaching at the right angle or your AOA is incorrect, immediately abort your landing. Increase throttle to 80% and pull your nose up. You'll now have to wing around and follow the same procedure for another pass. Don't be too hard on yourself if you have to abort. Landing is tricky business, and requires a lot of practice.

Landing

Just before your plane touches down, make sure that your AOA is not less than 8° and your airspeed is between 160–190 kts, or else you'll be doing a nosedive into the runway. Try to aim for the beginning of the runway, so that you'll have a greater distance to stop your plane.

As soon as you touch down, reduce throttle and push the nose of your plane down so the nose wheel comes down on the runway. Immediately after the nose wheel touches the ground, engage your speed brakes and flaps until you come to a complete stop. Now go ahead and set your wheel brakes, so your bird won't roll off the runway. There you have it, a perfect landing! I didn't get the moniker "Threepoint" for nothing, you know.

In closing

This lesson, I set you up to start out almost perfectly lined up with the airfield. In the real world, you won't have that luxury. You need to remember those three ingredients (heading, AOA and airspeed) before you get ready to land. With time and practice, you'll know which instrument to view at any given time. All need to be monitored, but never all at once.

Lesson 4 review:

In this lesson, you learned the following things:

- Instrument Landing System (ILS) HUD mode
- Glide Slope Deviation (GSD) Scale
- Localizer Deviation (LD) Scale
- Angle of Attack (AOA) System
- AOA Indexer
- AOA Indicator
- Waypoint Indicator
- Rudder keys
- Landing approach

The final lesson in this section is a review of the first four. I'll give you some general guidelines, but mostly it'll all be up to you. Good luck.

Review 1: Takeoff–Landing

Now that you've flexed your bird's muscle and learned a few things about her, it's time to check that knowledge. I'm not going to teach you anything new in this lesson — it's going to be strictly review.

You're going to start out on your home runway, take off, circle around to the left, come in behind the runway and land the plane. Simple. I'll be around to help you out if you've got some problems, but I hand over the stick to you. And, we're off!

On the runway

Go ahead and power up to 60% and let 'er rip. Kick in the afterburners and pull up when you reach 160 kts or so.

Takeoff

Raise your landing gear and keep climbing at an angle of about 20°. Keep this angle until you reach 15,000 feet, then level off. When you get to 15,000 feet, turn off your AB.

Circle around

As I said in the intro, you're going to circle around to the left and make a landing heading due north (0°). You're going to want to head 270°, then turn to 180°, then veer to 90° before finally heading north again. I'll explain what to do below.

Change heading to 270°

Right now, your heading should be 0°. Bank left until your heading is 270°, then level off.

Change heading to 180°

Go ahead and fly for about a minute or so and then bank left until you come to a heading of 180°. Level off and continue flying.

Pass by the airfield

Keep flying straight and level; then take a look out the left side of your cockpit and watch as you pass by the airfield in the distance.

Change heading to 90°

After you fly by the airfield, keep flying for a minute or so. Now, bank left again until you come to a heading of 90°, then level off again.

Change heading to 0°

Locate your airfield by looking out the left side of the cockpit. Right before the airfield comes into the middle of your view, start to bank left until you are heading 0°. Now, level off.

Engage ILS and begin descent

Turn on your ILS and check how far away you are from base. Right now, you should be about 15 or so miles from your airfield. Remember, you want to be at 10,000 feet when you are 10 miles away, so begin your descent now until you achieve that height and distance. Also, power your bird down to 450 kts when you get there.

Approach (five miles)

Keep the ILS bars in a cross while you make your descent. When you approach five miles from base, slow down to about 270 kts and ease her in.

Approach (two miles)

Once you get within two miles, drop your airspeed to 250 kts and lower your landing gear. Use those rudder controls to fine tune your approach.

Pass over the runway

After you're aligned with the runway, pass over it and make the first of your two 180° turns. Parallel the runway and go about two miles out before starting your second 180° turn. Now, line 'er up and check your ILS bars.

Landing

Your AOA should be between 10°–13° now, but if it isn't, you may want to abort and repeat the procedure. Aim for the start of the runway and when you touch ground, nose the plane forward and reduce speed immediately. Open up the speed brakes and flaps to drop your airspeed. When you come to a stop, engage the wheel brakes and you're finished!

In conclusion

Well that's all. Now, if you want, you can keep running this review mission until you've perfected it or else practice takeoff or landing using Lesson 1 or 4. If you did this review perfectly, congratulations! You've now graduated to weapons school.

Overview: Lessons 5–8

Well, you made it through basic training. By now, you should have a general familiarity with cockpit controls and an overall view of the HUD. These next four lessons are based on concepts you learned in Lessons 1–4, so if you didn't understand something in those lessons, be sure to review them before continuing.

The following four lessons are to establish your combat readiness. We'll go over the standard radar (called Situation Awareness Mode, or SAM), how to read your Threat Warning Indicator to find enemy aircraft, how to select and fire your weapons, all the air-to-air and air-to-ground HUD modes and their operation, and how to use the Padlock View in an A-A combat environment. After you complete these lessons, you should be able to compete with the best of them.

Lesson 5: Weapon Selection and SAM Radar

Ok, hotshot! Now's the time for your real test. It's all well and good to fly about with no enemy in sight, but now you've got to prepare for combat. The first things you need to know before you get in the heat of battle are how to select and fire your weapons as well as how to find enemy aircraft and get their info from your radar scope. Once you master these, at least you'll be able to figure out where that bandit is coming from and maybe even shoot him down.

This lesson will teach you how to choose weapons from your Stores Control Panel and how to launch those weapons. In addition, you'll learn how to interpret your Threat Warning Indicator and how to read the standard mode of the Radar/Electro-Optical display (a.k.a. the REO, or simply the radar).

The type of radar you will be learning here is called Situation Awareness Mode (SAM) radar. SAM radar is the default radar setting of the "Intermediate" skill level. Situation Awareness Display (SAD) radar mode is fully described in **Section II: Instant Action**, while the High Fidelity Radar (HFR) mode is explained in **Section VIII: Flight**.

Before you begin

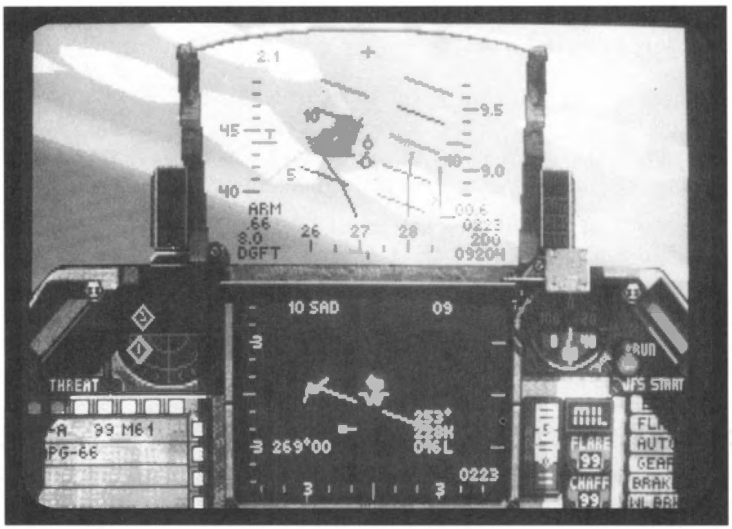
If you haven't done so already, click the Takeoff button now. When you get in the cockpit, pause the game and continue reading the lesson. After you've got some of the basics, I'll tell you when to begin flying around.

Weapon selection and firing

Before you get into a fierce knife fight, you need to know which weapons you have on board and how to fire them. Seems simple, right? Well, to the untrained eye, it can get really confusing. Just listen along for now while I go over it.

Stores Control Panel (SCP)

This display in the lower-left hand corner of your front cockpit is where you can view all the weapons you have on board your F-16. It'll tell you not only what you've got, but how many of each weapon you have left. You can read the SCP as follows:



The top line in the SCP shows what type of weapon is currently loaded, either "A-A" (air-to-air) or "A-G" (air-to-ground). Right after that is the amount and type of the current weapon loaded. The weapons you can see on the SCP may differ among aircraft, because you may select different weapons on different missions.

The second line reads "APG-66" and tells you that your radar is turned on. There may be times when you will want to turn your radar to standby to avoid detection by enemy radar and SAMs. That's discussed in **Section XII: Advanced Fighter Tactics**.

To find out the number and type of every weapon you have on board, you can hit the [V] key. Unpause the simulation, and keep pressing the [V] key until you have returned to the SCP's standard display.

Selecting a weapon

Your F-16 carries two basic types of weapons: air-to-air and air-to-ground. Air-to-air weapons include heat-seeking missiles, radar-guided missiles and guns. Air-to-ground arms include missiles, iron bombs, cluster bombs or guns.

To change to your A-G weapons, simply hit the [Backspace] key. Keep hitting the [Backspace] key to check out the remainder of your A-G stores. The weapon name will appear on the first line of your SCP. Also notice that the displays on the radar and HUD change each time you select a new weapon. I'll talk about the HUD more in Lesson 7.

You can select your A-A weapons by pressing the [Enter] key. Just as with the A-G weapons, keep hitting the [Enter] key to view your A-A stores. Toggle through your weapons systems until the words "4 AIM9M" appear in your SCP. This will select and arm your AIM-9M Sidewinder missiles.

Firing a weapon

I know it's a waste of a missile, but go ahead and launch one of your Sidewinders now by pressing the [Spacebar] key. If you're using a joystick, one of the buttons will launch the missile and the other one will toggle through your A-A stores.

Whether you are using an A-A or A-G weapon, the [Spacebar] key will always act as your trigger. Go ahead and pause the game again while I talk about target selection.

Changing targets

In a situation with multiple A-A or A-G targets, you can toggle through targets within radar range by pressing the [T] key. This Target Select Key will come in handy, because there may be times where your targeted aircraft is a lesser threat than another in the area. For example, you may be targeting on an AN-12 transport when there's a MiG-29 right at you!

This key works for ground targets as well. You might want to fire a Maverick at a tank, switch to another tank and launch a second missile all on your approach dive. Keep the Target Select Key in mind as I go into Lessons 6, 7 and 8.

Finding the enemy

Ok, now that you know how to select and fire your weapons, you need to be able to locate your foe. There are three devices you use to find out where an enemy plane is; the radar, the Threat Indicator and the HUD. You use the radar first to locate the enemy, and when he gets in range of your weapon, take a look at the HUD and Threat Indicator to see where he is heading. First, I'll talk about your Radar/Electro-Optical (REO) Display.

Radar/Electro-Optical (REO) Display

Directly below your HUD is the REO, simply known as the radar display. The radar is the primary device that you need to locate and lock on an enemy plane or ground target. For purposes of this lesson, I'm just going to talk about what the different numbers and such mean on your A-A radar. I'll discuss how to use specific weapon systems in Lessons 6 & 7.

Right now, your radar screen will be pretty much blank, save for a couple of numbers at the top. Unpause the simulation now and keep an eye on your radar. When a light green blip appears on your display, press [P] to pause again.

Viewing the radar

First, let's go over some basics. In Situation Awareness Mode (SAM), your plane is assumed to be at the bottom of the radar screen pointing "up." The green square is an enemy plane. As enemy aircraft close in on your position, they will be coming from the top of the radar screen down to the bottom. When you have achieved a radar lock on the enemy aircraft, the square will turn into a diamond.

Radar ranges

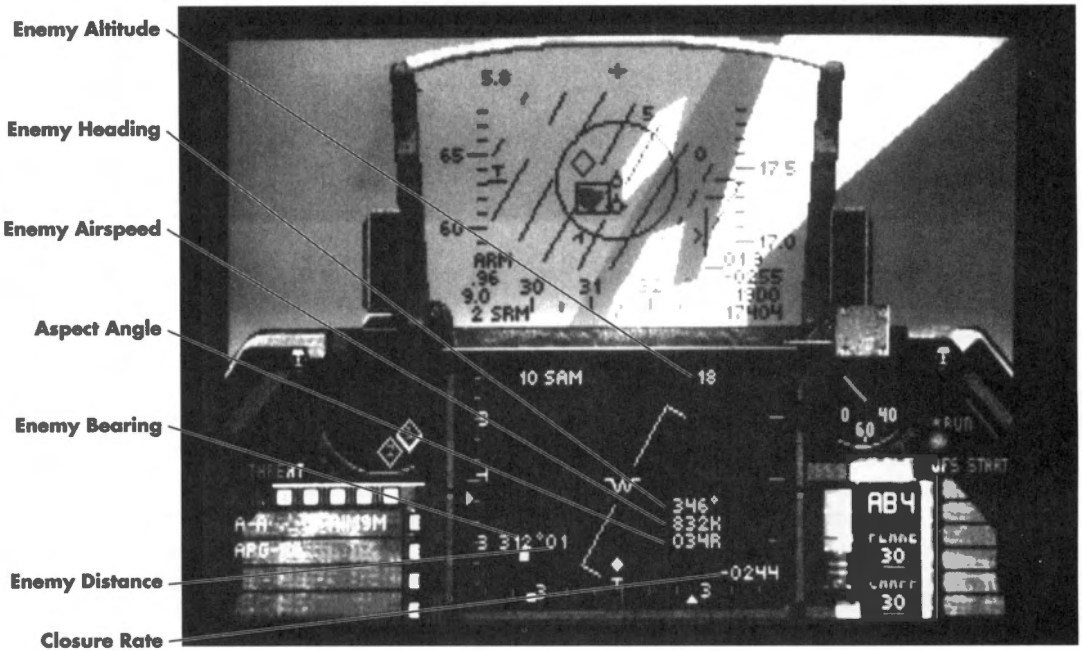
SAM radar is fairly simple because you don't have to manually change the radar scanning range. The radar will automatically change its scanning range betwee either 20 miles or 10, depending on how far away the closest enemy aircraft is. You can tell how large the scanning range is by looking at the upper left-hand corner of the REO.

This 20 mile range means that there is 20 miles of space between the top of the radar display and the bottom. Right now, the bogey should be about 15 miles away (about 75% up from

the bottom of the screen). Unpause the simulation again and watch as the bogey slowly moves down the screen. Pause the game again when a series of numbers appears on the right hand side of the REO and the green square changes to a diamond.

REO symbology

Now the upper left corner should read "10 SAM," (Situation Awareness Mode), meaning that the REO has changed to the 10 mile scanning range and is tracking a single target. Since you are within 10 miles of the enemy plane, you get the targeting info on the right-hand side of the screen. Your screen should look something like this:

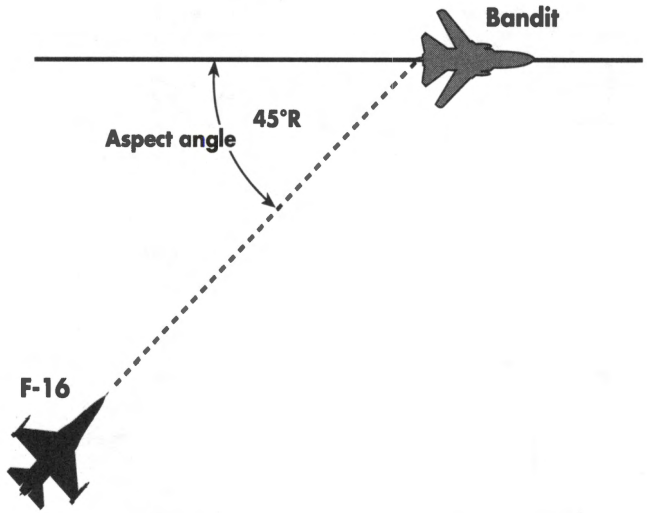


Enemy altitude: The number in the upper right-hand corner is the enemy's altitude (in thousands of feet) above terrain level. It should read somewhere around 10(000).

Enemy heading: This is the heading (in degrees) that the enemy aircraft is flying. You can compare your own heading (on the heading scale) with his to see what direction you need to fly to overtake him.

Enemy airspeed: This shows the airspeed (in knots) of the enemy aircraft. It's useful because you can compare it against your own speed and adjust accordingly.

Aspect angle: This is the horizontal angle measured from the tail of the enemy aircraft to the nose of your plane. Optimally, you want to have the aspect angle be 0° (directly behind the enemy's six o'clock). The number of degrees will be followed by a direction (either R or L). See the diagram below:



Enemy bearing: This is the compass direction from your F-16 to the enemy plane. In this case, 0° means he is directly in front of you and you're on his six.

Enemy distance: This shows how far away (to the closest mile) the enemy aircraft is. The fourth number up from the bottom right-hand corner of the HUD will display the same distance (in tenths of miles).

Closure rate: This number indicates the amount (in knots) that you are gaining or losing on the enemy aircraft. A positive number means you're closing in, while a negative number means you're losing ground. Closure rate is generally used when you are following an aircraft rather than in a head-on pass, because when you're following someone, you need to know if you're gaining or losing ground.

What does all this mean to me?

Glad you asked. Every read-out on the REO is important for air combat, especially , which is why I'm going over all the radar stuff in a separate lesson. There are times where you will use certain radar read-outs and times when you'll use others. For now, keep all these concepts in mind as I go over the Threat Warning System and I'll explain how to actually use everything later on.

Threat Warning System

The Threat Warning System has two major components: the Threat Warning Panel and the Threat Warning Indicator.

Threat Warning Panel

This panel has two lights on it that warn you of nearby threats. The LCK (Lock-on) Light flashes if an enemy plane, radar-guided missile or surface-to-air missile (SAM) is locked

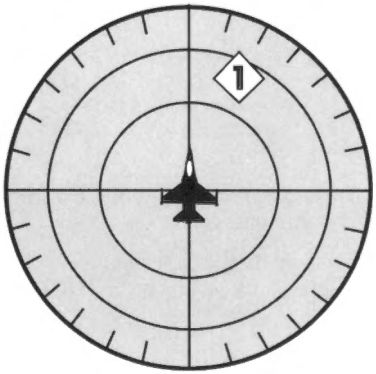
onto your F-16. You should take evasive maneuvers or activate an electronic countermeasures (ECM) pod if you have one.

The LNH (Launch) Light flashes when a SAM, radar-guided missile or heat-seeking missile has been launched. You should quickly take a look around to find out where the missile is so you can take evasive action, dump chaff and flares, and turn on your ECM.

Threat Warning Indicator

The Threat Indicator is a passive warning device that shows you the position of enemy aircraft, SAMs and radar-guided missiles within 30 miles. Different shaped "blips" can appear in this indicator, each type of blip representing a different threat.

When you look at the Threat Indicator, your F-16 is in the center of the two circles, facing "up" the screen. The top hemisphere of this indicator is the forward viewing half of your aircraft, while the lower hemisphere is the lower half of your plane. The dividing line for the top and bottom hemispheres runs through the wingtips of your plane. See the pic below for more details.



There are three different types of blips that might appear on the Threat Indicator:

1) Diamond – an enemy plane is within 30 miles of your F-16. Inside this diamond will be a number from 0 to 6. This number corresponds to the radar band the enemy plane is emitting. From this, the computer can roughly determine the type of enemy aircraft. (For more information on the types of radar and what aircraft use the various types of radar, see **Section VIII: Flight, Section XII: Advanced Fighter Tactics** and the Technical Specifications part of **Section XV: Reference.**)
2) Large green square – a radar installation within 30 miles is painting you. There will be a number inside this square as well indicating whether that radar is continuous wave (1) or pulse-doppler (2).
3) Small green square – an active-homing, radar guided missile or SAM has been launched within 30 miles of your F-16.

The Threat Indicator is mostly used when you actually get into a dogfight and to warn you of impending threats. Then, you'll need to use it for "situational awareness" of your combat surroundings.

How to use your radar

First off, this lesson isn't designed to teach you how to engage an enemy or what tactics you should be using. That stuff is covered in **Section XII: Advanced Fighter Tactics**. This lesson gives you the enemy plane dead in your sights, so you really won't have to worry about maneuvering. The game should still be on pause right now, so we can step our way though the acquisition process.

Step 1: Obtain visual sighting

If you look out the HUD, you should see the Target Designator box on the horizon. That's the bogey, just about coming into view. You want to aim your jet toward that box so you can get a good shot off.

In modern jet combat, you see your enemy for a very short time since both of you are racing at supersonic speeds. Don't worry, he'll get bigger in your sights soon enough.

Step 2: Check your IFF

In actual combat, you've gotta make sure that you're not going to fire on your buddies flying CAP for you. Before you even get ready to launch a missiles, hit the [N] key. This will check out the targeted plane on your IFF (Identification Friend or Foe) device. If you get a loud "squawk" from your instrument panel, the plane you're targeting is a friendly...don't shoot at him. If you hear nothing, it is an enemy plane.

Step 3: Check distance, bearing and heading

Take a look at the enemy's distance in the REO. The distance should be somewhere around 10 miles or so. It's important to keep flicking your eye back to this number so that you don't overshoot the enemy.

Since the enemy plane is within 10 miles of your F-16, you'll also need to check out his bearing (on the left side of the REO). You want to keep aiming at him, so keep an eye on that number and be prepared to head in that direction. His approximate bearing can be quickly found in the Threat Indicator. Also, take a look at his heading, so you can anticipate which direction he is aiming for.

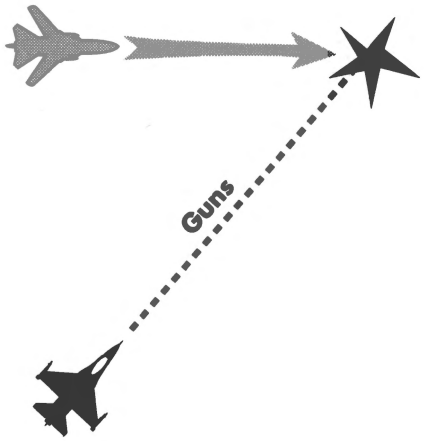
Step 4: Check relative altitudes

Look at your altitude on the Altitude Scale and compare your current altitude with the enemy plane's altitude. They should be about the same, but if they aren't, you're going to want to correct yours to correspond with his.

Step 5: Check missile lock

You have a radar lock if the blip on your radar screen is diamond-shaped. When you achieve a missile lock on a plane, the circle in the middle of your HUD (called the Aiming Reticle) will start to flash. Keep your target inside the reticle and, as it approaches, fire your missile.

When you use guns, you need to get in really close and lead your enemy before you fire. This is called "pulling lead" or "lead pursuit" and requires you to point the nose of your aircraft in front of the nose of the enemy aircraft so that the bullets and target arrive at the same place. See the diagram below.



Engage!

Ok, now unpause the simulation and follow the five steps I just mentioned. Make sure to keep the enemy near the center of your HUD. If, for some reason, he goes off the screen, look at the top of your HUD. There will be a line pointing down from a cross. This is the Target Locator Line, and it's pointing in the direction of the targeted enemy aircraft. You can also find out his relative position by looking at the Threat Indicator.

The other numbers on your REO are mostly useful if you are engaging an aircraft from the rear, since they display info that will require you to compensate to achieve missile lock. Closure rate and aspect angle are two of these things.

After you've blasted him out of the sky, hit the autopilot to return to base. By the way, did you notice what type of computer-controlled plane you were going up against? That was a late-model MiG, the MiG-27.

One last hint

Keep a steady hand. You don't want to be flailing around on the stick so much that you lose sight of the enemy.

If you didn't manage to grasp the radar concepts, go ahead and keep running the lesson until you've got the hang of it. It is pretty tricky, so don't get disappointed if you don't get it at first. These fundamentals are the basis for the next lesson where we'll go into the different A-A HUD modes.

Other scenarios

Lesson 5's scenario had an enemy plane coming at you head-on. If you want to try the same scenario but with the enemy in a different position, try the following lessons: LESSON5L puts the MiG-27 on your left side heading north, LESSON5R puts the MiG-27 on your right side heading north, and LESSON5B puts the MiG-27 directly on your tail heading north.

Lesson 5 review:

In this lesson, you learned the following about your weapons:

- Stores Control Panel (SCP) and how to view all weapons
- Selecting A-A and A-G weapons
- Firing a weapon
- Changing targets

In addition, you learned the basics of Situation Awareness Mode (SAM) radar:

- Viewing the radar
- Radar ranges
- How to read enemy altitude, heading, airspeed, bearing and distance
- Aspect angle
- Closure rate

You also learned about the Threat Warning System:

- Threat Warning Panel: LCK (Lock) Light and LNH (Launch) Light
- Threat Indicator and how to read it

Finally, you learned how to use these two systems together:

- Step 1: Obtain visual sighting
- Step 2: Check IFF
- Step 3: Check distance, bearing and heading
- Step 4: Check relative altitudes
- Step 5: Check missile lock

Next stop, the different A-A HUD modes. If you understood this lesson, those'll be a piece of cake.

Lesson 6: Air-to-Air Weapons Delivery

The last lesson taught you how to fire your weapons and how to read your REO. This lesson will describe all the different A-A weapons, how and when to use them, and how to interpret their HUD displays.

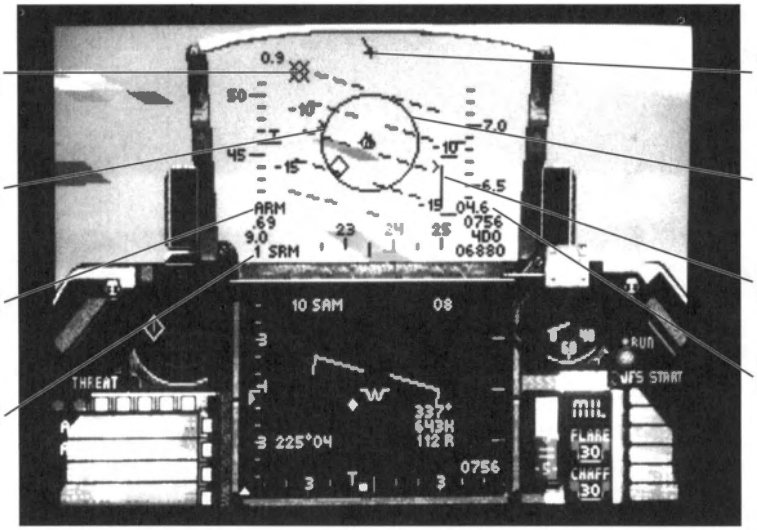
First off, I'll talk about basic stuff you'll find in all the A-A HUD modes. Then, I'll go into the A-A missile HUD modes: their characteristics, their strengths and weaknesses, and when and how to fire them. Finally, we'll talk about the A-A gun HUD mode and when it should be used.

In the air

Since you're going to be starting out right in front of a Mirage III, once you get in the cockpit, pause the game and read on.

A-A HUD mode basics

Most of the important weapon firing information is on your HUD. You gotta know how to read it if you want to be successful in air combat. Let's go over the basics first.



Master Arm Indicator

This display will always read ARM, meaning that the current weapon is armed and ready to fire.

HUD Mode Indicator

Aside from the Stores Control Panel, the HUD Mode Indicator is the easiest way to tell which weapon is currently selected. If any weapon but the A-A gun is selected, there will be a number in front of it displaying how many of that weapon you have left. The last line in the lower left-hand side of the HUD will have one of the following: SRM (AIM-9P or AIM-9M missile), MRM (AIM-120 missile) or DGFT (M61A1 gun).

Target Locator Line

Extending from the small "+" at the top of the HUD, the Target Locator Line helps you find the enemy aircraft you are currently targeted on. You can find the enemy aircraft by following the direction of this line.

5 Mile Radar Ranging Scale

This scale is located to the left of the Altitude Scale and only appears when you are within five (5) miles of an enemy plane. A small caret will appear at the top of the vertical bar and move downward as you approach the enemy. The top of the vertical bar indicates a distance of five miles while the bottom of the bar is zero miles (i.e. right on top of you).

Target Distance Indicator

You can find this display as the first line in the lower right-hand corner of the HUD. It shows your distance from the targeted enemy aircraft within tenths of miles.

Aspect Angle Indicator

This indicator duplicates the aspect angle reading in the lower right-hand corner of your REO. For an example of aspect angle and how it's measured, see the previous lesson or check out **Section XII: Advanced Fighter Tactics**.

Target Designator Box

The Target Designator box indicates where your current target is—if it's within the viewing range of the HUD. There may be times where you see this box, but don't see any target within it. When a target is beyond visual range, you will see the box but not the plane.

If the enemy aircraft is in your front quarter but off to one side of the HUD, the Target Designator Box will change to a diamond with an "X" through the center of it. This is known as the Diamond X. To change it back to a box, just head toward that diamond until it enters the HUD.

A-A missile HUD modes

Your F-16 can carry three different A-A missiles: the AIM-9P and -9M Sidewinders and the AIM-120 AMRAAM. Each of them has a few HUD items in common which I'll talk about now.

Missile Seeker Head

Within the perimeter of all A-A missile HUD modes, there's a small diamond representing the missile's seeker head. On the AIM-9M, the seeker head will bounce around the HUD, only coming to rest when it locks on a target. The other two A-A missiles keep the seeker head stationary in the center of the HUD.

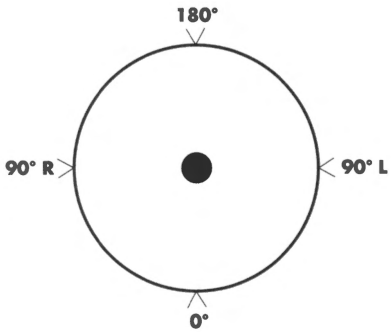
Aiming Reticle

The circle in the center of your HUD is called the Aiming Reticle. Optimally, you want your target somewhere within this circle before you fire your missile. When you have achieved a missile lock on your target, the Aiming Reticle will flash. Keep the enemy plane within the reticle and then fire your missile.

The major difference between the displays for the three different A-A missiles is the size of the reticle which is measured in milliradians (MR). The larger the reticle, the easier it is to keep your target within its confines and the easier it is to hit it. Of the three missiles, the AIM-9P has the smallest kill circle (35 MR), the AIM-9M has a 100 MR kill circle, and the AIM-120 has a 145 MR kill circle.

Aspect Angle Caret

This indicator graphically shows the aspect angle. With the caret, an aspect angle of 180° is at the 12 o'clock position and 0° is at the 6 o'clock position. See the diagram:



An easy way to figure out the aspect angle is to pretend that the point of the caret is the nose of the enemy plane. For example, if the enemy plane is at the bottom of the reticle (0°), the point of the caret is facing away from your plane, just like the actual enemy plane's heading.

AIM-9P Sidewinder

The AIM-9P Sidewinder is an rear-aspect, heat-seeking missile. Rear-aspect means that you need to shoot at an aircraft's rear quarter.

Sidewinders make a "growling" sound when they are seeking a target. When they achieve a lock, this growl turns to a high-pitched whine. At the same time, the Aiming Reticle will flash. This is the best time to launch your missile.

The AIM-9P is the most common A-A missile you will find in a campaign setting, since they are the least expensive A-A missile, although not as accurate as the AIM-9M or AMRAAM. Therefore, you should have plenty in supply. Their disadvantages are that they are rear-aspect only and have a smaller aiming reticle (both of which make it more difficult to lock onto a target). The effective range of the AIM-9P is 6 miles.

Firing the AIM-9P

Go ahead and unpause the game and aim at the retreating Mirage III. Keep heading toward the enemy until the Sidewinder whines and your reticle flashes. Launch your missile and keep your nose pointed at the enemy plane. You'll watch as the computer plane explodes into flames. Good shot! Now, go ahead and pause the game again while I talk about the next missile system.

AIM-9M Sidewinder

Unlike the AIM-9P, the AIM-9M is a more advanced heat-seeking missile. The AIM-9M is an all-aspect heat-seeking missile, which means that you don't need to aim at the rear quarter of an enemy before firing. The major differences between the two Sidewinders is their aiming area, reticle size and availability in a campaign. Also, the missile seeker head will be bouncing around the HUD until it locks on a target, and then it will drift toward the Target Designator Box.

The effective range of the AIM-9M is 6 miles, although it can be fired up to 10 miles. Since the aiming reticle is larger than the AIM-9P's, it is easier to lock-on an enemy plane. The AIM-9M costs a lot more to build and is in greater demand than the -9P, so they will be in shorter supply in a campaign.

Firing the AIM-9M

If you want, you can unpause the game and then select the AIM-9M missile by pressing the Enter key once. Turn your bird until you are heading due north (0°) and fly for a couple of minutes. Another Mirage III will appear on your radar scope and your HUD. Keep him in your sights, and when you achieve a lock-on, fire away. Another hit! Think you're getting good at this? Wait'll you try it in *real* combat, bucko. Go ahead and pause the game again.

AIM-120 AMRAAM

The AIM-120 AMRAAM (Advanced Medium-Range Air-to-Air Missile) is a radar-guided missile designed to be fired from beyond visual range (BVR). It has an incredible range of 30 miles, and a huge Aiming Reticle. In addition, the seeker head will stay in the center of the HUD until it locks on a target. Then it will drift over to that target and the reticle will flash.

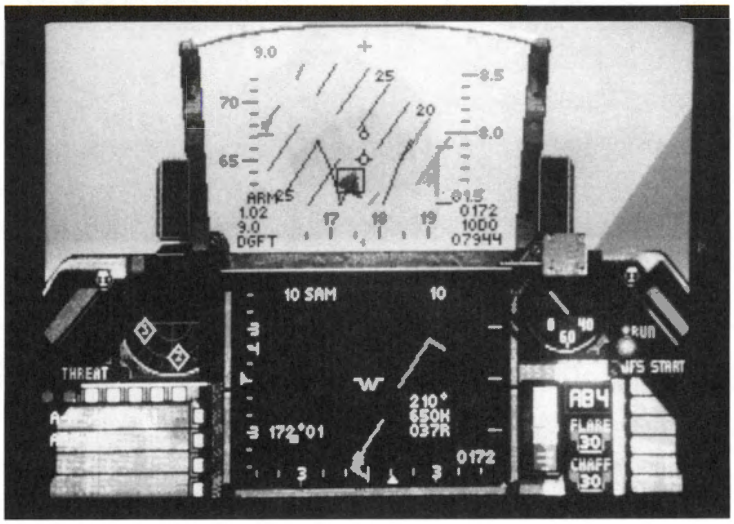
Its two drawbacks are that it's very ineffective at close range and it has an enormously expensive price tag. This cost factor means that you're not going to get a heck of a lot of them in a campaign.

Firing the AIM-120

All right, unpause the game and head north again. Choose the AIM-120 missile and watch your HUD. Soon, you'll see the Target Designator Box on your screen. Aim for it, and watch your reticle. Before you see any indication of the plane, the reticle will flash. Go ahead and launch a missile at this third Mirage III. The missile should impact just as the Mirage gets into view. Once you get him, change to A-A guns and then pause the game again.

A-A gun HUD mode

There is one major feature of the M61A1 gun HUD mode, the M61 Aiming Funnel. It's pretty simple to use, so let's go over it now.



M61 Aiming Funnel

The Aiming Funnel is the series of two lines that intersect in the center of the HUD. Unpause the game, level out and head north. Now, pull up on the stick. See how the two lines trail down the HUD? The bullets from your gun will end up at the smallest point of the funnel.

M61A1 Cannon

You can only use your guns within one (1) mile of an enemy target. Any farther away and you won't hit a thing. Your objective is to get the wingtips of the enemy aircraft between the edges of the funnel. Gun ammo is cheap compared to missiles, so you'll always have enough in a campaign.

You don't want to use your gun on a large aircraft like a transport, because a few bullet holes aren't going to bring down one of those monsters. Reserve the gun for fighters or as a last resort.

Firing the M61A1

Unpause the game now and aim for the oncoming MiG-23. When he gets within visual, try to place his wingtips at both edges of the narrow part of the funnel, then lay into him with the M61A1. With any luck, the aircraft will erupt in flame. If not, keep trying until you get the hang of it.

To finish off

Well, that's all for the A-A HUD modes. They're pretty easy to grasp once you've had a little practice. If you feel you need more work, keep running this lesson and use the different A-A weapons on any of the planes. When you're finished, simply select End Mission from the menu bar.

Lesson 6 review:

In this lesson, you learned these things found on all A-A HUD displays:

- Master Arm Indicator
- HUD Mode Indicator
- Target Locator Line
- 5 Mile Radar Ranging Scale
- Target Distance Indicator
- Aspect Angle Indicator
- Target Designator Box and Diamond X

You also learned specifics on A-A missile HUD modes:

- Missile Seeker Head
- Aiming Reticles and their differences
- Aspect Angle Caret
- AIM-9P Sidewinder operations
- AIM-9M Sidewinder operations
- AIM-120 AMRAAM operations

In addition, you learned about the A-A gun HUD mode:

- M61 Aiming Funnel
- M61A1 Cannon operations

Next lesson, I'll go into the A-G HUD modes and their operations. Then you'll learn what it's like to be a target, not a fighter.

Lesson 7: Air-to-Ground Weapons Delivery

Last lesson, I went over all the A-A HUD modes and their operations. Now you're going to get down to the nitty-gritty...literally. This is where you'll learn about your air-to-mud bombing techniques, when and when not to use certain weapons, and what their HUD modes look like.

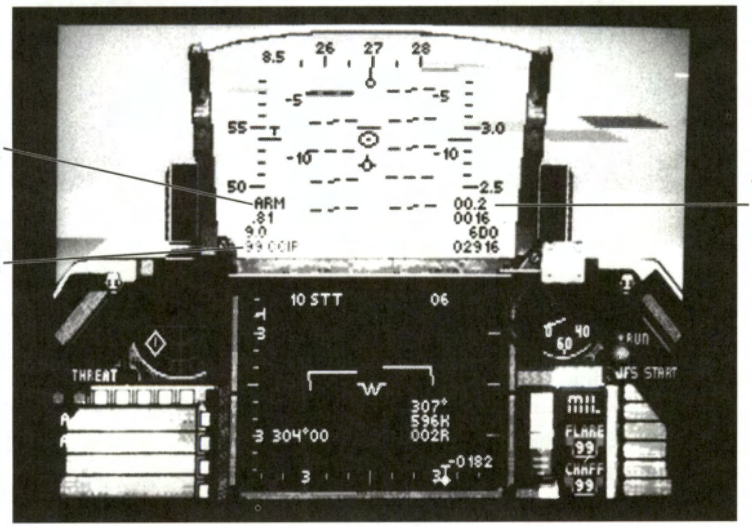
To begin with, I'll go over basic information on the air-to-ground (A-G) HUD modes and REO. Next, I'll talk about the specific A-G weapons — starting off with the various missiles. Then, I'll talk about how to drop iron bombs using the Continuously Computed Impact Point (CCIP) bombing system. I'll conclude with how to operate the rocket launcher and M61 cannon.

This lesson is in two parts: LESSON7A deals with the A-G missiles, while LESSON7B teaches you about the iron bombs and the rocket launcher. Go ahead and load LESSON7A for now.

Flying around

I'm starting you off in the air over Nellis' gunnery range. There are a ton of targets here, so you'll have plenty to shoot at. First off, pause the game and I'll talk about your basic A-G HUD mode.

A-G HUD mode basics



The main difference between the A-G and A-A HUD is the location of the Heading Scale. In A-G HUD modes, the Heading Scale is on the top of the HUD rather than on the bottom. This may seem weird at first, but it does make sense. When dropping iron bombs, the aiming cue is usually at the bottom of the HUD. If the Heading Scale was there, the display would be too cluttered and your view of the aiming cue would be obscured.

There are three general things found on all A-G HUD displays:

Master Arm Indicator

This works the same way as the one in the A-A HUD display — it always displays ARM, which means that your current weapon is armed and ready to fire.

HUD Mode Indicator

The function of this indicator is the same as in the A-A HUD display, but the display will be one of the following: CCIP (Mk82/82HD/83/84 iron bombs, CBU-84 cluster bomb and LAU-5003A rocket launcher), E-O (AGM-65B missile and GBU-15 guided bomb), A-R (AGM-45A and AGM-88A anti-radiation missiles), I-R (AGM-65D missile), DUR (BLU-107/B demolition bomb) or STRF (M61A1 cannon).

Target Distance Indicator

In certain A-G HUD modes, this indicator appears to show you the distance to your current target.

Ground Map radar

The Ground Map (GM) radar is used to find and identify ground targets. It has a 20 mile range and you can zoom in to 16x magnification. A complete description of Ground Map radar can be found in **Section VIII: Flight**.

A-G missiles

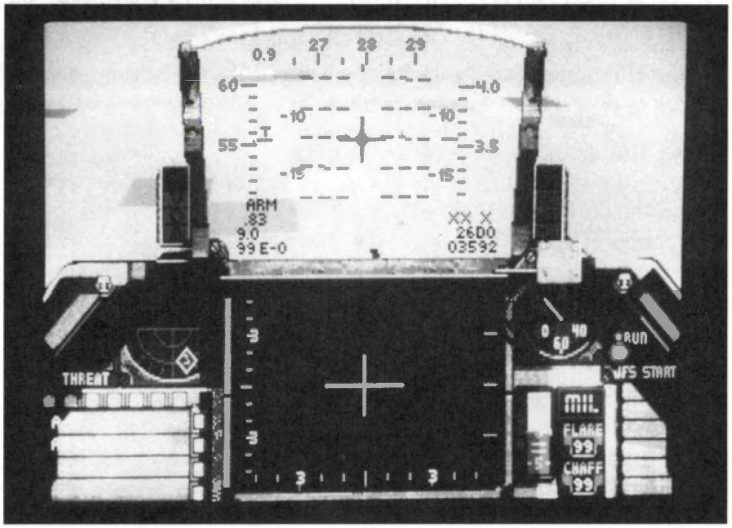
There are four types of A-G missiles your F-16 can carry: the AGM-65B and -65D Mavericks, and the AGM-45A Shrike and the AGM-88A HARM. Since each class of weapon (Maverick and anti-radiation missiles) work in different ways, we'll talk about them separately.

AGM-65 Mavericks

Both of the Mavericks have a maximum range of 12 miles and are used on smaller ground units such as trucks and tanks. They can also be used to hit bunkers, but they aren't so hot against bridges or large buildings. The main difference between the two is the method they use to track a target and when they should be used. Unpause the game now and hit the [Backspace] key until AGM65B appears in the Stores Control Panel. Then go ahead and pause again.

AGM-65B Maverick (Electro-optical)

The electro-optical (EO) version of the Maverick is generally used in daytime and good weather conditions. Since the Maverick uses a TV sensor in its nose, it does not track as well in the nighttime as it does in daytime. It also is better to use when firing at a target that's against a large heat source (like the desert floor), since the infrared signature will not fool the missile.



AGM-65D Maverick (Infrared)

The infrared (IR) version of the Maverick is primarily used in the nighttime, where the heat signatures of various ground object is more pronounced and not obscured by the earth's heat. It also can be fired in bad weather, because it tracks solely by IR.

Firing the AGM-65 Mavericks

Right now, we've only loaded the AGM-65B version of the Maverick, but both types work the same way. Go ahead and unpause the game. You should be at about 3,000 feet, heading due north (0°). Start pointing your nose earthward and look for some brown specks on the ground. That's a tank park, ripe for the picking. Aim the cross hairs at one of the tanks and watch your REO. When the image of the tank appears in the REO, go ahead and fire by pressing the Spacebar. Both of the Mavericks are fire-and-forget missiles, so you can press T to switch to another tank and launch another missile. The locking system is fairly automatic, so it's a no-brainer to hit those sitting ducks. Pause the game again while I talk about the radar-hunters.

AGM-45A Shrike and AGM-88A HARM

These two missiles are designed for use against radar installations and mobile radar units. The primary differences between the two missiles are their maximum ranges, their availability in a campaign and which type of radar targets they are effective against.

AGM-45A Shrike

The Shrike has a maximum range of 12 miles and is only used against continuous wave (CW) radar. CW radar is used with almost every enemy defense system except the SA-8 SAM. You're more likely to get these missiles in a campaign, because they cost a whole lot less than the HARM.

AGM-88A HARM

The HARM's range is a whopping 30 miles and is effective against both CW radar and pulse-doppler (PD) radar emissions. Its broad range of targets and expensive price tag makes it difficult to obtain in a campaign setting.

Firing the AGM-45A and AGM-88A

Unpause the game and hit the [Backspace] key until AGM45 appears in the SCP. At first glance, the Shrike and HARM HUD modes look like the Maverick HUD modes, but there are a couple of noticeable exceptions. You'll notice that the cross hairs automatically track to the nearest radar-emitting target. That's the main HUD difference between these missiles and the Mavericks. Also, if you lock onto a radar-emitting target and that target leaves the HUD's region, the lock-on will remain as long as it's within the forward arc of your plane. The Mavericks will break lock if the target is outside of the HUD.

Right now, you should be at about 2,000–3,000 feet. Once a target is acquired (when the cross hairs move to a radar-emitting target), go ahead and fire away by pressing [Spacebar]. With a HARM, you can be a lot farther away from the target before firing because of its long range. Circle around again and take another shot if you missed. Then, go ahead and select End Mission from the FILE menu and load LESSON7B for the second half of this lesson.

A-G bombs

With free-fall munitions, you've got a lot of choices: Mk82, Mk82HD, Mk83 and Mk84 iron bombs, CBU-84 cluster bomb, and the BLU-107/B Durandal anti-runway bomb. Each type of bomb is used in a different situation, but the method of dropping them is exactly the same. I'll go into where you should use the different bombs below.

Mk82 iron bomb

Mk82s are generally used against soft targets such as infantry and light armor. It can also be used against small buildings, but then you should drop a few just to make sure. You can get a lot of Mk82s in a campaign, since each F-16 can hold up to 24 of them.

Mk82HD Snakeye

The Snakeye has the same amount of explosive as the standard Mk82, but this bomb is used for low-altitude releases. Since the Snakeye has fins that slow down the bomb, it will always land far enough behind your plane that you won't get caught in the explosion. You can use this bomb against the same targets as the regular Mk82.

Mk83 iron bomb

The Mk83 is a good bomb to use against medium-sized targets such as average buildings, petroleum, oil and lubricant (POL) tanks and railroad shelters. One thing to think about is that this bomb weighs about twice as much (1,000 lbs) as a Mk82. So, don't be lugging the 83s around if you could be using the 82s instead.

Mk84 iron bomb

This is the largest and heaviest of the iron bombs. You can use it on the largest buildings, power plants, bridges, bunkers, factories and protected aircraft hangars. These suckers make one humongous crater when they land. Their major drawback is that they weigh nearly 2,000 lbs each, so your Falcon'll fly like a stuffed pig.

CBU-84 cluster bomb

When you release a cluster bomb, you're not just dropping one single weapon: you're dropping over 200 little bombs. The CBU-84 is great against a group of lightly armored vehicles or infantry, because the CBU disperses over a fairly wide area and hits a lot of targets.

BLU-107/B Durandal

The Durandal's only use is against runways. You release this weapon just like the other iron bombs, but the Durandal's effect kicks in on impact. It buries itself in the runway and then explodes outward, making repairs far more difficult than a standard iron bomb.

Before you start

First thing you need to do is find a target to hit. In this part of the lesson, you'll be starting at about 5,000 feet with a number of targets due north. I've given you a number of Mk82s to play around with. Don't drop 'em all in one place.

Dive down a bit until you see some specks in the distance. That's the same tank park you hit in the first part of this lesson. Go ahead now, unpause and select your Mk82 bombs. Then pause the game as I explain how to ripple your bombs.

Rippling bombs

Rippling is when you want to drop a lot of bombs over one target. For example, if you've got 12 Mk82 bombs on your F-16, you can set the ripple anywhere from 2–8 (in multiples of two). This way, you won't have to keep flying back just to drop a couple bombs.

You can increase and decrease the ripple count by pressing the [']and [;] keys respectively. The ripple number is on the second line of the Stores Control Panel, displayed as "R" and then a two-digit number.

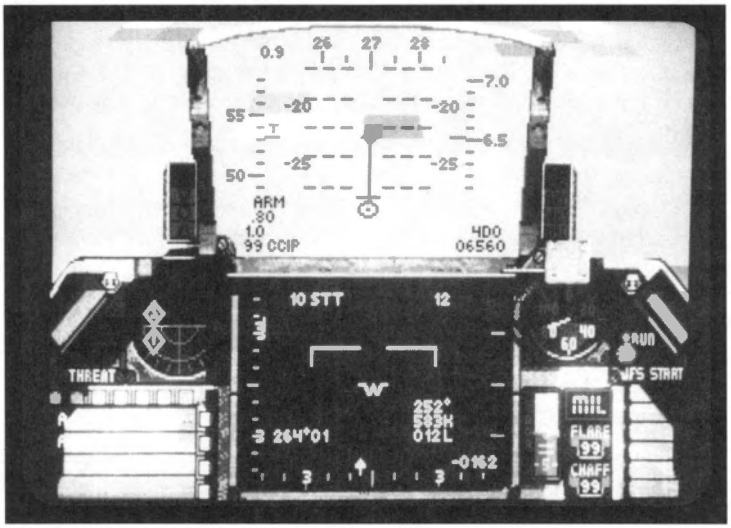
Dropping bombs

All the bombs I just talked about are released using the Continuously Computed Impact Point (CCIP) method of bombing. With CCIP, there are two major stages before a bomb is released: the target designation stage and the release stage.

Target designation stage

You'll notice a couple of new features on your HUD: the Bombsight and the Displayed Impact Line. The Bombsight is the circle and dot at the bottom of the HUD, while the Displayed Impact Line is the vertical line that is above the Bombsight. The Bombsight is also known as the CCIP Pipper or "death dot."

First, dive down a little so that you can see the tanks a little better. Then, line up the pipper with the tank and designate the target by pressing [Spacebar]. This will change the way your HUD looks.



Release stage

Now that you've chosen a target, you need to release your bombs. You may have noticed that the Displayed Impact Line has grown to the full length of the HUD. There's also a horizontal line called the Time Impact Bar that should be about halfway between the Center Point and the top of the HUD. The Time Impact Bar lets you know when the bombs are going to be released. If you keep flying straight and level, the bar will slowly move down the Displayed Impact Line until it reaches the Center Point, at which time the bombs will drop.

You can also drop the bombs prematurely by pressing the Spacebar. Remember, the greater the angle of descent you have before choosing the target, the less time before your bombs impact after release. After you've dropped some Mk82s, go ahead and change weapons so that the SCP reads LAU and then pause the game again.

A-G rockets

While the HUD Mode Indicator displays CCIP, the firing method for the LAU 5003A rocket launcher is very different than that for the iron bombs.

LAU 5003A rocket launcher

Each LAU pod you load onto your aircraft holds 19 small air-to-ground missiles. Since you load them in pairs, you'll have a minimum of 38 rockets when you load 'em. You fire them individually, so don't worry about wasting your shots. The LAU's rockets are most effective against soft targets such as light armor, infantry, trucks and jeeps.

Firing the LAU 5003A

Wing around to the tank park again, at about 2,000 feet, and look for some jeeps. If you can't find any, go ahead and look for some tanks. For this demonstration, it doesn't really matter what you shoot at. The center of your HUD has a fixed pipper showing the direction of your missiles. Point your pipper at the target and launch a few missiles by pressing the Spacebar a few times. Fairly simple, isn't it? Once you've shot up a few targets, fly back to about 2,000 feet, change weapons so that the SCP shows M61 and then pause the game again.

A-G gun

The HUD mode for the A-G M61A1 cannon looks very similar to the HUD mode for the LAU, but the difference is that the M61A1 pipper moves around based on which direction your F-16's nose is pointing. The cannon isn't very effective in A-G combat, being used only to strafe infantry and other very soft targets. Generally, you're not going to use your M61 cannon in A-G combat unless you are otherwise out of ordnance.

Firing the M61A1 cannon

To shoot up some targets, wing around again and look for some trucks. When you find them, drop down to 1,000 feet and point your nose at the trucks. After you get them in your sights, hold down the Spacebar as you riddle them full of holes. If you drop below 300 feet, pull up and swing around again.

A final word

If you have any other questions about any of the A-G HUD modes, you might want to check out **Section VIII: Flight** for more details or re-run these two lessons. A-G attacks, especially CCIP bombing, is a tricky thing. It takes a lot of time and practice to perfect. Keep working at it: the F-16 lets you get away with a lot, and in a while you'll be bombing things left and right.

Lesson 7 review:

In this lesson, you learned these things about the A-G HUD modes:

- Master Arm Indicator
- HUD Mode Indicator
- Target Distance Indicator

In addition, you learned how to use the following A-G missiles:

- AGM-65B Maverick (EO)
- AGM-65D Maverick (IR)
- AGM-45A Shrike
- AGM-88A HARM

You also were instructed on how to use the various A-G bombs:

- Mk82, Mk82HD, Mk83 and Mk84 iron bombs
- CBU-84 cluster bomb
- BLU-107/B Durandal

Finally, you were taught how to use the A-G rocket launcher and A-G gun:

- LAU 5003A rocket launcher
- M61A1 cannon and strafing

In the last lesson, I'll give you some pointers on how to use the Padlock View for dogfighting. Just wait, it'll knock your socks off!

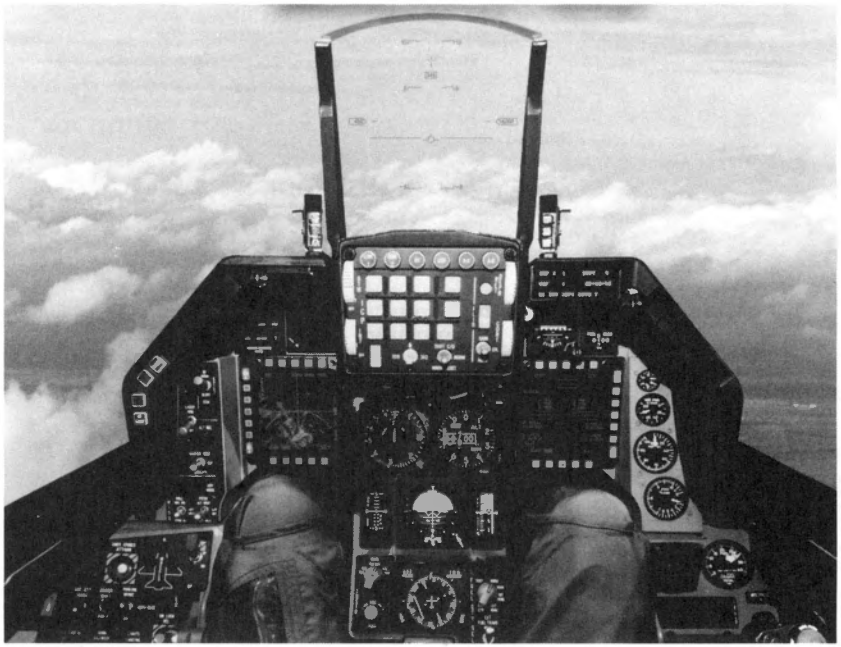
Lesson 8: Padlock View

Ok, here you are in your eighth and final lesson. Don't be thinking this is the least important, though. Although you don't absolutely need the Padlock View for air-to-air combat, once you've tried it, you'll never go back to dogfighting in any other view. Yes, it's that good.

This lesson will cover all about how to use the Padlock View, its four windows, where to look and when. It'll also cover the best (and worst) times to use this view as well as a brief description of how to use the Padlock View for landing. Go ahead and hit Takeoff to begin, and then pause the game.

What is the Padlock View?

Some of you are probably wondering where the term "padlock" came from. It's an old fighter jock term for "keeping your eyes glued to the target." This view is designed so that you'll always have the enemy in your sights.



Picture yourself in the cockpit of an F-16. Its bubble canopy and reclined cockpit seat give you the ability to virtually swivel your head completely around and allows you to see 360° around you. That's what the Padlock View simulates; the sense of complete vision in combat. This brings me to the three rules of air combat. (Thanks to Hollywood, Club, Dooley and the rest of the guys at Fightertown, USA!)

The golden rules

There are three things you need to remember in air combat. Even if you forget any of your other training, there are a couple of things you must not forget:

1. Lose sight, lose the fight
2. Speed is life
3. Always look good

All three of these can be directly related to the Padlock View. I'll go into these rules now.

1. Lose sight, lose the fight

This axiom is, by far, the most important of the three. In air combat, you need to keep your eyes glued to the target, or you're history. For example, let's put you in a head-on, one-versus-one dogfight. If you were looking through the Front View, when the enemy plane closed and then shot by your vision, you'd lose him. You could take a guess as to which way he turned and try to compensate, but with your limited field of view, you could never be sure and might not hear from him again...until he shoots a missile up your tailpipe.

With the Padlock View, the only time your enemy may disappear from view is when he flies beneath your field of view. Even then, you'll only lose him for a matter of seconds and then you'll padlock on him again. In a dogfight, your attention should be focused on the enemy plane only. Everything else — the ground, sky, birds, whatever — is secondary. You'll tend to rely heavily on your peripheral vision to view all of your displays while keeping your eyes focused on the enemy.

2. Speed is life

The worst situation happens when you're in a heated one-versus-one encounter, following the bandit into the vertical, and you stall out due lack of airspeed. While you're dropping like a rock, he'll be on your rear so fast, it'll make your head swim. Always keep a close eye on your airspeed. Before engaging in a dogfight, you want your airspeed to be at least 400–450 knots. In the Padlock View, you can see your airspeed in the upper left-hand window, just below the Target Indicator.

When you go into the vertical (climb rapidly), you bleed off airspeed. In order to maintain a sufficient dogfighting speed, you'll need to keep your hands near the throttle and probably the afterburner switch. If you're chasing a bandit and start to lose airspeed, kick in some more RPMs or hit that AB switch to keep your airspeed somewhere between 400–450 knots. Anything more than 450, and you're a human rocket. You'll overshoot enemy aircraft, giving them a perfect opportunity to take you down. Speeds less than 400 are fine for tight, high-G turns, but when you start dropping toward 300 or 200 knots, you won't have enough energy if your bandit heads skyward.

3. Always look good

A fighter pilot's only as good as his last run. Mistakes are rarely forgotten, and usually end up becoming your moniker. You need to keep your cool, have a steady hand on the stick, don't waste your weapons and bring your bird back in one piece. You'll never get marks for oversteering or plowing into the ground by accident.

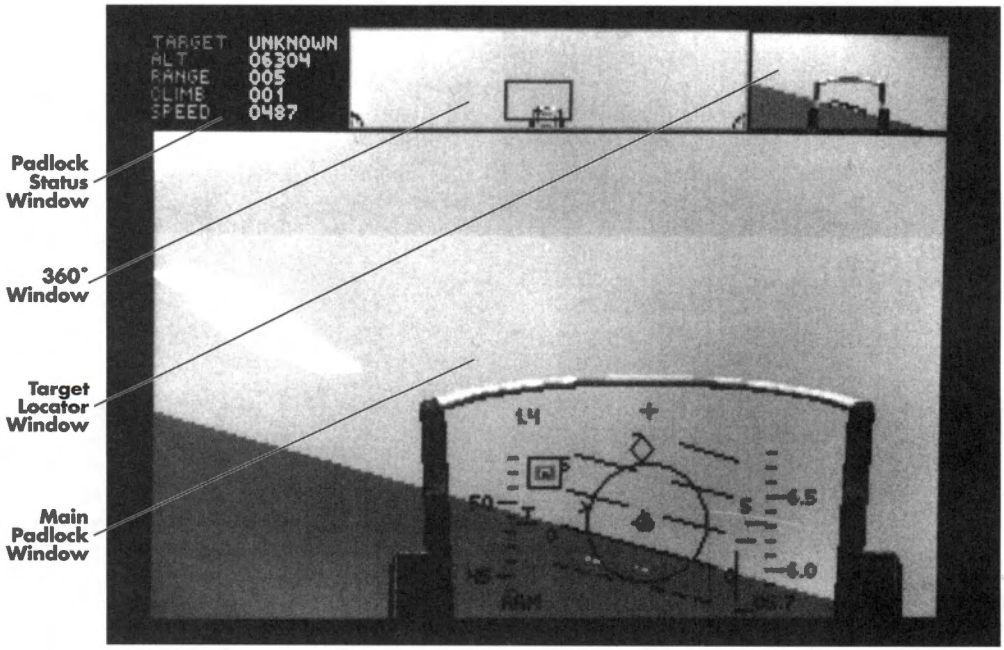
In the Padlock View, you can tell your angle of climb or dive, what type of aircraft you're focused on, your relative position to the horizon and, most importantly, your altitude. When

flying, you'll be checking these out constantly to make sure you're on the right track and not skimming the trees.

Components of the Padlock View

Unpause the game now and press [8] (or [*] on the numeric keypad) to go to Padlock View. Then pause the simulation again and continue reading.

There are four main windows in the Padlock View; three small ones at the top and a main lower one. Each one of these is essential to use the Padlock View effectively.



The upper left-hand corner window is called the Padlock Status Window. It displays vital information about the current target and its range as well as your present airspeed, altitude and degree of climb or dive.

The upper center window is known as the 360° Window. It shows you where the Main Padlock window is in relation to your canopy. A tiny representation of the HUD is located in the center of the 360° Window, while the rear seat is split on the right and left sides of the window.

The upper right-hand corner window is the Target Locator Window. This has two major functions: a target locator line to find enemy planes and an artificial horizon to determine relative position to the earth.

The lower window is the Main Padlock Window. This is where your eyes are looking. If there is an enemy plane or one of your wingmen within range, your eyes will lock on that target and follow it wherever it goes. The target will stay roughly in the center of the window as long as it doesn't fly under your aircraft. If it flies underneath your bird, you'll lose sight for a moment but acquire your target again after it reappears in view.

Let's go over each of these in detail and I'll explain how they work together.

Padlock Status Window

This window is your information on the world. It's mostly used for checking out stuff about your plane and your enemy. The five lines of info consist of the following:

Target: This is the type of aircraft you're currently targeting on. When there's no target within range, it'll display the word NONE. If you aren't in visual range of your target, this line will display the word UNKNOWN. Otherwise, it'll give you the name of the plane you're looking at.

Alt: This shows the current altitude above terrain of *your* aircraft. The Alt line is the most important line in this window, since it's fairly easy to lose track of your altitude when you're dogfighting and your HUD isn't always in view.

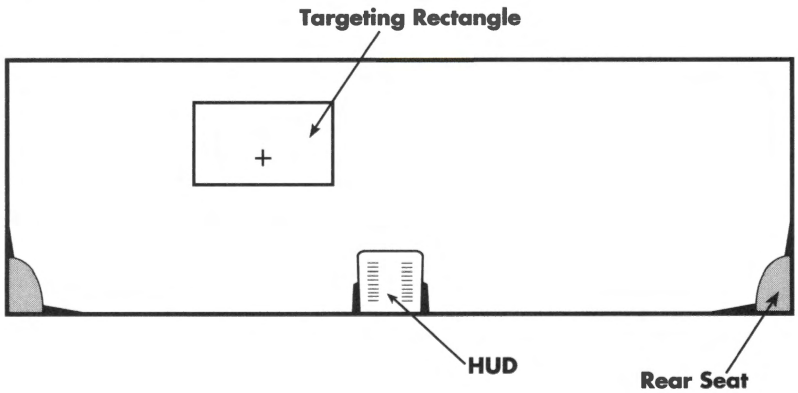
Range: This number is the range (in miles) to the targeted aircraft.

Climb: This shows the degree of climb your aircraft is taking. A negative number indicates a degree of dive.

Speed: This is your current true airspeed (in knots).

360° Window

The 360° Window shows your viewing range in the horizontal axis only. Your HUD is in the lower center of the window, while the back of the seat (the Rear View) is split on either side. The effect is as if you took a panoramic picture of the landscape. The Main Padlock Window viewing area is represented by a red area known as the Targeting Rectangle. If there is a targeted plane in sight, it will appear in this rectangle as a "+" sign.



You use the 360° Window to determine the direction of your targeted aircraft. With the Padlock View, you want to get the red rectangle directly over the small HUD in the center of the window so you can fire on the enemy target.

Target Locator Window

The Target Locator Window has two main purposes: to determine the direction of the targeted aircraft and to show your aircraft's orientation as compared to the horizon. You can picture this as a miniature version of the Front View. The tiny HUD in the center of this window will display a red Target Locator Line that shows the direction of your targeted aircraft. It also has a green bar that shows your relative position to the horizon.

In combat, you want to pull your aircraft toward the point of the Target Locator Line. If the targeted aircraft is behind your F-16, the red line won't be there, but the word "REAR" will appear above the HUD.

Main Padlock Window

The Main Padlock Window is where your eyes are currently looking. Your vision will be "padlocked" on the targeted plane, regardless of where he goes. If he goes underneath your aircraft, you will lose sight of him for a moment, but when he reappears, you will regain "tally" (sight). In combat, you'll probably only look at this view once you have maneuvered your opponent directly in front of your aircraft.

The plane you're targeting will be highlighted by a small red box. If your radar is locked onto the target and the enemy is within the front quarter of your F-16, the red box will turn to green. When this box turns green and your Aiming Reticle begins to flash, launch your missile.

Using the Padlock View

Now that you know the features of the four windows, let's put that knowledge to work. Currently, there aren't any enemies in sight, so you can see how the three windows in the Padlock View work.

No enemies in sight

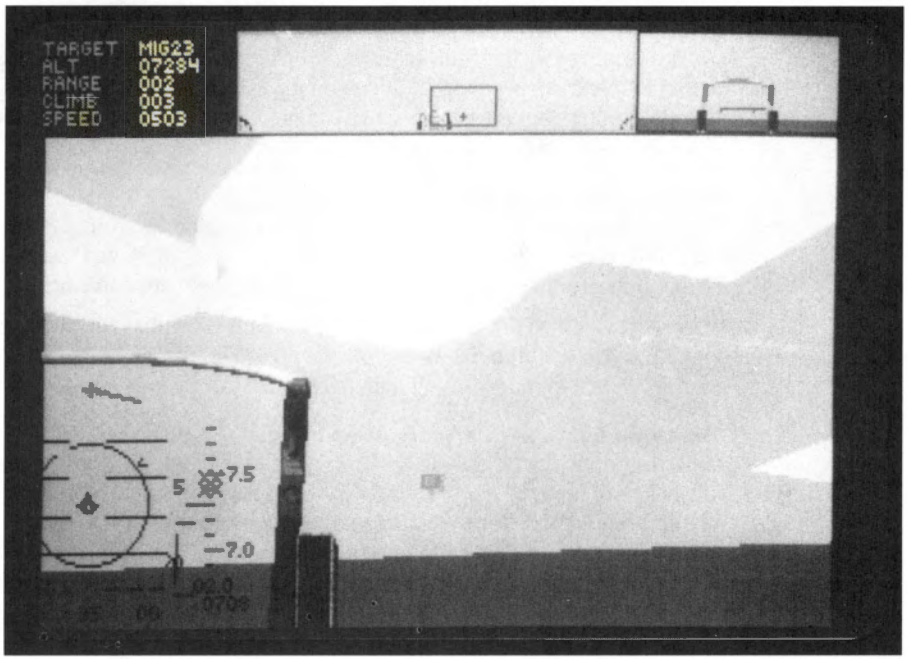
Since you're flying straight and level, you'll notice your HUD in the Main Padlock Window is motionless and in the bottom center of the window. The Targeting Rectangle in the 360° Window will remain in the lower center of that window, while the Target Locator Window will have the same orientation as the Main Window.

Unpause the game, switch to your AIM-9M, and then go ahead and make a gentle bank to the left. Notice how the Main Window and the Target Locator Window move in unison? Since there isn't a target in sight, these two windows will act as one. This, however, will change radically in combat. Fly around a bit and try to get a feel for how the windows work in relation to your stick movements. When you're not in combat, it's fairly simple to operate.

After you feel comfortable with flying around in this view with no enemies, engage the autopilot. After a bit, the autopilot will fly due north and your view will suddenly be tracking an enemy MiG-23. When you see the focus of your Padlock View windows shift to this enemy plane, pause and then continue reading.

First engagement — single bandit

Right now, you're padlocking on an computer-controlled MiG-23 in the main window. If you look to the 360° Window, you'll see him just to the right of the miniature HUD, while the Target Locator Window will have the Locator Line pointing to the right.



You'll have noticed that the HUD in your Main Window shifted off to the left of you. This means that the front of the aircraft is to your left, while your eye position is focused just off the right side on the enemy plane. Unpause the game now and try banking to the right. You'll also notice that when you bank to the right, the horizon in your Main Window will move upward.

As with any A-A engagement, since you want to get behind the bandit, your best bet in this situation is to pull the direction the Locator Line is pointing. Keep banking right and pulling the direction of the Locator Line. You'll notice that the Targeting Rectangle is beginning to move towards your HUD. Continue pulling along the Locator Line until the Targeting Rectangle is over the miniature HUD. At this time, your HUD will appear in the Main Window.

Try to get the MiG within your reticle and wait for the red box to turn green. Then, when the Aiming Reticle flashes, launch that AIM-9M. Keep aiming at him until you see the missile hit. See, no problem! Pause the game again and keep reading.

Second engagement — multiple bandits

Ok, now that you've had your taste of action using the Padlock View, we're going to throw a twist in. Next, we're going to give you a MiG-23 and a MiG-27 to deal with. They'll be coming at your from either side in a head-on engagement, so you'll have to make a choice which one to engage first.

When to use the Padlock View

Anyway, unpause the game, switch to Front View and turn on your autopilot. This'll turn your bird north for a while, so you'll be waiting a bit. Once you see some bogeys on your Threat Indicator, switch back to Padlock View, pause the game again and read on.

Generally, when you're on a mission and not in A-A combat yet, you'll be using your Front View. You don't want to be using your Padlock View until you're sure that there are some enemies in visual range or you gain tally on them.

Changing targets in a multiple-bogey engagement

You can change the target you're viewing in the Padlock View by pressing the [T] key. This will switch to the next nearest target in your viewing range. If you want to re-scan the area for the greatest threat to you and your F-16, hit the [8] key. When you're engaged with multiple threats, you'll be wanting to switch back to the Front View after you down each plane to see what the greatest threat is. Then you should return to the Padlock View for combat.

Prepare for combat!

Here we go! Generally, you don't want to take part in a one-versus-many dogfight, but for purposes of this lesson, I just want to let you know of the possibilities.

Anyway, now that you're in Padlock View, choose one of the two enemies and start making your turn toward him. Keep using the fundamentals I talked about before — follow your Locator Line and draw the Targeting Rectangle in so that your HUD appears in the Main Padlock Window. Another thing to remember about one-versus-many dogfights — you want to dispatch enemy planes as quickly as possible. So, when you draw the first bandit into your sights, launch a couple of missiles at him and then keep your eyes glued for the next bandit.

Not all A-A missiles will destroy an enemy in one hit; it may take multiple missiles to down some aircraft. If you don't obliterate him with your missiles, but see him going down in flames, you need to switch to the second bandit right away by using the [T] key. The Padlock View will follow your enemy down into the dirt unless you switch targets.

Odds are that if you didn't pay attention to the second bandit, he'll probably be on your six. Lower your airspeed to around 400 kts and make some high-G horizontal maneuvers. Jink him off your tail and try to draw him to the front of your aircraft. After you get him there, increase airspeed and move into firing position. Once you've tagged him, switch to the Front View to check out your Threat Indicator. It's good to get in the habit of switching to the Front View to scan your REO and Threat Indicator for approaching bogeys.

In conclusion

The Padlock View is a useful but tricky view. Because it takes a lot of practice to master, don't be discouraged if you don't get it all at once. Take it slow. Keep practicing this lesson until you get the hang of it. If you find that you still don't understand, you might take a look at the description in **Section VIII: Flight**.

Lesson 8 review

In this lesson, you learned about the golden rules and how they apply to air combat:

- Lose sight, lose the fight
- Speed is life
- Always look good

You also learned about the four windows in the Padlock View:

- Padlock Status Window
- 360° Window
- Target Locator Window
- Main Padlock Window

Finally, you were instructed about the Padlock View in the following situations:

- No bandits in sight
- Single bandit engagement
- Multiple bandit engagement

Congratulations, you've completed the last of the eight lessons we're giving you. Before you can earn your wings, however, you need to complete the "final exam." Read on and learn.

Review 2: A-A/A-G engagement

Ok, here you go. This is the "Final." This review is going to use all your skills and knowledge to complete, so if you aren't sure about anything I've talked about, go back and read over those lessons.

Your final is going to cover the works: takeoff, following waypoints without the autopilot, destroying a nuclear power plant, the return trip to your home airfield and landing. Along the way, you may encounter a number of aircraft, both friendly and enemy, so be alert to their presence. Good luck.

Before you start

One thing about this final, don't be using your autopilot during this test. I'll know if you've been relying on it, so don't try to pull a fast one.

Takeoff

Here you are in your familiar cockpit on the runway. Go ahead, takeoff and bring 'er to 10,000 feet. When you reach 10,000, check out your Waypoint Caret to find the direction to the next waypoint.

Stay in the Front View for now, and switch to your AIM-9Ms. If, at any time along your route, you happen to see anything on your Threat Indicator, switch to the Padlock View when you get within visual range and use your IFF check to see if they're friendly or enemy.

Waypoint one

You'll be heading north right after your first waypoint, so keep an eye on your Waypoint Indicator to see how far it is to your target area at waypoint two. When you get within 10 miles of the second waypoint, change to the Front View, switch to your Mk84 bombs and prepare for your bomb run.

Waypoint two — target area

When you get within two miles of your target, you should be able to see the twin towers of the nuclear facility. Point the death dot on the base of the first tower and press [Spacebar] to designate the target. Level out at about 2,000 feet and fly straight over the tower.

After the bomb is released, take a look out your Rear View and see if you got the target. If so, turn around again and do exactly the same thing to the other tower. Remember, you've only got two pairs of Mk84s, so there isn't any margin for error. In a combat situation, you're never going to be hanging around a hostile area to see if you hit your target — that's a sure way to be a trophy in the landscape.

When you've taken your shots at both of the targets, change back to your AIM-9Ms and head for the third waypoint.

Waypoint three

When you hit the third waypoint, you'll be heading south for your home base. It's a long way, but don't get complacent simply because you nailed your target. Returning home is half the trip.

Waypoint four — landing

As soon as you get within 10 miles of your airbase, start your landing approach. After you've landed, engage the wheel brakes and select "End Mission." Now check out how you did in Debriefing.

Debriefing

Here, you'll find out if your mission was a success or failure. You'll also see if you bagged any bandits or destroyed any friendly aircraft. If you got both the towers, congratulations again. You can now call yourself a pilot. If you missed the targets or were shot down, well, go ahead and try again. Keep trying until you complete this mission. If you're having trouble with a certain aspect of this mission, you might want to review some of the previous lessons.

Well, it's been fun. I'd like to extend my thanks and wish you luck in the future. Remember, if you ever need some brushing up on your skills, I'll always be here at Nellis. Take care, and check six!

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SECTION

VI

RED FLAG

Red Flag introduction

Red Flag is an air combat weapons training school. The actual Red Flag is an annual exercise held at Nellis Air Force Base in southern Nevada. Pilots from bases around the world visit Nellis AFB to pit their skills against the resident Aggressor squadrons. The Red Team, made up of highly experienced pilots, simulates the tactics used by Air Forces hostile to the United States against the visiting Blue Team pilots in a mock mini-war. Our version of Red Flag is designed primarily as a training center and mission editor. We've already created a number of training missions that you can fly, which cover many aspects of your F-16 from basic flying to dogfighting and bombing skills. These training missions are discussed in depth in **Section V: Air Combat School**. In addition, in Red Flag, we've also given you the ability to create your *own* missions.

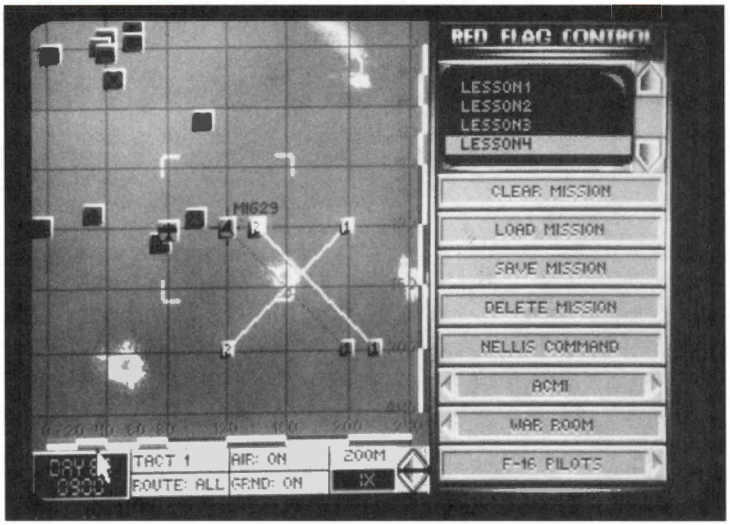
Red Flag training can be used to improve the "skills" of pilots in your squadron. If they are successful in certain aspects of their mission, the relevant ability scores (i.e. bombing or dogfighting) will increase. If they fail or are "shot down," their skill level in these areas may decrease. Red Flag is not a lethal exercise — the only way you can be killed here is by colliding with the ground.

This section of the manual deals with how to load and fly our pre-generated missions and also how to create your own missions from scratch.

How to get here

Red Flag can be entered from the War Room once you have selected a squadron. Simply move the pointer over the Red Flag monitor and either click a mouse button or press Enter on the keyboard. If nothing happens, be sure that a squadron patch is displayed in the far right monitor in the War Room. If the monitor says SQUAD, click it to select a squadron.

Red Flag Control screen



The Red Flag screen allows you to load, save and delete mission files. You can create or edit a mission by entering Nellis Command, and you can review mission action with ACMI. After you create your Red Flag mission, you will also select pilots for your aircraft, load the planes with ordnance, and then hit the runway.

Clear Mission

This button should be used when you want to create a new mission from scratch. It will remove all mission data from the map (save for one Allied and one Enemy flight of aircraft). After selecting this button, you can select the Nellis Command button to edit your mission.

Load Mission

To load an existing mission, use the scroll arrows on the side of the small video screen to highlight the name of the mission file you wish to load. Then select the Load Mission button. You can now either edit the mission (by selecting Nellis Command) or assign pilots to your F-16s (by selecting F-16 Pilots).

Save Mission

To save a mission you have created, select the Save Mission button, type in a name for the mission (maximum of eight characters), then hit [Enter].

Delete Mission

If you want to permanently remove one of the missions, highlight the mission name on the small video screen with the scroll arrows and then select Delete Mission. All of the supplied training missions are permanent, and you will be unable to delete them.

Nellis Command

To enter the mission editor, select the Nellis Command button. You can edit existing missions you have loaded, or you can create new missions from scratch in Nellis Command.

ACMI

If you have just finished a mission and want to see a replay of the parts you have videotaped, select the ACMI button. This will bring you to the ACMI area (see **Section X: ACMI** for complete details).

War Room

To return to the War Room, select the War Room button.

F-16 Pilots

Once you have created a mission in Nellis Command, select the F-16 Pilots button to finish preparations for takeoff.

Creating or editing a mission

At Nellis AFB, the actual Red Flag training is similar to a mini-campaign: squadrons are selected as either Red Team or Blue Team and they conduct a simulated war over a number of days. Our version of Nellis/Red Flag has been designed as more of a scenario editor and training ground rather than a small campaign.

The procedure for creating or editing a mission is very similar to setting up a mission in the Campaign area. If you are familiar with playing a campaign, you will already know most of what you need to know to create a mission in Red Flag.

Before you begin

Missions you create in Red Flag can cover a variety of scenarios. You have the option to include different allied and enemy aircraft, as well as allied and enemy ground units such as SAMs, AAA batteries, tanks, infantry, artillery and transportation units. You by no means need all these elements to create an exciting mission. Simply pick and choose the items you want. The only item necessary is at least one F-16, and we give that to you automatically.

Who you are

The most important thing to remember is that the plane *you* will fly is Aircraft #1 of Flight #1. Flight #1 has already been created with one F-16 as the leader of that flight. Remember that you are not only the Squadron Commander but also a pilot.

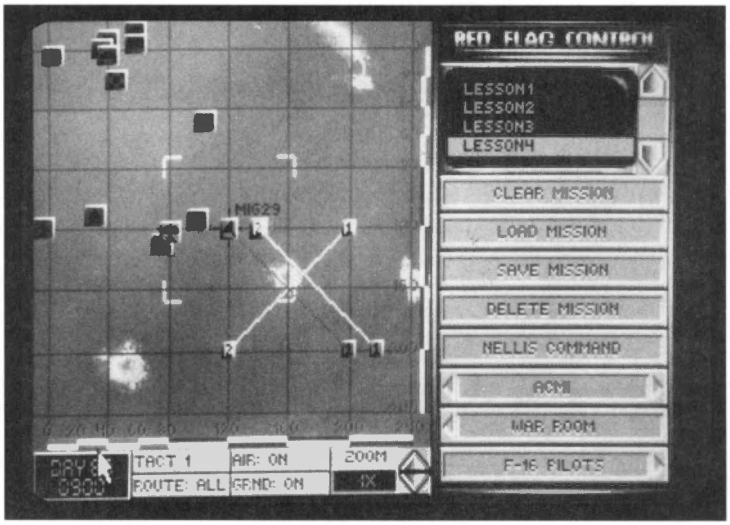
When you choose a pilot for Aircraft #1 of Flight #1, *you* become that pilot. His ability scores will be affected by your actions because you are assuming his identity. If you are successful in combat, that pilot's ability scores will increase; if you fail, his scores may decrease. The skills of computer-controlled pilots may also change, depending on mission success. More information on a pilot's ability scores can be found in **Section IV: Squadron Ready Room**.

Red Flag areas

There are three distinct areas in the Red Flag screens: the map, the map controls and the button panel. From the keyboard, you can cycle through the three areas by pressing Tab.

The map

This map of Nellis AFB in Nevada shows the placement of all runways, permanent "SAM" sites, bull's-eye targets, bunkers and other buildings. This is where you will create flights and edit their waypoints.



Icons: The map of the Red Flag range in Nevada shows the topography of the area along with map icons. The red icons indicate target sites; the two blue icons mark the position of Nellis AFB and the city of Las Vegas. (These icons are described in **Section XV:**

Reference.) In addition to the fixed map icons, you will see waypoint indicators connected by lines representing the assigned routes of all aircraft and ground vehicles taking part in the exercise.

Waypoints: Waypoints have two functions. They represent both the turning points in the flight route and the point where an aircraft will switch to a new mode of action. Each waypoint has its own action associated with it. Some actions, such as ESCORT and INTERCEPT, are performed *between* waypoints (and begin after you pass the *previous* waypoint). Others, such as BOMB and LAND, are performed at the waypoint itself. The various actions that can be assigned to a waypoint are described below. You can assign up to eight waypoints in a route.

The waypoints determine the path for all the computer-controlled aircraft except the wingmen in your flight, who will follow your lead. Whenever you engage the autopilot, however, your plane will head toward the next waypoint and switch to the assigned action mode for that waypoint.

Ground unit routes have only a beginning and an ending waypoint. The ground forces will travel from one point to the other and engage any enemy forces they encounter.

To move a waypoint, place the pointer over the waypoint icon, press the left mouse button or the Shift key on the left side of the keyboard, and drag it to the position you want with the mouse or arrow keys. If you drag it close to a map icon, it will snap to that location. This will ensure that computer-controlled planes will be able to find a particular target.

When an individual waypoint is selected, you will be able to edit all the information for that waypoint in the button panel.

To scroll the map, click and hold the right mouse button or the Shift key on the right side of the keyboard and then drag the zoom box with the mouse or arrow keys to the position you want.

The map controls

The row of buttons below the map allows you to manipulate the map features. These are listed below:

Time: This display shows you the day and time of your mission to start. All times are displayed in military time.

Tact/Strat: This button has six positions that are used for displaying information on the map. Three of the positions are tactical, and three of them are strategic. All tactical positions will show your home airfield and the mission target, while all strategic positions will show all friendly and enemy occupied key areas. These are the six positions: Tact 1 (shows grid and scale), Tact 2 (shows grid only), Tact 3 (doesn't show grid or scale), Strat 1 (shows grid and scale), Strat 2 (shows grid only), and Strat 3 (doesn't show grid or scale).

Route: This button gives you the option to display either one or all of the air or ground paths on the map. Use the Route button together with the Air and Ground button to filter the number of paths displayed on your map. See below for details on how this works.

Air: This button displays or hides any air routes on the map. If Route is set to All, you will see all the air routes that have been created. You can limit the display to only one air route by selecting the one you want to see and toggling the Route button until it says One. Only

the route you have selected will be displayed on the map. This is useful to eliminate the clutter of multiple routes.

Ground: This button displays or hides any ground paths on the map. It works identically to the Air button, but controls ground unit paths instead of aircraft flight routes. Use it in conjunction with the Route button to limit which ground paths are displayed on the map.

Zoom: The Zoom button (or the [+] and [-] keys on the keyboard) allows you to change the magnification of your map so that you can plot waypoints more precisely. You will zoom in or out on the rectangle-shaped area that surrounds the cross hairs. It magnifies your view in the following increments: 1x, 3x, 8x and 20x. After 20x, the view changes to an aerial view of the 3-D landscape. You can continue to zoom in to 50x, 120x and 250x.

When you reach 250x, you can slowly increase magnification all the way to 999x. The more you increase your view, the lower the angle of viewing becomes. This allows you to see the horizon and gain a different perspective of your viewing area.

By using the same controls as in moving the map, you can move around and see different parts of the map in 3-D perspective.

The button panel

The button panel at the right of the screen represents the main menu on all Red Flag screens. Buttons with arrows will change screens. The bottom-most button on each screen will take you to the next screen, while the second button from the bottom will return you to the previous screen.

The half-size buttons with LED displays allow you to cycle through a series of options with the mouse buttons or [Shift] keys (e.g. the Formation button) or to enter a number from the keyboard (e.g. the Altitude button).

If a button has diagonal gray stripes across it, that button is disabled.

The button panel video screen

Above many of the button panels a small video screen will appear containing a list of information. To select items from the list, you can either highlight the item directly with the pointer or scroll the list with the scroll arrows located to the right of the screen.

Nellis Command

From the Nellis Command screen, you can edit the details of your mission. You can assign aircraft and ground forces to both teams. You can also review 3-D models, photographs and specifications for every air and ground vehicle in the game by selecting the Report button.

Enemy/Allied Aircraft

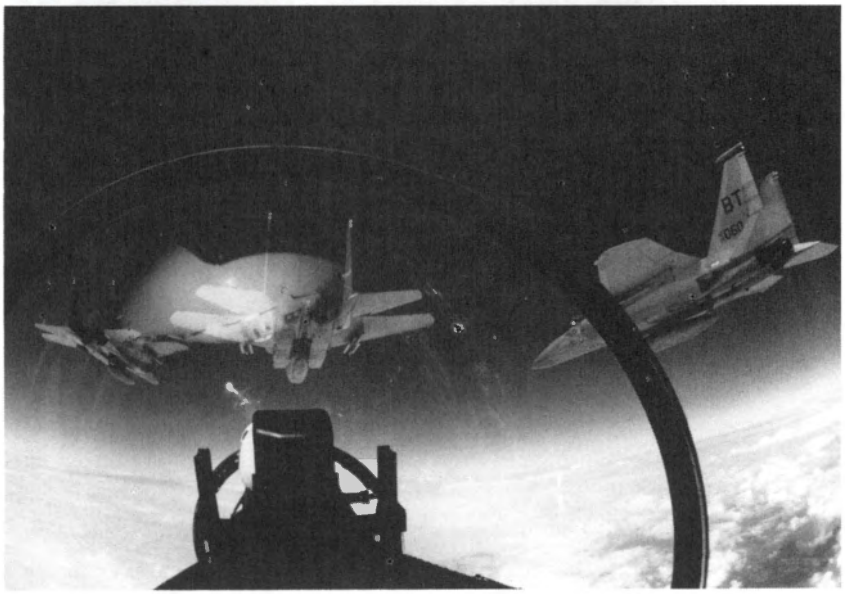
The Enemy Aircraft and Allied Aircraft sections of Red Flag allow you to choose and position different types of enemy or allied aircraft and set up their flight routes. You can also give the aircraft a variety of weapons (or none at all!).

There are three identical screens dedicated to aircraft mission planning for each side. The Aircraft screens allow you to create the separate flights involved in the mission. The Waypoint screens let you plot the flight route, speed, altitude and actions for each flight of aircraft. The Setup screens allow you to select the type of ordnance the non-F-16s in the

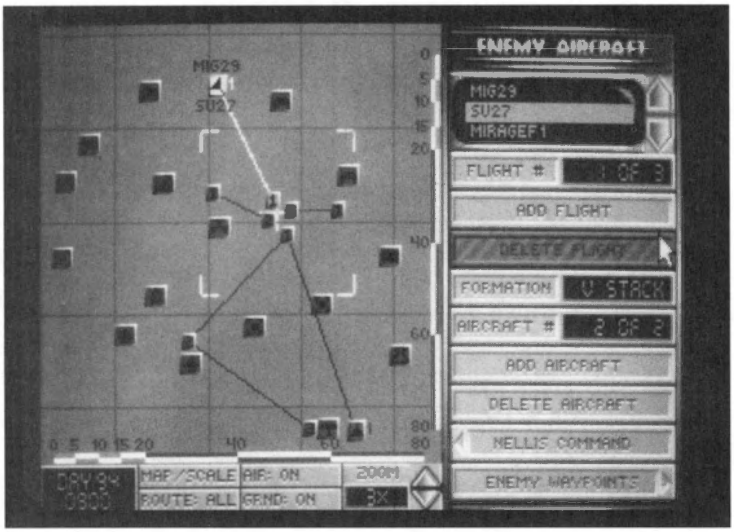
mission will carry. The F-16s in the mission will be manned and armed just prior to takeoff in the F-16 Pilots and F-16 Armament screens.

Note that you will always have at least one allied flight with your own F-16 as flight leader.

Enemy/Allied Aircraft screen



The Allied and Enemy Aircraft screens allow you to create the basic aircraft flights for both sides. You can add or delete both flights and individual aircraft as well as assign flight formations. You have a maximum of eight enemy and eight allied aircraft to work with. You may create up to four flights for each side within these aircraft constraints (i.e. one allied flight with eight aircraft, four allied flights with two aircraft, etc.).



Aircraft List: In the small video screen at the top of the button panel, there is a scrolling list of available aircraft. When you want to add a plane to one of your flights, highlight a plane from this list using the scroll arrows to the right of the aircraft list and then select the Add Aircraft button.

Flight #: This button cycles through the existing flights of aircraft.

Add Flight: This button adds a new flight route with one aircraft of the type highlighted in the aircraft list. A standard flight route with a starting point and two waypoints will be added to the map display. You may find it helpful to roughly position these points near their final position before continuing to the next screen or adding more flights.

Delete Flight: This button will delete the current flight with all its waypoints and aircraft.

Formation: This button allows you to change the formation of the current flight of aircraft. The possible formations are: V STACK, H STACK, C STACK, LADDER, WEDGE, VIC and ECHELON. These formations are described in **Section XII: Advanced Fighter Tactics.**

Aircraft #: This button displays the current aircraft by number within the current flight. This number corresponds to the aircraft's position in the list displayed on the map (next to the starting waypoint of its flight). Selecting the button will cycle through the aircraft in the current flight.

Add Aircraft: This will add one aircraft to the currently selected flight of the type highlighted in the aircraft list. The aircraft's name will appear on the map next to the initial waypoint of that flight.

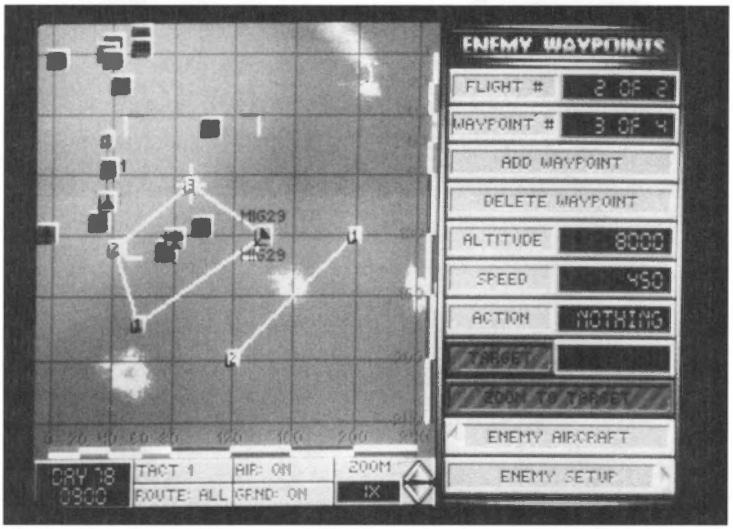
Delete Aircraft: This will delete the aircraft displayed on the Aircraft # button LED from the currently selected flight. Important note: you will not be able to delete Allied Aircraft #1 from Flight #1 because this is your own F-16.

Nellis Command: Select this button to return to the Nellis Command screen. If you have not set up waypoints, you may wish to do so first, since newly created flights will only fly to the first waypoint and return without taking any other action.

Enemy/Allied Waypoints: Select this button to continue to the next mission planning screen, where you may assign specific routes and actions to each flight.

Enemy/Allied Waypoints screen

Now that you have your aircraft and flights set up, you can use this screen to edit the actions and waypoints of each flight. There are a maximum of eight waypoints per flight. Note that individual aircraft on a flight cannot have different actions at a single waypoint.



Flight #: This button cycles through the existing flights of aircraft.

Waypoint #: This button cycles through the existing waypoints of the current flight. The information displayed by the Altitude, Speed and Action buttons pertains to this waypoint.

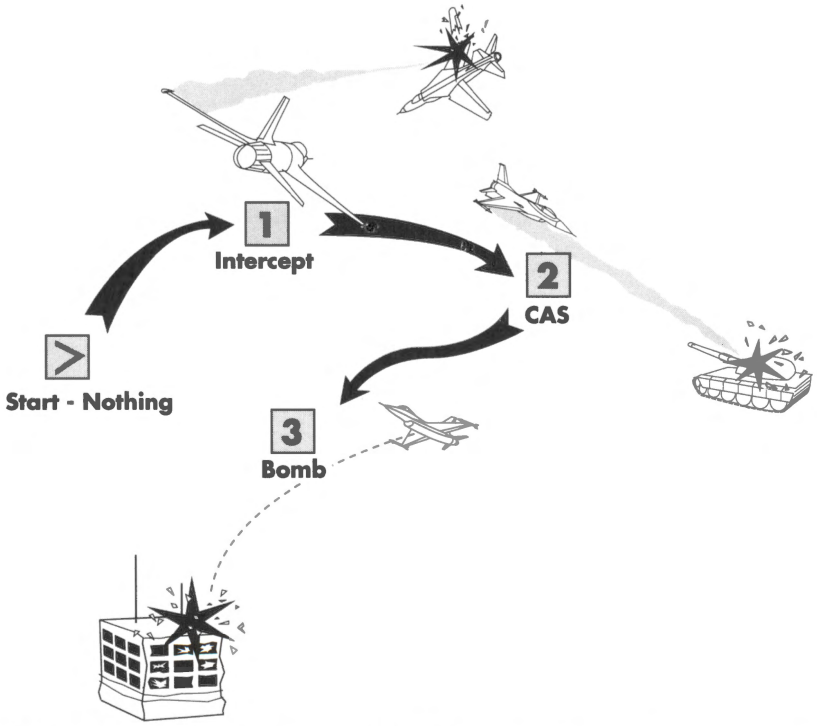
Add Waypoint: This button adds a new waypoint after the current waypoint.

Delete Waypoint: This button deletes the currently selected waypoint from the flight you are working on.

Altitude: After selecting this button, type in a number (from 0–70000) to set the altitude *above ground level* (AGL) at which the flight will approach the waypoint.

Speed: After selecting this button, type in a number (from 160–1350) to set the speed (in knots) at which the flight will approach the waypoint. Unless they encounter hostile forces, the flight will maintain this speed at the set altitude once they pass the previous waypoint. Remember, however, that the top speed of some aircraft is limited. Check the Report screen or **Section XV: Reference** for more information on aircraft specifications.

Action: This button allows you to assign a particular action that the flight will perform as it approaches the waypoint. You may need to give the aircraft time to prepare for an upcoming action. Once the flight passes this waypoint, the aircraft will switch to the action mode of their next waypoint.



As it flies along this path, the flight will INTERCEPT enemy aircraft between Start and waypoint 1, look for ground forces to destroy (CAS) between waypoint 1 and waypoint 2, and will prepare to BOMB the target at waypoint 3 as soon as it passes waypoint 2.

The possible actions are:

NOTHING: The flight will take no action. It will simply continue on to the next waypoint. Aircraft on the flight will defend themselves if attacked, but they will not actively search for enemy aircraft or ground units.

CAP: Combat Air Patrol. The flight will seek to protect the area along their flight route from enemy aircraft. Aircraft will not attempt to locate or destroy any unfriendly ground units they encounter, nor will they stray very far from their assigned flight route to chase enemy planes. You can use a string of CAP waypoints to make your aircraft circle an area (see LOITER). Use this action to provide air cover over a localized area. Use INTERCEPT for wider coverage.

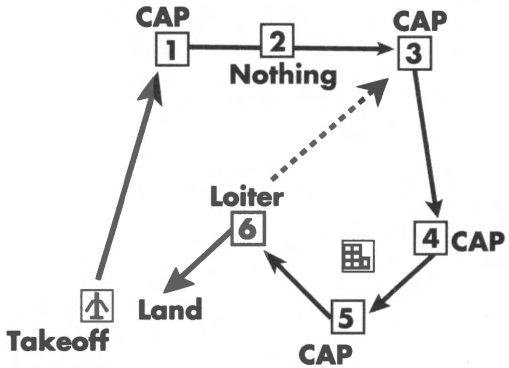
CAS: Close Air Support. The flight will actively search for unfriendly ground units to destroy. Aircraft will not attempt to locate or destroy enemy aircraft. The aircraft in the flight will need time to select A-G weapons and acquire targets, so any CAS waypoint should be placed at least seven miles from the previous waypoint.

S AND D: Search and Destroy. This option combines the functions of CAP and CAS. The flight will aggressively engage and destroy all unfriendly aircraft and ground units it can find.

BOMB: The flight will bomb the target chosen with the Target button (described later). Since all planes in a flight will bomb the same target, you should set up a flight for each target to destroy multiple targets at one site. If the waypoint is not near a target site, no target can be selected and the flight will drop their bombs on the dirt. Computer-controlled planes will only make one pass at the target. The aircraft in the flight may need up to 15 miles to select weapons and acquire their target for this action.

INTERCEPT: The flight will engage and seek to destroy all enemy aircraft they detect. Use this action for a wide area defense and for aggressive patrols. Do not use it to defend a localized area, because the flight may wander far from their assigned flight route to pursue hostile aircraft, leaving the area undefended. To defend a small area, use CAP instead.

LOITER: This action is used in conjunction with CAP to set up a continuous patrol.



Normally after passing a CAP waypoint, the flight will continue on to the next waypoint. Using LOITER, however, you can instruct the flight to repeat a string of CAP waypoints until they run low on fuel. To do this, create a number of consecutive CAP waypoints around the area you want the flight to patrol. After the last CAP waypoint, create a LOITER waypoint. When the flight reaches the LOITER waypoint, the pilots will calculate the fuel needed to redo the circuit. If they have enough, they will continue the patrol; otherwise they will return to base. Note that the flight will only repeat a consecutive string of CAP waypoints immediately preceding the LOITER waypoint. If a waypoint of another action separates the CAP and LOITER waypoints, any CAP waypoints before this other action are not repeated. No waypoints other than CAP can be repeated with LOITER.

ESCORT: The flight will protect a corridor around their assigned flight route from incursion by enemy fighters. They will stay as close as possible to their flight route and will not engage aircraft which do not pose an air-to-air threat to the escorted flight, such as strike aircraft or non-aggressive fighters. To use this action effectively, the speed and flight routes of the escorting flight should match those of the flight it is escorting.

LAND: This should be set only at an airfield. If you program a waypoint for landing where there is no airfield, those aircraft will attempt to land on whatever terrain they find. Use this action with caution. This action will automatically be set for the last waypoint of the route.

TAKEOFF: The TAKEOFF action will only affect your personal F-16. The action can only be assigned to the start waypoint of your flight route, and only when this waypoint is over Nellis AFB. The wingmen in your flight will already be in the air circling the airfield waiting for you to take off. You also have the option of starting a mission already in flight. Simply select a different action for the start waypoint and set your desired altitude and speed. The start waypoint for all other flights should be given an appropriate altitude and speed to begin the mission in the air.

Target: Selecting this button will cycle through the target frag list and assign the displayed target to the flight. The frag list contains the most significant military targets at the site, in order of importance. The Target button will only be enabled when the Action button displays BOMB. If you move the waypoint away from the site, the target selection will be reset to the top of the list, even if the waypoint is subsequently returned to that site.

Zoom to Target: Clicking this button will zoom the map display to a 3-D close-up of the assigned target to help you identify your objective when you reach the target site. The zoomed image will rotate, giving you a 360° view of your target, until you click the mouse button or press the [Enter] key.

Enemy/Allied Setup screens

The Enemy/Allied Setup screens are used to customize the *non-F-16* aircraft in the mission. Each aircraft can be fitted with a host of different weapons.

Initially, all planes will have a default weapon load corresponding to their mission. Note that you will individually man and load all F-16s in the mission just prior to takeoff.

Armament: The armament list displayed on the small video screen allows you to customize the weapons load of the currently selected aircraft. If one of the weapons options does not have a circle to the left of it, the plane is unable to carry that type of ordnance. If a circle is solid, that weapons system will be loaded on the aircraft for the mission. If the circle is hollow, the weapons system will not be loaded.

Flight #: This button cycles through the flights of aircraft.

Aircraft #: This button cycles through the aircraft in the current flight.

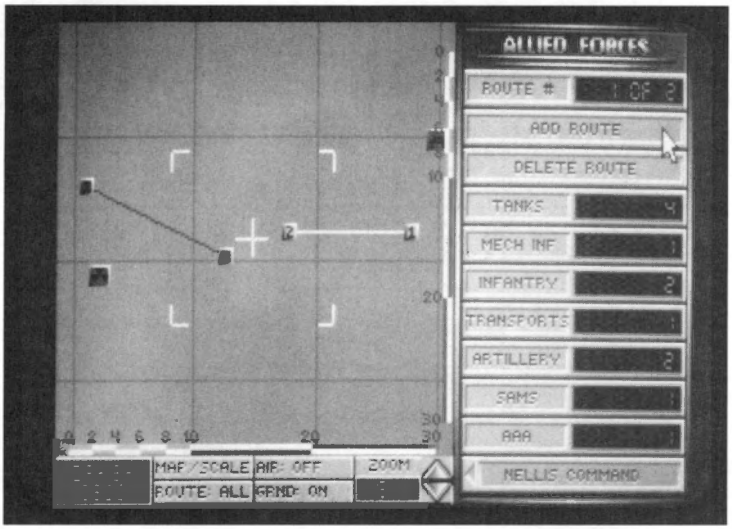
Enemy/Allied Forces

The Enemy Forces and Allied Forces screens allow you to place ground forces (such as tanks, AAA, SAMs, infantry, etc.) anywhere on the map. You will get a starting point and ending point for each group (known as a route), and you can move these points to any position.

You can place up to a maximum of 60 units total, which you may divide any way you choose (30 enemy and 30 ally vs. 40 enemy and 20 ally, for example). These ground units will travel from point 1 to point 2 in a straight line, not avoiding any terrain features. In addition, if they encounter unfriendly units in their path, they will stop and shoot it out until one side or the other is destroyed.

Enemy/Allied Forces screen

Since many of the same generic types of forces exist in the Enemy Forces and Allied Forces screens, we can discuss both screens together. Whenever applicable, specific enemy and allied forces will be listed.



Route #: This button cycles through the existing routes of ground units.

Add Route: This button adds a new route to the map. You can create up to four routes distributed between the two sides. Note that the Route # button will only display routes assigned to the side you are currently working on.

Delete Route: This button deletes the current route from the map.

To set the number of any type of unit in the current route, select the button displaying the type of unit. You can place up to seven of each type in every route, but if the total number of units in the four routes exceeds 60, the number of units actually participating in the mission will be proportionately reduced to 60. The unit types you can use are: Tanks, Mechanical Infantry, Infantry, Transports, Artillery, SAMs and AAA. For a description of the vehicles in these units, see the Report screen.

The following vehicles and weapons will be assigned to the indicated side when you select the corresponding button:

	Allied Team	Enemy Team
Tanks	M1 Abrams	T-72
Mech Infantry	M2 Bradley	BMP-1
Infantry	Shoulder-launched SAMs	Shoulder-launched SAMs
Transports	Green Army trucks	Brown Army trucks
Artillery	D-130 122mm howitzer	M198 155mm howitzer
SAMs	Roland	SA-6 Gainful
AAA	M163 Vulcan	ZSU-23-4 Shilka

Report screen

The Report screen allows you to view 3-D models, photographs and specifications for every aircraft and ground vehicle in the game. You can use this information to identify enemy and friendly aircraft and ground vehicles, and to learn their capabilities, their strengths, and their weaknesses.

To use the Report Screen, select the button of the type of unit you wish to view. The screen will change to display the mission computer, which holds information on all aircraft and ground vehicles for both sides.

The mission computer displays the specifications for the current vehicle or aircraft, a photograph, and a rotating 3-D model.

View: The view buttons will cycle the display through the list of aircraft or vehicles you selected when you engaged the mission computer. Use the mouse or the ← and → keys to operate the View buttons.

Scroll text: The scroll text buttons move the text up and down on the screen. Use the mouse or the ↑ and ↓ keys to operate the Scroll Text buttons.

Exit: To return to the Report Screen menu, select the Exit button with the mouse or press Esc.

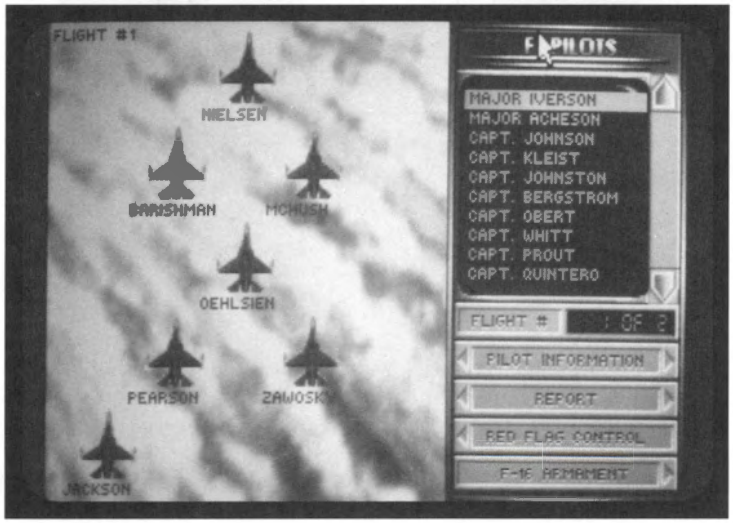
Done

After setting up the allied and enemy aircraft and ground forces you want for your mission, you are ready to fly it. Select Done to return to the Red Flag screen. Then select the F-16 Pilots button to begin final mission preparations.

F-16 Pilots screen

From the F-16 Pilots screen you select particular pilots to fly the F-16s in a mission. You can run any mission several times using different pilots and weapons, if you wish. Because Red Flag is designed as a training area, you may want to train the least experienced pilots in your squadron. Sending them through missions in Red Flag will give them invaluable experience for a campaign.

As with the rest of Red Flag, you do not have to make adjustments on these screens. However, if you want to train specific pilots to gain proficiency with a particular type of ordnance, you will want to make some minor changes to the default setup of the F-16 Pilots and F-16 Armament screens.



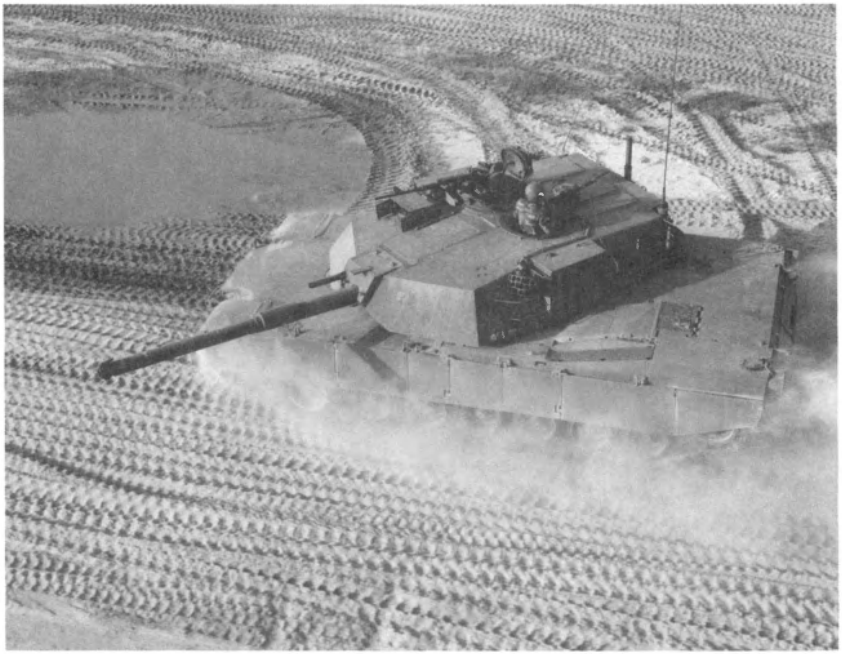
All the F-16s in the mission will be displayed on the left side of the screen, with default pilots from your squadron assigned. If you have assigned non-F-16 aircraft to fly as wingmen in any of your flights, they will not be displayed. You can only assign pilots to the F-16s; other aircraft will have their own pilots.

When flying around during your Red Flag mission, you may receive radio messages on the top of the screen from other aircraft in your flight. You can recognize the F-16 pilots from your squadron by their callsigns. Non-F-16s will be identified by their aircraft type (A-10 #1, C-130 #3, etc.). An explanation of these radio messages can be found in **Section VIII: Flight**.

Pilot roster: The pilot roster is displayed on the small video screen on the right. This is a list of all the F-16 pilots in your squadron. To assign a pilot to an aircraft, simply highlight a name on the list with the scroll arrows and then select the F-16 you want them to fly. The pilot initially assigned to that aircraft will be returned to the roster.

Flight #: This button cycles through the allied flights of F-16s.

Pilot Information: This button takes you to the Pilot Information screen where you can view pilots in your squadron.



Pilot Information screen

The Pilot Information screen allows you to view individual pilots in your squadron. The left side of the screen contains important information about these pilot's abilities such as the number of sorties (missions) flown, the number of enemy aircraft shot down, the number of ground targets destroyed, and any medals and commendations that have been awarded. In addition, you can view the pilot's face, name, rank and callsign. (A complete explanation of pilot abilities can be found in **Section IV: Squadron Ready Room.**)

In Red Flag, you can use this screen to determine who is best suited for your mission. For example, if you were conducting a bombing exercise, you would look for a pilot that is particularly skilled in Bombing Accuracy and Flying Ability to accompany you on your bomb run. In Red Flag, however, you may not always want the most skilled pilot to fly a specific exercise. The intent here is to train the less skilled pilots so that they can become better. Increased ability scores come from repeated training.

Pilot roster: To view the statistics of a particular pilot, highlight the pilot's name on the small video screen.

Name: To change a pilot's name, select this button and type in the new name. The new name can have up to 12 letters.

Callsign: Use this button to change a pilot's callsign. The new callsign can have up to 15 letters. Any radio messages you receive from a pilot will use the callsign, rather than the name.

Change Face: Use this button to cycle through the available faces for your pilot.

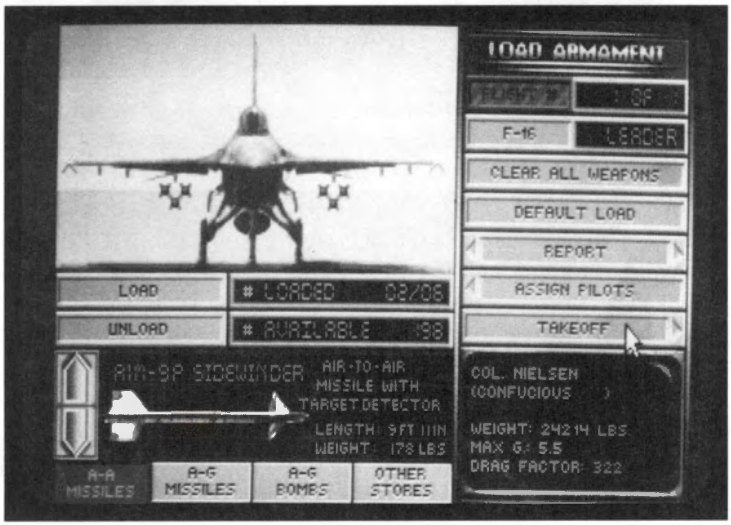
Awards: Select this button to change the left side of the screen to display the awards a pilot has received instead of the pilot information. Awards are given to recognize excellent performances in combat. To redisplay the pilot information, select the Information button (which has replaced the Awards button in the menu).

Done: Select this button to return to the F-16 Pilots screen.

F-16 Armament: When you are satisfied with your pilot assignments, select this button to advance to the F-16 Armament screen, the last step before takeoff.

F-16 Armament screen

The F-16 Armament screen allows you to customize the weapons load of any F-16 in the mission. The planes will already be loaded with a basic set of weapons to carry out their assigned mission, but you can change the armament if you wish.



Loading Armament: The left side of the screen shows a picture of an F-16, a number of buttons and a weapons display. The F-16 has four pylons or "hard points" per wing as well as a centerline mount on which weapons and other stores can be loaded. Note that the heavier weapons and stores can only be loaded on the inner pylons. These items will also be both loaded and dropped in tandem to maintain the aircraft's balance during flight. The M61A1 20mm cannon is mounted internally and is always loaded with 515 rounds.

To load a weapon or another type of store, first select the category of weapon with the buttons on the bottom of the screen. Then select the Load button. You may also click directly on a weapon or store on the F-16 to bring up its selection in the weapons display window. You have a choice of A-A Missiles, A-G Missiles, A-G Bombs and Other Stores. The various weapons and stores are briefly described below:

A-A Missiles:

There are three different air-to-air missiles that you can load: the AIM-9P and -9M Sidewinders and the AIM-120 AMRAAM.

AIM-9P and -9M: The Sidewinders are heat-seeking missiles. The AIM-9P is a rear-aspect missile with an effective range of approximately 10 miles. The AIM-9M is an all-aspect missile with an effective range of 10 miles. The rear-aspect AIM-9P requires that you be behind an enemy aircraft in order to get a good lock. The all-aspect AIM-9M can lock on to an aircraft from any angle or aspect.

AIM-120: The AMRAAM is an active-homing radar-guided missile which has an effective range of approximately 25 miles and is designed for use beyond visual range (BVR). The problem with carrying AMRAAMs is that each one of them weighs nearly twice as much as a Sidewinder. This affects your aircraft's maximum Gs and drag, which are major factors in air-to-air combat.

A-G Missiles:

There are four types of air-to-ground missiles and one air-to-ground rocket launcher: the AGM-65B and -65D Mavericks, the AGM-45A Shrike, the AGM-88A HARM and the LAU-5003A rocket launcher.

AGM-65B and -65D: The difference between the AGM-65B and -65D is that the -65B is optically-guided while the -65D is infrared-guided. The -65B is much more effective in the daytime, while the -65D can be used at night. Both Mavericks are effective against tanks, trains and other small targets. These two weapons have an effective range of approximately 14 miles.

AGM-45A: The Shrike anti-radiation missile is designed to take out SAM sites and radar installations. It has an effective range of approximately 12 miles.

AGM-88A: The HARM anti-radiation missile is similar to the Shrike. The HARM, has over twice the range and weighs twice as much as the Shrike. The effective range of the HARM is approximately 30 miles.

LAU 5003A: This rocket launcher contains 19 small rockets which are fired individually. It has an effective range of approximately 3–4 miles and is primarily used for CAS on "soft targets" such as trucks, jeeps and infantry.

A-G Bombs:

There are seven different types of bombs: the Mk82, the Mk82HD, the Mk83, the Mk84, the Durandal, the CBU-84 and the optically guided GBU-15.

Mk82, Mk83 and Mk84: These weapons are standard iron bombs that have been used in one form or another for the past 20 years. The differences between them are the munitions load (500, 1,000 and 2,000 pounds respectively) and the corresponding weight. You should base your choice of iron bombs on the size and "hardness" of the target.

Mk82HD: The Mk82HD (High Drag) bomb should be used instead of the other iron bombs for low altitude drops, so that the bombs will decelerate sharply and explode behind, rather than underneath, your plane. It otherwise contains the same munitions load as the Mk82.

Durandal: The Durandal is only used for destroying runways. Upon impact, the Durandal will plow under the surface of the runway and explode outward. This will buckle the runway and create a sub-surface cavity much more difficult to repair than a normal bomb crater.

CBU-84: The CBU-84 releases a cluster of 202 bomblets that disperse over a wide area. Use this weapon to defeat infantry and other soft targets such as trucks, jeeps and light armor.

GBU-15: The GBU-15 is a precise, optically-guided bomb that is used to destroy large targets like buildings, nuclear power plants, and factories. It can also be used to destroy important hardened structures like command bunkers and aircraft shelters. It operates very much like a Maverick missile, but has an effective range of approximately five miles.

Other Stores:

In addition to any weapon systems you may load, you also have the option of equipping your F-16 with external fuel tanks or an ALQ-131 ECM pod.

External fuel tanks: You have your choice of two different fuel tanks — a 300-gallon tank that is loaded under the belly of your plane or two 370-gallon tanks that are loaded on the wings. Depending on the target distance of your mission, you may want to choose one or the other of these options. Remember, however, that adding additional fuel tanks will severely hamper your maneuverability.

ALQ-131 ECM pod: The ALQ-131 is an electronic countermeasures device designed to defeat radar lock-on from SAMs on the ground. It is primarily used on air-to-ground missions but is moderately effective against enemy aircraft radar lock-on. However, there is a catch. Turning on your ECM pod broadcasts your position to every enemy aircraft in the area. The ECM pod can only be mounted on the aircraft centerline, so it cannot be loaded with the 300-gallon fuel tank in place.

To add or subtract stores from your aircraft, choose a weapon in the selected category with the scroll arrows to the left of the weapons display, then simply select either the Load or Unload buttons just below the F-16 picture. The number of weapons loaded and the total number of weapons in stock are just to the right of the Load/Unload buttons. The # Loaded display will tell you how many units of a weapon are currently loaded and how many more could be loaded.

Flight #: This button cycles through the flights of allied aircraft.

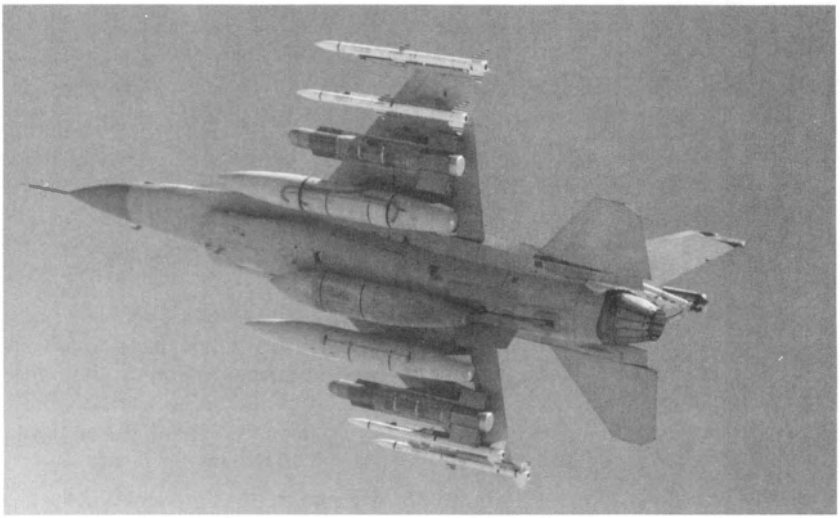
F-16: This button cycles through the aircraft in the current flight. The leader of the flight will be indicated in this button by the term LEADER. Wingmen will be indicated by the term 1st WING, 2nd WING, etc.

Clear All Weapons: This will remove all weapons and external stores from the current F-16, leaving only a pair of AIM-9Ps mounted on the wingtips.

Default Load: When you first enter the Load Armament screen, the computer will have determined a proper weapons load to carry out the aircraft's assigned mission. Select this button if you wish to cancel any changes you have made and restore the default load.

Aircraft Information: The screen in the lower right-hand corner displays the current F-16's loading information — its takeoff weight, the maximum Gs it can pull (with the current weight) and the amount of drag affecting the F-16. The higher the drag factor, the more "resistance to flight" the plane will have. Drag is based on the shape and weight of the armament loaded. Determining the best configuration for your aircraft is a balancing act between firepower, maneuverability and range. The success of many missions may be determined by your decisions here.

Takeoff: Select the takeoff button to begin the mission. Refer to **Section VIII: Flight** for detailed instructions on flying and using weapons. Refer to **Section XI: Aerodynamics and G Forces** and **Section XII: Advanced Fighter Tactics** for more advanced information about air combat.



SECTION

VII

CAMPAIGN

Campaign introduction

The Campaign is the core of *Falcon 3.0*. Here, you take the part of a squadron commander in one of three theaters of conflict: Kuwait, Israel or Panama. The outcome of each campaign may very well be determined by your performance on the battlefield. The Central Command of each theater will map out allied strategy for the war and send an Air Tasking Order (ATO) to your air wing. During the war you will be given a variety of different missions, ranging from simple aerial patrols to cutting off enemy supply routes to multiple-aircraft surgical strikes deep into enemy airspace.

Under your command are 30 pilots, each with their own strengths and weaknesses. As Squadron Commander it is your job to manage your men and equipment as best you can. The war will require a grueling schedule of four missions a day, and your pilots will get tired. Aircraft and supplies will not always be plentiful, so you will have to budget the equipment and stores for future missions. Initially you have 18 working F-16s assigned to your squadron, but this number will inevitably drop during the course of the war. Your job as commander is not simply a desk job — you will *lead* your men into battle as well.

You will plot each flight's route in and out of the target area. Since you have a limited amount of armament and because planes can be damaged or destroyed in combat, you need to keep track of current and forthcoming supplies. This is the second part of your duty as Squadron Commander.

Every so often, you will receive a number of new pilots, F-16s and armament. The day the armament comes in, there will be a mission to escort the C-130 cargo planes to your home airfield. If those C-130s don't make it, you won't receive your supplies and you will have to wait until the next supply date.

You will have specific objectives to accomplish in order to attain victory, but there is no certain path to achieve these goals. Wars are fluid, and the race is not always to the swift, the battle not always to the strong. Still, the victor is likely to be the one who can seize fortune

and turn it to his advantage. In *Falcon 3.0,* there is no fixed set of missions which you must successfully complete to achieve victory. Central Command creates missions based on the ever-changing war situation. You might end up in a long war of attrition, or you might swiftly end the battle with one surgical strike. Alternately, you might be so outnumbered in some campaigns that all you can hope for is to stave off the worst enemy attacks. The White House determines the campaign objectives based on both political and military considerations, and will define your conditions for victory on the War Update screen when you first enter a campaign.

The Campaign may seem daunting, but you are not alone. You will fly many missions in conjunction with other aircraft and ground forces. You will be called upon to act in both offensive and defensive roles. You will escort other planes on their missions and mow a path through forests of SAMs and nests of enemy fighters on the way to the target. You will provide air cover and close air support for ground operations. You will also receive needed help from other aircraft on your own missions. Since even the F-16 flies like a cow when loaded with heavy ordnance, you will need fighter escort for your bombing missions and perhaps SAM suppression as well. With so many aircraft in the air, you will also need to learn to identify other aircraft to avoid shooting down your friends.

The campaign will continue to progress in the background, with sorties and skirmishes going on, even when you are on the ground.

Starting a campaign

To begin a campaign, enter the War Room, select a squadron to command, choose a theater in which to fight, and then commit your squadron to action.

Choose a squadron

Before you can enter one of the three theaters, you must choose a squadron to command. In the War Room, you can choose a squadron by selecting the up and down arrows in the lower right-hand corner of the screen.

For more information on squadron selection and editing, see **Section III: War Room** (to choose a squadron) and **Section IV: Squadron Ready Room** (to edit or view a squadron's info).

Selecting a theater

Now that your squadron is chosen, you must select a theater of operations. *Falcon 3.0* has three theaters: Kuwait, Israel and Panama. In each theater, your squadron will need to accomplish a different objective. Further information on the different theaters can be found in **Section XIII: Theaters of Conflict**.

Click on the Theater button in the War Room and watch the map. Each time you select the Theater button, a small box will appear on the area of the map where the theater is located. When you decide on one, you'll need to commit your squadron to that campaign theater.

Commit to a theater

Once you have your theater selected and your squadron is ready to roll, you need to "commit" them to a theater. "Committing" places your squadron in Day 1 of a new campaign. If they were in another campaign at the time, a dialog box will appear asking you if you want to wipe out your squadron's old campaign. If you are continuing a previous campaign, just select your squadron and press the Commit button.

Overview of a campaign

What is a campaign? A campaign is a series of interlinked missions in a specific geographical war zone. Your F-16 squadron is but one offensive weapon in this war — other squadrons of various aircraft are also involved and may assist you by assigning planes to your missions. You may be also called on to provide support for bombers or ground troops. Overall, you will have a variety of missions to complete and the success of each will be a major factor in the campaign.

Campaign objectives

Each campaign has a specific objective that you must accomplish to win the war. At the beginning of each campaign, the War Update screen will explain how to become victorious in this theater. Complete theater objectives, backgrounds and rationales can be found in **Section XIII: Theaters of Conflict**.

War Update screen

In addition to giving you the conditions of victory at the beginning of the Campaign, the War Update screen will also appear just before the first mission of the day and give you a briefing of the prior day's events. In addition, at the beginning of the campaign, the War Update screen will give you a detailed description of the theater's objectives and how you should go about accomplishing them.

Campaign Information screen

At the beginning of each mission, you will be presented with a status screen showing the current date, time, weather forecast and a host of other items. Use this information as the basis for assigning planes and pilots to the current mission.

Mission Planning screens

Following the Campaign Information screen will be a series of screens where you can plot out your mission. Here, you can add or subtract planes from the mission, change the flight route in and out of the target area, assign pilots to planes, and load weapons on those aircraft.

Flying the mission

Once you select the Takeoff button on the last Mission Planning screen, you'll be placed in your aircraft on the runway. From here you can follow your prescribed flight route in and out of the target area and then return to base. Any wingmen you have will automatically follow your aircraft.

Debriefing screens

After your mission is over — whether you fail or succeed — you will be presented with a debriefing sequence. Debriefing will show all the relevant statistics of your current mission and allow you to view your squadron's records. In addition, medals will be awarded here if any of your pilots have earned them.

Summary

All of these stages comprise a campaign. Campaign Information, Mission Planning, Flying the mission, and Debriefing will be repeated up to four times a day for as long as the

campaign lasts. Whether you have won or lost, you can then *lead* your surviving pilots into combat in a new theater.

Who you are

The most important thing to remember is that the plane you will actually fly on a mission in a campaign is F-16 #1 of Flight #1. In each mission, Flight #1 has been already created with one F-16 as the leader of that flight. You are not only the Squadron Commander, but you're also a pilot.

When you choose a pilot for F-16 #1 of Flight #1, you become that pilot. His ability scores are no longer valid for that mission because you are assuming his identity. If you are successful in combat, that pilot's ability scores will increase; if you fail, his scores may decrease. In addition, computer-controlled pilots will increase and decrease their skill levels based on their successes or failures. More information on a pilot's ability scores can be found in **Section IV: Squadron Ready Room**.

The Enemy

As a military commander your primary objective is to destroy the enemy's war fighting potential. While the enemy forces will vary from theater to theater, they will always contain the following components:

Ground Forces

Consisting primarily of armor, infantry and artillery, with support from transportation and anti-aircraft defense units, the army is always the core of any war fighting machine. Its effectiveness, however, is strongly influenced by the other components. You will be targeting enemy troops in three situations. When friendly ground forces come under assault, they may request air power to blunt the enemy attack. They will also request close air support for offensive maneuvers if the battalion commander believes that his own firepower is insufficient for the task. Finally, you may be assigned to interdict the enemy's second echelon forces before they can reach the battlefield.

Air Power

Unhampered, air power can have a devastating effect on opposing ground forces. Gaining air superiority is essential to a successful war effort. At minimum, you must deny it to the enemy. Achieving air superiority will require suppressing all parts of the enemy's air power complex, including runways, hangars, command centers and radar installations, as well as destroying the enemy aircraft themselves.

Command, Control and Coordination (C^3)

Operation Desert Storm demonstrated both sides of the C^3 equation. The Coalition had excellent C^3; Iraq had none by the time the ground war started. Destroying the enemy's C^3 structure will require a systematic and persistent campaign of bombing strikes against headquarters, command centers, and radar and communication facilities.

Logistics

Every army runs on its stomach. A logistics system has three main components which can be attacked and destroyed. First, is the production capacity of war materials by the enemy's industrial complex. Military targets will include weapons and munitions factories, machine

factories, oil and chemical refineries, and any chemical, biological or nuclear weapon research and production facilities the enemy may possess. Second, the enemy will have a reserve supply of war materials when the campaign starts. These stockpiles, held in warehouses, railyards, and Petroleum, Oil, and Lubricants (POL) and chemical storage tanks, might actually represent a more important target initially than the production facilities themselves. Finally, the supplies must be transported. Supply route targets include bridges, railroad trestles and the transport vehicles (cargo planes, trains and trucks).

The relative importance and vulnerability of these components will vary from campaign to campaign for both sides. Political as well as military considerations can make some assets unassailable. In Kuwait, for example, most of the Coalition logistics system is too well defended for the Iraqi Air Force to attack. Only the forward supply depots and transportation vehicles are at risk. At the same time, most of Iraq is within range of your F-16. In Panama, the rules of engagement preclude attacks on the home countries of the enemy forces, so only assets near the battle can be attacked. In Israel, the situation is fairly balanced.

While Central Command determines overall strategy, you still must make important decisions within this framework. In choosing targets, always remember the Golden Rule: Whatever you are trying to do to the enemy, he will be trying to do to you.

War Update screen

The War Update screen displays the morning's military news. This news report will give you a feel for what is happening in the war. Remember that your F-16 squadron is not the only unit operating in the theater. You will find out the results of other war actions here. This screen is shown immediately before your first mission in a campaign and at the beginning of each day.

Before a campaign

Just before your first mission in a campaign, the War Update screen will provide information on your campaign's objectives and what steps you need to take in order to win the war. Your F-16 squadron is a pivotal instrument in each campaign; if you make constant mistakes during the course of your missions, the tide of the war will most surely turn against you.

Before each day

In addition, before your first mission of each day, you will be presented with an update on what happened in the war the previous day. You will be told how your squadron fared in its mission as well as what other squadrons and land-based units managed to accomplish.

Campaign Information screen

Your squadron must undertake up to four missions a day, and the Campaign Information screen gives you the following logistical information pertinent to your duties as squadron commander along with a current weather report:

Current Date

This displays the date and time of your upcoming mission. There are four different times you will be flying in *Falcon 3.0:* early morning, mid-morning to afternoon, evening and night. All times are displayed in standard military time format.

Available Aircraft

This line shows the number of air-worthy F-16s you have assigned to your squadron. You will start out with 18 F-16s, but during the course of the war some may be damaged or lost.

Available Pilots

This line displays the number of pilots you have remaining in your squadron. You begin with 30, but if any are lost in combat, this number will diminish.

Current Weather

This tells you the current weather conditions. It will also let you know of a cloud ceiling (if any) and its elevation.

Tomorrow's Forecast

Similar to the Current Weather line, this is the prediction for the next day's weather. It isn't 100% accurate, however, so you may need have a contingency plan if the weather ends up being rough.

Resupply Date

The Resupply Date lets you know when you will be resupplied with weapons, fuel and other stores. One of the important missions on the resupply day is to escort your cargo planes to your home base.

Replacement Date

The Replacement Date tells you when new pilots and replacement F-16s are due to arrive at your home base. Usually, every few days, you will get some new pilots and planes to replace any lost in the war. Don't rely on this, though, since aircraft are in short supply and you might not receive any for a long stretch of time.

Mission Planning screens

The tools for Mission Planning consist of a number of screens where you can choose and edit your current mission. You can modify nearly every aspect of your mission on these screens. You make the following decisions: the number of F-16s to fly, the formation type, the route in and out of the target area, which pilots are going to fly, and what the ordnance loads will be on each F-16. If you already familiar with Red Flag mission planning, you will notice a few differences here. Your missions will be assigned; you will only control the flight paths of your own squadron, and some of the four allied flights may be allocated to other squadrons. There are also intelligence and reconnaissance tools not available in Red Flag. You must fight with limited equipment and stockpiles. Finally, your pilots can actually die in a campaign.

Correct planning is the key to your success on a mission. However, if you are a beginning player and don't want to go into all the complexities of planning a mission, defaults for each

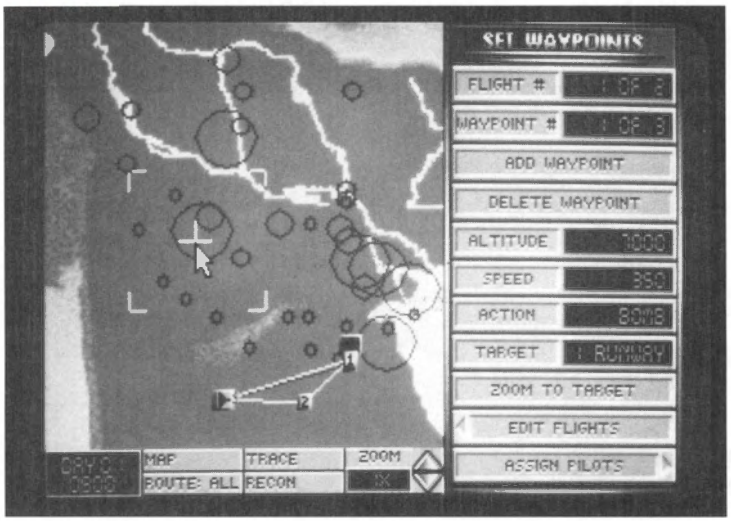
screen will be given. All you will need to do to accept the mission defaults is to hit the Enter key as each screen appears.

Choosing mission parameters

Before you start to plan a mission, there are a few things to realize about how Mission Planning works. There are three distinct areas on the Mission Planning screens: the map, the map controls and the button panel. From the keyboard, you can cycle through the three areas by pressing Tab.

Complete commands for controlling the cursor on the map can be found on the **Quick Reference Card** included in your *Falcon 3.0* box.

The map



Icons: The Theater map will display the topography of the region along with markers pertinent to the particular mission planning screens. Red map icons indicate an enemy-held target site; Blue icons mark the position of sites held by the allies. (The meaning of these icons is given in **Section XV: Reference.**) Beginning on the Edit Flights screen, you should see waypoint indicators connected by lines representing the flight paths assigned to your F-16s for the mission. Starting with the Set Waypoints screen, threat circles will be shown on the map as well.

Waypoints: Waypoints have two functions. They represent both the turning points in the flight path and the point where an aircraft will switch to a new mode of action. Each waypoint has its own action associated with it. Some actions, such as ESCORT and INTERCEPT, are performed between waypoints (and start after passing the *previous* waypoint), others, such as TAKEOFF, BOMB and LAND, are performed at the waypoint itself. The various actions which can be assigned to a waypoint are described below.

The waypoints determine the path for all the computer-controlled aircraft except the wingmen in Flight #1, who will follow your lead. Whenever you engage the autopilot,

however, your plane will head toward the next waypoint and switch to the assigned action mode for that waypoint.

To move a waypoint, place the pointer over the waypoint icon, press the left mouse button or the Shift key on the left side of the keyboard, and drag the waypoint icon to the position you want with the mouse or arrow keys. If you drag it close to a map icon, it will snap to that location.

When an individual waypoint is selected, you will be able to edit all the information for that waypoint with the button panel.

Threat circles: The threat circles map the range of influence of the major known enemy air-defense installations. The Trace and Recon buttons will give you more detailed information on the types of threats these circles point out.

Moving the map: To scroll the map, hold down either the right mouse button or the Shift key on the right side of the keyboard and then drag the zoom box with the mouse or arrow keys to the position you want.

The map controls

The map controls are used to manipulate all the features relating to the map. These are listed below:

Time: This readout displays the time of day for the current mission. All times are displayed in military time.

Tact/Strat: This button has six positions that are used for displaying information on the map. Three of the positions are tactical, and three of them are strategic. All tactical positions will show your home airfield and the mission target, while all strategic positions will show all friendly and enemy occupied key areas. These are the six positions: Tact 1 (shows grid and scale), Tact 2 (shows grid only), Tact 3 (doesn't show grid or scale), Strat 1 (shows grid and scale), Strat 2 (shows grid only), and Strat 3 (doesn't show grid or scale).

Route: This button gives you the option to display either all flight routes or only the highlighted route.

Trace: Selecting the Trace button will examine the current flight path for enemy threats and activities. The Trace button becomes enabled on the Edit Flights and Set Waypoints screens. When you press this button, the computer will begin "tracing" your flight route from your home airfield to each waypoint on your flight. The threats it will display are air-defense radar installations (primary and secondary) and enemy fighter bases. Each threat circle will have a number associated with it which will appear with a threat description on a small video screen to the right of the map. Select the Done button when you are ready to return to the main display.

NOTE: the accuracy of this information depends on the level you have set in the Intelligence setting on the Configuration screens. See **Section IX: Configuration** for more details.

Recon: The Recon feature gives you an aerial reconnaissance view of the map, showing the last known position of ground forces. Note that this information can be up to a week old. When you select the Recon button, the map will zoom in on the cross hairs and show icons marking the unit positions. Anti-aircraft weapons will have a circle marking their range of fire.

NOTE: the accuracy of this information depends on the level you have set in the Intelligence setting on the Configuration screens. See **Section IX: Configuration** for more details.

Zoom: The Zoom button (or the [+] and [-] keys on the keyboard) allows you to change the magnification of your map so that you can plot waypoints more precisely. You will zoom in or out on the rectangle-shaped area that surrounds the cross hairs. It magnifies your view in the following increments: 1x, 3x, 8x and 20x. After 20x, the view changes to an aerial view of the 3-D landscape. You can continue to zoom in to 50x, 120x and 250x.

When you reach 250x, you can slowly increase magnification all the way to 999x. The more you increase your view, the lower the angle of viewing becomes. This allows you to see the horizon and gain a different perspective of your viewing area.

By using the same controls as in moving the map, you can move around and see different parts of the map in 3-D perspective.

The button panel

You use the button panel on the right side of the screen to make modifications to your current mission. Buttons with arrows on the left-hand or right-hand side will take you to new screens. The bottom button on any screen will bring you to the next screen, while the second button from the bottom will return you to the previous screen.

The half-size buttons with LED displays allow you to cycle through a series of options with the mouse buttons or [Shift] keys (the Formation button) or to enter a number with the keyboard (the Altitude button).

If a button has diagonal gray stripes across it, that button is disabled.

The button panel video screen

Above many of the button panels a small video screen will appear containing a list of information. To select items from the list, you can either highlight the item directly with the pointer or scroll the list with the scroll arrows located to the right of the screen.

Report screen

The Report screen gives you a great deal of information about the war, in addition to statistics on aircraft and ground units for allied and enemy forces.

Campaign Status: This button will bring up a screen that displays information about your current campaign including day, time, how much of the conflict area is occupied by allied and enemy forces, missions flown and completed, sorties flown, and a complete breakdown of allied and enemy aircraft and targets destroyed.

Supply Status: This button bring up a screen that shows your total stores you have available. If stores become scarce, you may need to budget your weapons for upcoming missions.

Allied Aircraft: See Mission Computer below.

Enemy Aircraft: See Mission Computer below.

Allied Forces: See Mission Computer below.

Enemy Forces: See Mission Computer below.

Occupation: This button will bring up the campaign map with areas colored in red and blue. Areas in pure red represent enemy occupation, while areas in blue show allied occupation. When areas in blue and red overlap, you will see a purplish effect. This is the battlefront — areas of major conflict where most of your missions will take place. Keeping track of the changes on this screen over time will give you a good indication of how well the war is going.

Mission computer

The middle buttons on this screen access the mission computer. The mission computer allows you to view 3-D models, photographs, and specifications for every aircraft and ground vehicle in the game. You can use this information to identify aircraft and ground units (enemy and friendly) and to learn their capabilities, strengths and weaknesses.

To use the mission computer, select the button of the type of unit you wish to view. The screen will change to display the mission computer, which contains information on all aircraft and ground vehicles for both sides.

The mission computer displays the specifications for the current vehicle or aircraft, a photograph, and a rotating 3-D model.

View: The View buttons will cycle the display through the list of aircraft or vehicles you selected when you engaged the mission computer. Use the mouse or the [←] and [→] keys to operate the View buttons.

Scroll text: The scroll text buttons move the text up and down on the screen. Use the mouse or the [↑] and [↓] keys to operate the Scroll Text buttons.

Exit: To return to the Report Screen menu, select the Exit button with the mouse or press the [Esc] key.

Done: When you are finished studying the information on the report screen, select Done.

Briefing screen

Missions are sent to your air wing by the Cent Com Air Liaison Officer (ALO). There are three squadrons of F-16s in your wing, but yours gets first choice of missions.

Campaign map

On the left-hand side of the screen is your campaign map. Each mission will show an icon for your home base and an icon for that mission's target. Blue icons represent allied-controlled areas, while red icons represent enemy-owned areas.

The mission briefing can be found just to the right of the map in the video screen. This gives pertinent information about the name of the target area, type of target, characteristics of the mission and any additional planes that may accompany you.

Occasionally, you will be sent on a mission with accompanying aircraft. These extra aircraft will generally be either fighters that are designed to fly Combat Air Patrol (CAP) for you or bombers/transports that you need to protect.

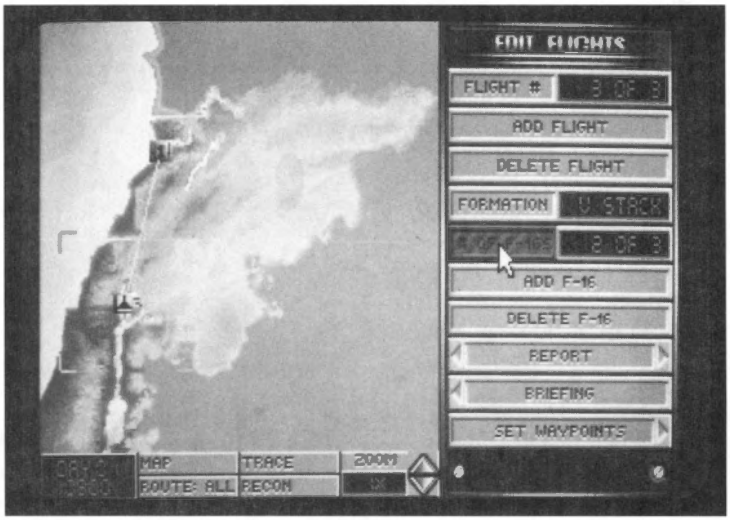
One you have reviewed your mission, press the Edit Flights button to go to the Edit Flights screen.

Edit Flights screen

The flights and routes for your aircraft will already be set up for the mission, but you can alter them in the Edit Flights screen if you wish. A maximum of eight aircraft arranged in up to four flights can be assigned in each mission. This number includes any flights of aircraft from other squadrons that are also involved in the mission.

If you plan to adjust your flights, we highly recommend keeping aircraft in pairs. In actual combat, a pilot would rarely fly solo because there would be no one to cover his back.

In addition, if your mission is to destroy an entire airbase (including runway, hangar and tower targets), you may want to break up into multiple flights so each flight can attack a specific target at the destination. See the Set Waypoints screen for more information.



Flight #: This button cycles through the existing flights of aircraft.

Add Flight: This button adds a new flight path with one aircraft. If this button is shaded, it means that you have either already assigned all the aircraft available for the mission or there are already four flights created.

Delete Flight: This button will delete the current flight of aircraft.

Formation: This button allows you to change the formation of the current flight of aircraft. The possible formations are: V STACK, H STACK, C STACK, LADDER, WEDGE, VIC and ECHELON. Explanations of these formations are described in **Section XII: Advanced Fighter Tactics**.

# of F-16s: This button allows you to increase and decrease the number of F-16s on the current flight. The LED displays the number of aircraft assigned to the current flight along with the maximum number of planes that could be assigned to the flight. You may have a maximum of eight F-16s per flight.

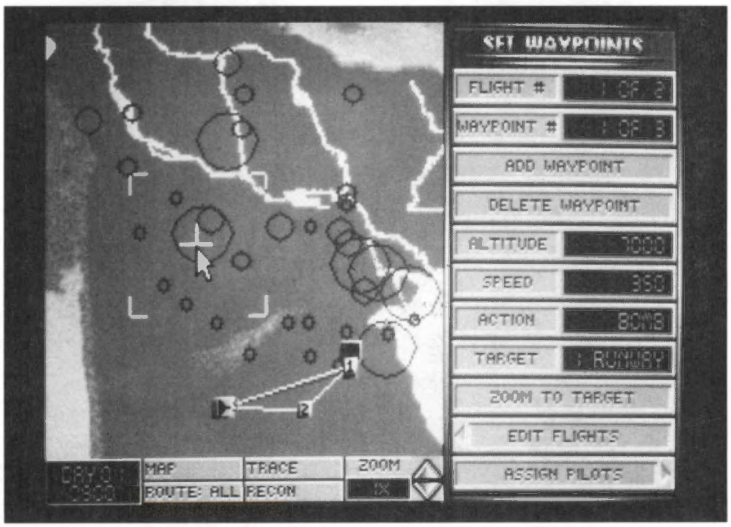
Add/Delete F-16s: These buttons will add or subtract aircraft from the current flight.

Once you have made any changes to your flight, select the Set Waypoints button.

Set Waypoints screen

The waypoints for the mission have already been set up, but you can alter them if you wish. Remember, however, that the flights of other non-Falcon aircraft in the mission will not alter their flight plans to accommodate you. You may want to alter your waypoints if, by using the Trace and Recon buttons on the map, you determine that the threats are too great on the current waypoint settings.

There are a maximum of eight waypoints per flight. Note that individual aircraft in a flight cannot have individual actions at a single waypoint.



Flight #: This button cycles through the existing flights of aircraft.

Waypoint #: This button cycles through the existing waypoints of the current flight. The information displayed by the Altitude, Speed and Action buttons will correspond to this waypoint.

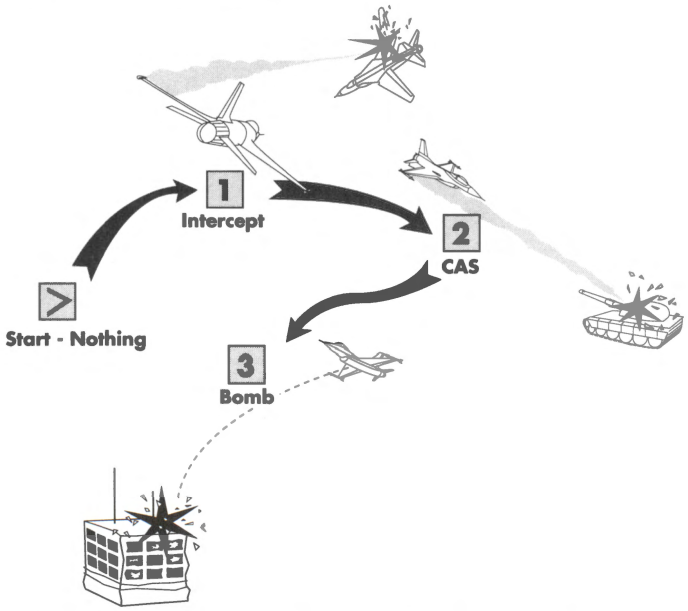
Add Waypoint: This button adds a new waypoint after the current waypoint.

Delete Waypoint: This deletes the current waypoint from the flight you are working on.

Altitude: After selecting this button, type in a number (from 0–70000) to set the altitude *above ground level* (AGL) at which the flight will approach the waypoint.

Speed: After selecting this button, type in a number (from 160–1350) to set the speed (in knots) at which the flight will approach the waypoint. Unless they encounter hostile forces, the flight will maintain this speed at the set altitude once they pass the previous waypoint. Remember, however, that the top speed of some aircraft is limited. Check the Report screen or **Section XV: Reference** for more information on aircraft specifications.

Action: This button allows you to assign a particular action that the flight will perform as it approaches the waypoint. You may need to give the aircraft time to prepare for an upcoming action. Once the flight passes this waypoint, the aircraft will switch to the action mode of their next waypoint.



As it flies along this path, the flight will INTERCEPT enemy aircraft between Start and waypoint 1, look for ground forces to destroy (CAS) between waypoint 1 and waypoint 2, and will prepare to BOMB the target at waypoint 3 as soon as it passes waypoint 2.

The possible actions are:

NOTHING: The flight will take no action. It will simply continue on to the next waypoint. Aircraft on the flight will defend themselves if attacked, but they will not actively search for enemy aircraft or ground units.

CAP: Combat Air Patrol. The flight will seek to protect the area along their flight path from enemy aircraft. Aircraft will not attempt to locate or destroy any unfriendly ground units they encounter, nor will they stray very far from their assigned flight path to chase enemy planes. You can use a string of CAP waypoints to make your aircraft circle an area (see LOITER). Use this action to provide air cover over a localized area. Use INTERCEPT for wider coverage.

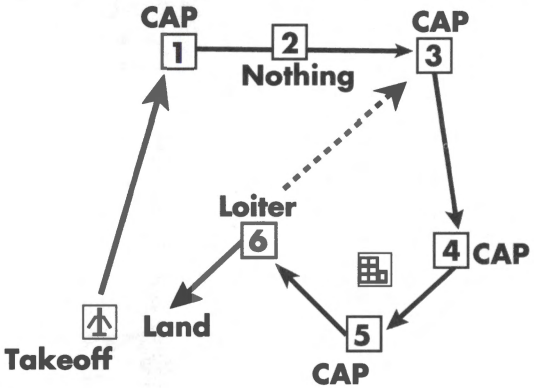
CAS: Close Air Support. The flight will actively search for unfriendly ground units to destroy. Aircraft will not attempt to locate or destroy enemy aircraft. The aircraft in the flight will need time to select A-G weapons and acquire targets, so any CAS waypoint should be placed at least seven miles from the previous waypoint.

SAND D: Search and Destroy. This option combines the functions of CAP and CAS. The flight will aggressively engage and destroy all unfriendly aircraft and ground units it can find.

BOMB: The flight will bomb the target chosen with the Target button (described below). Since all planes in a flight will bomb the same target, you should set up a flight for each target to destroy multiple targets at one site. If the waypoint is not near a target site, no target can be selected and the flight will drop their bombs on the dirt. Computer-controlled planes will only make one pass at the target. The aircraft in the flight may need up to 15 miles to select weapons and acquire their target for this action.

INTERCEPT: The flight will engage and seek to destroy all enemy aircraft they detect. Use this action for a wide area defense and for aggressive patrols. Do not use it to defend a localized area, because the flight may wander far from their assigned flight path to pursue hostile aircraft, leaving the area undefended. Use CAP instead.

LOITER: This action is used in conjunction with CAP to set up a continuous patrol.



Normally after passing a CAP waypoint, the flight will continue on to the next waypoint. Using LOITER, however, you can instruct the flight to repeat a string of CAP waypoints until they run low on fuel. To do this, create a number of consecutive CAP waypoints around the area you want the flight to patrol. After the last CAP waypoint, create a LOITER waypoint. When the flight reaches the LOITER waypoint, the pilots will calculate the fuel needed to redo the circuit. If they have enough, they will continue the patrol; otherwise they will return to base. Note that the flight will only repeat a consecutive string of CAP waypoints immediately preceding the LOITER waypoint. If a waypoint of another action separates the CAP and LOITER waypoints, any CAP waypoints before this other action are not repeated. No waypoints other than CAP can be repeated with LOITER.

ESCORT: The flight will protect a corridor around their assigned flight path from incursion by enemy fighters. They will stay as close as possible to their flight path and will not engage aircraft which do not pose an air-to-air threat to the escorted flight, such as strike aircraft or non-aggressive fighters. To use this action effectively, the speed and flight paths of the escorting flight should match those of the flight it is escorting.

LAND: This should be set only at an airfield. If you program a waypoint for landing where there is no airfield, those aircraft will attempt to land on whatever terrain they find. Use this action with caution. This action will automatically be set for the last waypoint of the route.

TAKEOFF: The TAKEOFF action will only affect your personal F-16. The action can only be assigned to the start waypoint of your flight path and only when this waypoint is over your home base. The wingmen in your flight will already be in the air circling the airfield waiting for you to take off.

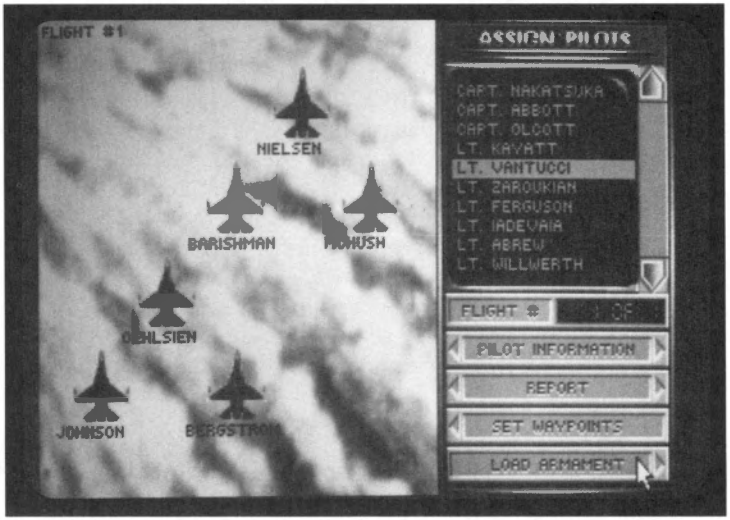
Target: Selecting this button will cycle through the target frag list and assign the displayed target to the flight. The frag list contains the most significant military targets at the site, in order of importance. The Target button will only be enabled when the Action button displays BOMB. If you move the waypoint away from the site, the target selection will be reset to the top of the list, even if the waypoint is subsequently returned to that site.

Zoom to Target: Clicking this button will zoom the map display to a 3-D close-up of the assigned target to help you identify your objective when you reach the target site. The zoomed image will rotate, giving you a 360° view of your target, until you click the mouse button or press the Enter key.

Once you are satisfied with your flight plan, select the Assign Pilots button.

Assign Pilots screen

The Assign Pilots screen allows you to select particular pilots to fly the F-16s in a mission. You will only be able to assign pilots to the F-16s in your flight. All other aircraft will have their own pilots automatically assigned. If your pilots fly on too many consecutive missions they will become fatigued and their performance will drop. The pilots assigned when you first enter the Assign Pilots screen will be the freshest, but if you reassign pilots, be aware of the Fatigue rating of your pilots given on the Pilot Information screen.



During the mission, you may receive radio messages on the top of the screen from other aircraft. You can recognize the F-16 pilots from your squadron by their callsigns. Non-F-16s will be identified by their aircraft type (A-10 #1, C-130 #3, etc.). An explanation of these radio messages can be found in **Section VIII: Flight.**

Pilot roster: The pilot roster is displayed on the small video screen on the right. This is a list of all the F-16 pilots in your squadron. To assign a pilot to an aircraft, simply highlight a name on the list with the scroll arrows, then select the F-16 you want him to fly. The pilot that was assigned to that aircraft will be returned to the roster.

Flight #: This button cycles through the flights of aircraft.

Pilot Information: This button will bring you to the Pilot Information screen where you can view the pilots in your squadron.

Pilot Information screen

The Pilot Information screen allows you to view individual pilots in your squadron. The left side of the screen contains important information about these pilot's abilities such as the number of sorties (missions) flown, the number of enemy aircraft shot down, the number of ground targets destroyed, and any medals and commendations that have been awarded. In addition, you can view the pilot's face, name, rank and callsign. (A complete explanation of pilot abilities can be found in **Section IV: Squadron Ready Room**.)

In a campaign setting you can use this screen to determine who is best suited for a particular mission. For example, if you were conducting a bombing mission, you would look for a pilot that is particularly skilled in Bombing Accuracy and Flying Ability to accompany you on your bomb run.

Pilot roster: To view the statistics of a particular pilot, highlight the pilot's name on the small video screen.

Name: To change a pilot's name, select this button and type in the new name. The new name can have up to 12 letters.

Callsign: Use this button to change a pilot's callsign. The new callsign can have up to 15 letters. Any radio messages you receive from a pilot will use the callsign, rather than the name.

Change Face: Press this button to cycle through the available faces for your pilot.

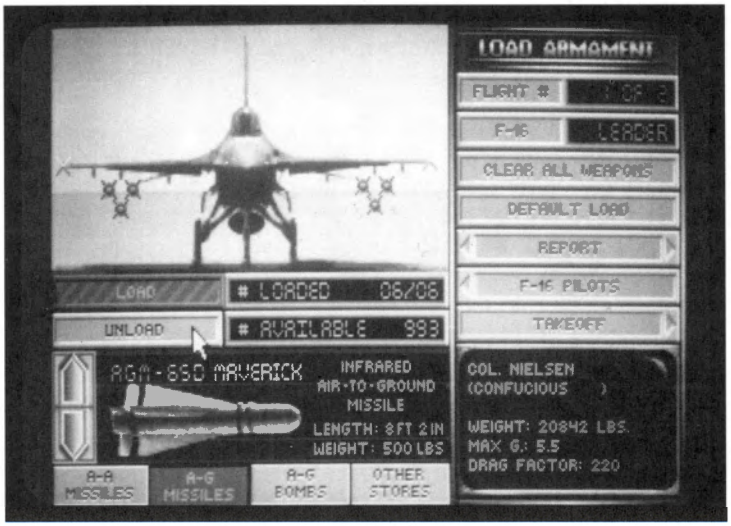
Awards: Select this button to change the left side of the screen to display the awards a pilot has received instead of the pilot information. Awards are given to recognize excellent performances in combat. To redisplay the pilot information, select the Information button (which has replaced the Awards button in the menu).

Done: Select this button to return to the Assign Pilots screen.

Load Armament: When you are satisfied with your pilot assignments, press this button to advance to the Load Armament screen, the last step before takeoff.

Load Armament screen

The Load Armament screen allows you to customize the weapons load of the F-16s in the mission. The planes will already be loaded with a basic set of weapons to carry out their assigned mission, but you can change the armament if you wish.



Loading Armament: The left side of the screen shows a picture of an F-16, a number of buttons and a weapons display. The F-16 has four pylons or "hard points" per wing as well as a centerline mount on which weapons and other stores can be loaded. Note that the heavier weapons and stores can only be loaded on the inner pylons. These items will also be both loaded and dropped in tandem to maintain the aircraft's balance during flight. The M61A1 20mm cannon is mounted internally and is always loaded with 515 rounds.

To load a weapon or another type of store, first select the category of weapon with the buttons on the bottom of the screen. Then select the Load button. You may also click directly on a weapon or store on the F-16 to bring up its selection in the weapons display window. You have a choice of A-A Missiles, A-G Missiles, A-G Bombs and Other Stores. The various weapons and stores are briefly described below:

A-A Missiles:

There are three different air-to-air missiles that you can load: the AIM-9P and -9M Sidewinders and the AIM-120 AMRAAM.

AIM-9P and -9M: The Sidewinders are heat-seeking missiles. The AIM-9P is a rear-aspect missile with an effective range of approximately 10 miles. The AIM-9M is an all-aspect missile with a range up to 10 miles. The rear-aspect AIM-9P requires that you be behind an enemy aircraft in order to get a good lock. The all-aspect AIM-9M can lock on to an aircraft from any angle or aspect.

AIM-120: The AMRAAM is an active-homing radar-guided missile which has an effective range of approximately 25 miles and is designed for use beyond visual range (BVR). The problem with carrying AMRAAMs is that each one of them weighs nearly

twice as much as a Sidewinder. This affects your aircraft's maximum Gs and drag, which are major factors in air-to-air combat.

A-G Missiles:

There are four types of air-to-ground missiles and one air-to-ground rocket launcher: the AGM-65B and -65D Mavericks, the AGM-45A Shrike, the AGM-88A HARM and the LAU-5003A rocket launcher.

AGM-65B and -65D: The difference between the AGM-65B and -65D is that the -65B is optically-guided while the -65D is infrared-guided. The AGM-65B is much more effective in the daytime, while the -65D can be used at night. Both Mavericks are effective against tanks, trains and other small targets. These two weapons have an effective range of approximately 14 miles.

AGM-45A: The Shrike anti-radiation missile is designed to take out SAM sites and radar installations. It has an effective range of approximately 12 miles.

AGM-88A: The HARM anti-radiation missile is similar to the Shrike. The HARM has twice the range and weighs twice as much as the Shrike. The effective range of the HARM is approximately 30 miles.

LAU 5003A: This rocket launcher contains 19 small rockets which are fired individually. It has an effective range of approximately 3–4 miles and is primarily used for CAS on "soft targets" such as trucks, jeeps and infantry.

A-G Bombs:

There are seven different types of bombs: the Mk82, the Mk82HD, the Mk83, the Mk84, the Durandal, the CBU-84 and the optically guided GBU-15.

Mk82, Mk83 and Mk84: These weapons are standard iron bombs that have been used in one form or another for the past 20 years. The differences between them are the munitions load (500, 1,000 and 2,000 pounds respectively) and the corresponding weight. You should base your choice of iron bombs on the size and "hardness" of the target.

Mk82HD: The Mk82HD (High Drag) bomb should be used instead of the other iron bombs for low altitude drops, so that the bombs will decelerate sharply and explode behind, rather than underneath, your plane. It otherwise contains the same munitions load as the Mk82.

Durandal: The Durandal is only used for destroying runways. Upon impact, the Durandal will plow under the surface of the runway and explode outward. This will buckle the runway and create a sub-surface cavity much more difficult to repair than a normal bomb crater.

CBU-84: The CBU-84 releases a cluster of 202 bomblets that disperse over a wide area. Use this weapon to defeat infantry and other soft targets such as trucks, jeeps and light armor.

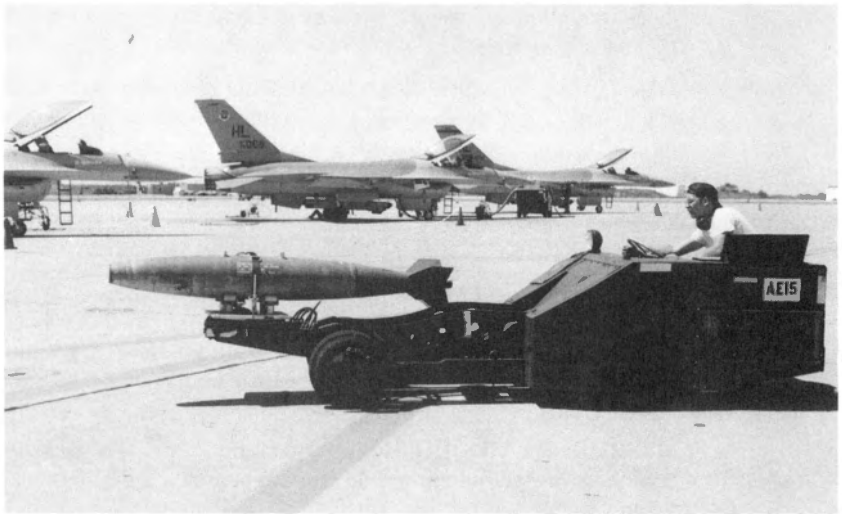
GBU-15: The GBU-15 is a precise optically-guided bomb that is used to destroy large targets like buildings, nuclear power plants and factories. It can also be used to destroy important hardened structures like command bunkers and aircraft shelters. It operates very much like a Maverick missile, but has an effective range of approximate five miles.

Other Stores:

In addition to any weapon systems you may load, you also have the option of equipping your F-16 with external fuel tanks or an ALQ-131 ECM pod.

External fuel tanks: You have your choice of two different fuel tanks — a 300-gallon tank that is loaded under the belly of your plane or two 370-gallon tanks that are loaded on the wings. Depending on the target distance of your mission, you may want to choose one or the other of these options. Remember, however, that adding additional fuel tanks will severely hamper your maneuverability.

ALQ-131 ECM pod: The ALQ-131 is an electronic countermeasures device designed to defeat radar lock-on from SAMs on the ground. It is primarily used on air-to-ground missions but is moderately effective against enemy aircraft radar lock-on. However, there is a catch. Turning on your ECM pod broadcasts your position to every enemy aircraft in the area. Because the ECM pod can only be mounted on the aircraft centerline, it cannot be loaded with the 300-gallon fuel tank in place.



To add or subtract stores from your aircraft, choose a weapon in the selected category with the scroll arrows to the left of the weapons display, then simply select either the Load or Unload buttons just below the F-16 picture. The number of weapons loaded and the total number of weapons in stock are just to the right of the Load/Unload buttons. The # Loaded display will tell you how many units of a weapon are currently loaded and how many more could be loaded. The # Available button tells you how many are in your storage reserves.

Flight #: This button cycles through the flights of allied aircraft.

F-16: This button cycles through the aircraft in the current flight. The leader of the flight will be indicated in this button by the term LEADER. Wingmen will be indicated by the term 1st WING, 2nd WING, etc.

Clear All Weapons: This will remove all weapons and external stores from the current F-16, leaving only a pair of AIM-9Ps mounted on the wingtips.

Default Load: When you first enter the Load Armament screen, the computer will have determined a proper weapons load to carry out the aircraft's assigned mission. Select this button if you wish to cancel any changes you have made and restore the default load.

Aircraft Information: The screen in the lower right-hand corner displays the current F-16's loading information — its takeoff weight, the maximum Gs it can pull (with the current weight) and the amount of drag affecting the F-16. The higher the drag factor, the more "resistance to flight" the plane will have. Drag is based on the shape and weight of the armament loaded. Determining the best configuration for your aircraft is a balancing act between firepower, maneuverability and range. The success of many missions may be determined by your decisions here.

Takeoff: Select the takeoff button to begin the mission. Refer to **Section VIII: Flight** for detailed instructions on flying and using weapons. Refer to **Section XI: Aerodynamics and G Forces** and **Section XII: Advanced Fighter Tactics** for more advanced information about air combat.

Flying the mission

Once you click the Takeoff button, you will be placed in your cockpit on the runway. Now your mission begins in earnest. There are three steps you need to take to complete your mission: 1) Fly to the mission area, 2) Accomplish the mission objective, and 3) Return to your home airfield. These three are described below:

The missions assigned to you will require all of your resourcefulness and demand that you match your temperament to the situation. The cautious pilot lives to fly another day, but wars are not won with timidity. Restraint might accomplish your mission, or you might have to resort to reckless abandon. If you thunder off after the first bogey you spot while escorting a flight of B-52s, the BUFFs will be left easy prey for the MiG you didn't see behind you. In other missions, though, you must storm into enemy airspace broadcasting your position to every enemy pilot, daring them to take you on. You will go on Wild Weasel hunts using your own plane as bait for radar-guided missiles in a deadly game of roulette with SAMs. Courage alone is not sufficient. To complete your mission, you will need skill, knowledge and a steady hand at the controls.

1) Fly to the mission area

Whether you're on a bomb run, intercept or close air support mission, there will always be a target area you need to reach. Your first priority is to reach that target area in one piece. Your F-16 has some features that can help you find and reach that target quickly. They are the autopilot and accelerated mode.

Finding the target

To find your target, simply follow the route marked by your waypoints. Since most of the navigational aides you have are based on the waypoints set up in mission planning, you should memorize which actions you are supposed to take at each waypoint. Two indicators on the aircraft HUD will help you reach the waypoints. On the heading scale there is a marker indicating the direction of the waypoint. On the right-hand bottom of the HUD, you are given the distance to the next waypoint in the form "25D1." The first number is the distance, in this case 25 nm. "D" is for "Destination, and the last number is the waypoint.

Once you reach a waypoint, the indicators will switch to the next waypoint on the route. You can also request waypoint information from the AWACS plane by pressing Shift N. To bypass a waypoint, you must request permission from the AWACS with Shift B (you will not be able to bypass your last waypoint). Pressing Shift V requests permission to revisit a previous waypoint.

Autopilot

When you engage the on-board autopilot (by pressing the A key), your F-16 will turn immediately toward the next waypoint and attempt to follow any of the instructions you gave to that flight route in the Set Waypoints screen. You can find out where your next waypoint is by asking the folks in the AWACS plane for directions (Shift N).

Accelerated mode

One fighter pilot described a combat mission as "three hours of boredom and ten minutes of stark terror." Fortunately, in the simulation we have added an accelerator mode to cut out the boredom. The terror is your problem.

By pressing and holding the Tab key, however, you can increase the rate of events in the simulation. The speed of all aircraft, ground units, missiles, etc. will be increased by four times (4x). If you press the Shift and Tab keys simultaneously, your plane will be locked into accelerated mode. You can go back to normal mode by pressing the Tab key again. However, if enemy planes enter your airspace when you are in locked accelerated mode and you don't turn it off, you may find yourself with a missile up your tailpipe!

Accelerated mode is useful for flying through the "dead space" in the world. For example, if you know that the next 20 miles of territory are empty of threats, you can use the accelerated mode to quickly get through this area.

Warning: You should engage autopilot before locking accelerated mode. If you don't, you might become the world's biggest lawn dart.

2) Accomplish the mission objective

When you reach the target area for your mission, you should make your best attempt at completing your mission before returning home. Obviously, if the other three planes on your flight have been downed and you're up against six MiG-29s, you shouldn't risk your plane trying to take out more ground targets. Of course, if you *do* manage to defeat those six planes, you'll surely be up for a high commendation!

Remember that any computer-controlled planes will only take one run at a target on a bombing mission. If you fly over a target for another pass — especially one that's heavily defended — you're likely to come away with casualties.

Ejecting

You can eject from your aircraft by hitting Ctrl E three times in succession (Eject! Eject! Eject!). With any luck — and a lot of skill! — you'll never have to eject from your aircraft.

3) Return to your home airfield

Granted, this sounds obvious, but returning to your home airbase is the most crucial part of your mission. Even if you are successful in destroying your mission target and fighting off the enemy planes, if you're careless on the way back, you might get jumped and lose half your flight. Here are a couple of tips to help make this return journey as uneventful as possible:

1. *Stay off the accelerated mode key until you enter friendly airspace.* The less you rely on accelerated mode in enemy territory, the safer you will be. As mentioned earlier, you don't want to be zooming back home and suddenly find yourself plunging earthward due to a "rendezvous" with an enemy missile.
2. *Don't fly too low to the ground.* The last thing you want on your return trip is to be shot down by enemy ground fire.

Landing and ending the mission

Once you finish your mission and get back to your home airbase, you need to land your plane. Any wingmen or other flights will land on their own. After you touch down, roll to the end of the runway and stop, bring up the menu bar by pressing Esc and select End Mission from the FILE menu. The End Mission option is significantly different from the Abort Mission option as explained below.

If you select End Mission *before* landing, the simulation will calculate the probability of your squadron making it home safely. It will take into consideration your fuel state and any enemy air defenses between you and your home base. Some of your aircraft could make it back, some might not. The closer you are to friendly airspace when you select this option, the more likely your planes will make it home.

The Abort Mission option differs significantly from the End Mission option. Abort Mission will terminate your current mission, return you directly to the War Room, and act as if that mission never happened.

On occasion, you may not have enough fuel to return to your home airbase, or your bird might be so damaged that you have to attempt an emergency landing. These cases are described below:

Landing at another friendly airbase

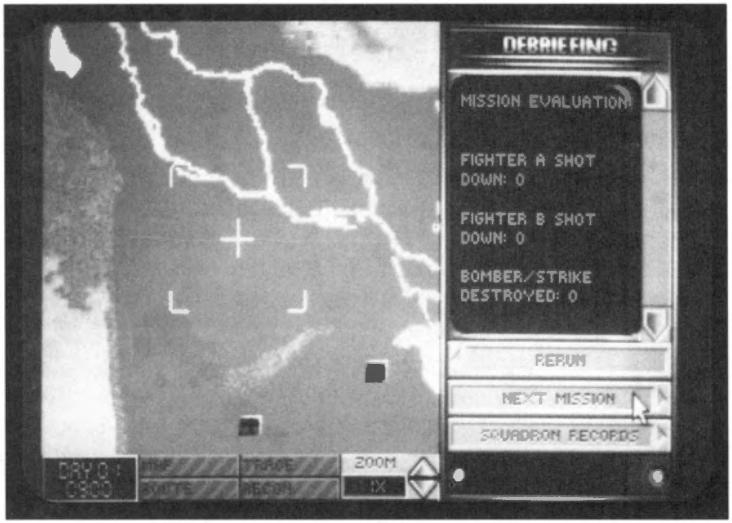
Occasionally, you may be so low on fuel, perhaps due to jettisoning your external fuel tanks or overusing your AB, that you don't have enough fuel to make it back to your home base. You can attempt to land at another friendly airbase on the return trip, but the penalty for doing so is that the aircraft and pilots that land there will not be able to return to their home base and thus the duty roster until the first mission of the next day. It goes without saying that you should avoid landing at an enemy airbase unless you want to see what the war looks like as a POW.

Emergency landings

There may be times where your bird is so shot up that you can't even make it to a friendly airbase, so you may be forced to attempt an emergency landing. If you're over enemy territory, if at all possible, try to keep your bird in the air until you enter friendly territory before ditching, otherwise you risk capture. Also, when looking for a place to set down, roads are your best bet.

Debriefing

After you end the mission, you will be debriefed. The debriefing will first trace your flight path, describing all the events that occured, and then it will evaluate the mission as a whole. This evaluation will included a summary of kills and losses and you will be told whether the group commander rates the mission a success or failure. Following the debriefing there might be an awards ceremony to reward the valor of any deserving pilots. Afterward the Occupation screen will show you the state of the ground war.



Mission Summary

The first part of Debriefing is known as the Mission Summary. During the Mission Summary, you will be given a detailed breakdown of what your flight did on your mission. Every enemy aircraft, SAM or ground unit you encountered will be reviewed, along with the results of those encounters. You will see a review of the weapons you fired and whether or not any aircraft (both friendly and enemy) were downed. You will also be informed if your part of the mission was a success or failure.

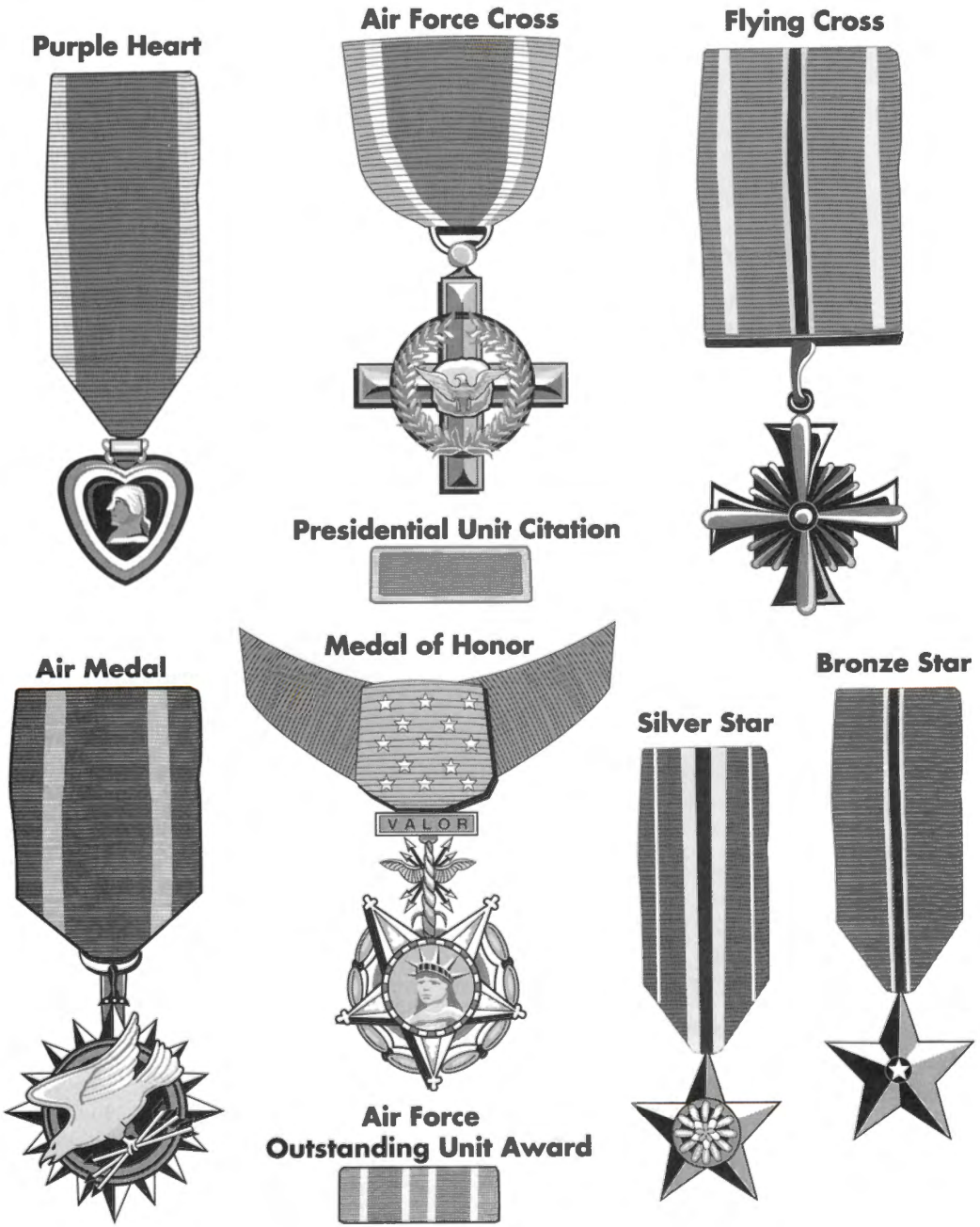
Your flight path will be drawn on the map, and at each encounter the video display at the right will describe the events that occurred.

Additional Flights Summary

When your Mission Summary is complete, you will see a summary of any other flights you assigned. It will describe major actions and whether or not those flights completed their part of the mission.

Finally, you will be told if your overall mission was successfully completed or not.

Medals and Awards



After the debriefing, you may attend an awards ceremony where one or more pilots receive medals. This animation may also appear if your squadron receives a special citation. If this animation doesn't appear, it means that none of your pilots (or your squadron) was eligible for medals or citations.

A pilot may receive any medal after only one sortie, but it is more likely that a medal will be awarded after repeated successful flights. Medals are acquired through the accumulation of "points." You earn points for such things as shooting down enemy fighters or bombers, assisting in an air-to-air kill, destroying or damaging your primary targets, and for completing your mission.

The following medals may be awarded to an individual pilot and are listed in order of importance (except for the Purple Heart, described at the end of the individual awards section):

Air Force Medal of Honor

The Air Force Medal of Honor is the highest award that the Air Force can bestow. It is given in the name of Congress to persons who distinguish themselves by extreme bravery, risking their lives above and beyond the call of duty, while in actual combat with an enemy of the United States or its allies.

The Medal of Honor is a very rare award and is only given in extraordinary circumstances.

Air Force Cross

The Air Force Cross is awarded for tremendous heroics, but ones that don't quite justify an Air Force Medal of Honor. It is given to any person serving with the U.S. Air Force when engaged in action with an enemy of the United States or when serving in conjunction with allied forces engaging opposing foreign forces.

The primary difference between this award and the Air Force Medal of Honor is the degree of heroism and actions taken.

Silver Star

The Silver Star is awarded to a member of any branch of the U.S. Armed Forces for gallantry when engaged in action with an enemy of the United States or when serving in conjunction with allied forces engaging opposing foreign forces.

Distinguished Flying Cross

The Distinguished Flying Cross is awarded to a member of any branch of the U.S. Armed Forces who has distinguished himself by "heroism or extraordinary achievement while participating in an aerial flight." The requirements for this award need not include the engagement of enemy forces.

Bronze Star

The Bronze Star is awarded to a member of any branch of the U.S. Armed Forces who has distinguished himself by heroic or meritorious achievement or service, not necessarily involving participation in aerial flight, when engaged in action with an enemy of the United States or when serving in conjunction with allied forces engaging opposing foreign forces.

Air Medal

The Air Medal is awarded to a member of any branch of the U.S. Armed Forces who has distinguished himself by meritorious achievement while in active flight. This award is given for both combat and non-combat actions.

Purple Heart

The Purple Heart is awarded to any member of the U.S. Armed Forces who is injured while in combat. It is also given posthumously to the next of kin for those who died from their wounds or were killed in action.

The remaining two awards are actually unit citations given to an individual squadron that performs exceptionally in a campaign.

Presidential Unit Citation

The Presidential Unit Citation is awarded to units of the U.S. Armed Forces that have performed with extraordinary heroism in action against an armed enemy of the United States. The particular unit must have performed its duties to such a high level as to set itself apart from all other units in a campaign. This is the squadron equivalent of an individual's Air Force Medal of Honor.

Air Force Outstanding Unit Award

The Air Force Outstanding Unit Award is given to Air Force units that have distinguished themselves by performing outstanding achievements that set the unit above and beyond other like units acting in the same campaign.

The primary difference between this award and the Presidential Unit Citation is that the former award can be given to any unit in the U.S. Armed Forces, making it that much harder to come by and that much more meaningful.

Campaign ribbons

Each squadron that participates in a successful campaign will receive a campaign ribbon signifying that they have seen action in a particular theater of operations. Further successes in that theater will be displayed as clusters on the ribbon. You can view the campaign ribbons and other squadron-based awards in the Squadron Ready Room and following the debriefing.

Winning or losing a campaign

Eventually all good things must come to an end (and, fortunately, the bad things too). The Air Force cannot win the war by itself; the infantry grunts must still trudge, step by step, into enemy territory and plant the flag in the hill of dirt that represents victory. Your performance in the air can make their trip either a Sunday stroll forward or a bloody march backward. Use the Occupation screen to view the progress of the ground forces. This is probably the best indication of how well the war is going.

When the ground troops reach the campaign objective, your side will win the war. If the enemy reaches its objectives first, however, you will lose. Hopefully, you can then take the lessons you learned from this war into a new theater of conflict.

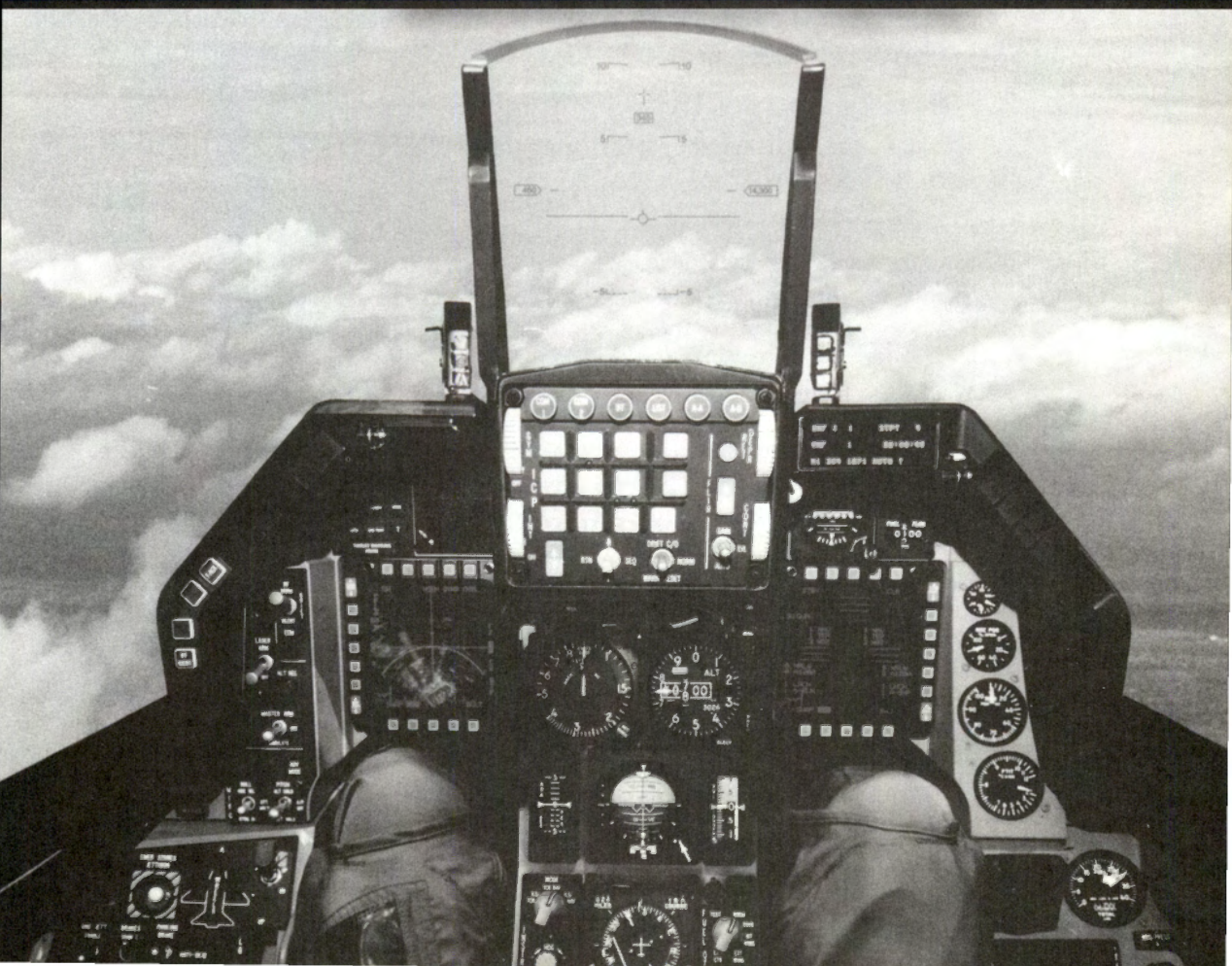
Post-war promotions

Finally, at the end of every campaign, your pilots will be eligible for post-war promotions. These increases in rank are based directly on individual and overall achievements in the campaign. For example, if a pilot received a Medal of Honor, two Air Force Crosses and a Silver Star in one campaign, you can be sure he'll get promoted! On the same note, if the squadron received any of the two special commendations, that may add to the chances of promotion for individual pilots.

SECTION

VIII

FLIGHT



Flight introduction

This section provides a synopsis of several parts of the manual. It covers the basics of flying the plane, selecting and firing weapons, the HUD, the various cockpit instruments, the Voice Message System, messages from your wingman, using the APG-66 Radar, the external views, takeoff and landing, and the menu bar.

You can use this section as a compact reference section for operating the simulator.

Flying the plane

Although your cockpit is crammed with instruments, the basic controls that deal with the phenomenon of flight are the stick and throttle. They make it possible to climb, dive, turn and bank. Once you gain mobility in the air with the stick and throttle, you can go after those choice targets.

Using the stick

The stick controls the direction of your aircraft as it moves through the air. When you move the stick, you move control surfaces on the wings, tail and rudder which change the direction or orientation of the aircraft. The stick has traditionally been placed between the knees of the fighter pilot and linked to the control surfaces through mechanical and hydraulic linkages. Things have evolved a bit in the F-16.

The stick in the F-16 is near the pilot's right arm and is called a sidestick controller. It senses force on the stick and passes that information to the flight control computer. The sidestick only has about one quarter of an inch of flex. The control surfaces are fed information from the flight computer and are moved by electric actuators. We'll usually refer the the sidestick controller as the stick in this manual.

There are three control devices you can use to simulate movement of the F-16 stick. We'll describe each of these here. Throughout the manual, the stick will refer to whichever flight control device you are using.

You choose the flight control device you want to use from the System Setup screen. To change your input device, first select the Configuration monitor in the War Room. Then select the System Setup button at the top of the screen. You can choose the keyboard, the joystick or the ThrustMaster to control the movements of the stick (you may also change the flight control device while flying by pressing the Esc key and choosing the Control menu).

Keyboard

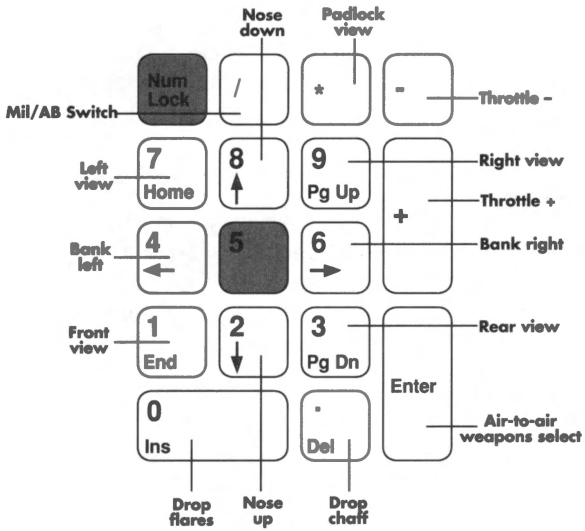
In some ways the keyboard is closer to the real sense of control over the F-16 than the joystick. Like the ThrustMaster (described later), it simulates the hands-on-throttle-and-stick (HOTAS) arrangement in the F-16. From the keyboard you can control movement of the F-16, adjust the throttle, light your burner, select and fire your weapons, and manipulate your radar. The keyboard "stick" is surrounded by other controls that you need to fight and win.

The stick is controlled by four keys arranged like a cross. This arrangement is found in three places on the keyboard. In the alphabetic part of the keyboard, the I key pushes the stick forward, which pushes the nose down. The M key pulls the stick back, which pulls the nose

up. The J key banks the plane left, and the L key banks the plane right. You can press two of these keys together at the same time to combine directions.

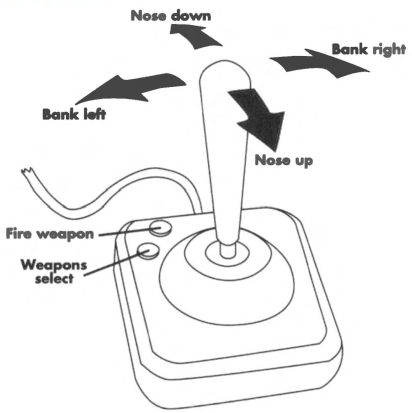
On the numeric keypad the 8 key pushes the stick forward, the 2 key pulls the stick back, the 4 key banks left and the 6 key banks right.

The cursor keys also control the movements of the stick. The ↑ key moves the stick forward, the ↓ key moves the stick back, the ← key banks left and the → key banks right.



As long as you press a key, you will be applying pressure to the stick in that direction. When you release the key, you release pressure on the stick. As with a real stick, when you turn, you need to apply a bit of back pressure to the stick while you bank. If you were banking left, using the numeric keypad, you would need to press both the 4 and the 2 keys to keep your nose from dropping.

Joystick



The joystick most closely matches the real sidestick from a physical point of view. You can get a great sense of flying by cranking on the joystick and watching the horizon spin. The direction you move the joystick controls the direction you move the F-16 stick. You will notice that if you bank to a side, you will also need to add a bit of backstick to keep the nose from dropping.

On the joystick, button A is used to select a weapon from whichever weapons mode you are currently in (air-to-air or air-to-ground) and button B fires the selected weapon.

If you are using a second joystick as a throttle, moving this joystick forward and back increases or decreases the throttle while moving it to the right and left applies pressure to the corresponding rudder. Button A on the second joystick switches between air-to-air (A-A) and air-to-ground (A-G) weapons mode, and button B toggles the speed brakes on and off.

Joystick calibration

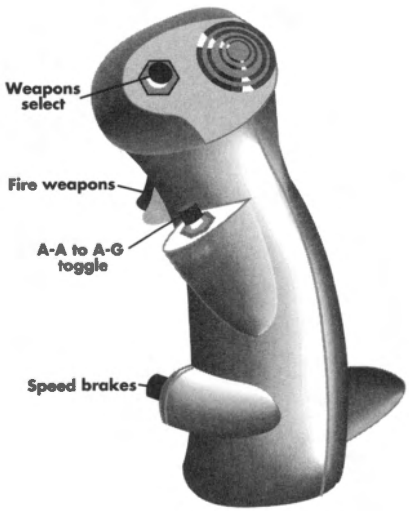
To calibrate the joysticks, press the Esc key once you get into the simulation. Then select the Control menu. Choose Joystick and then Recalibrate. You will see a box with several buttons at the top and a small F-16 in the box. Follow the prompts below the box and center the F-16 by moving the joystick. Press the button when the F-16 is centered in the box.

Next, move the joystick to its limit to the left, to the right, forward and back. Then press the joystick button.

To save this calibration as your default, click the button "Save as Default." To simply use the current calibration, click "Exit." If you want to start over, click "Restart." If you have saved the calibration as a default, the next time you select the Joystick item from the Control menu, you can simply choose Default instead of Recalibrate and your last calibration will be used.

If you have a joystick with a throttle wheel, like the CH Flightstick or the Kraft Thunderstick, you will be prompted to calibrate the throttle wheel. Just follow the on-screen instructions.

ThrustMaster



The ThrustMaster control devices are designed to give you the most realistic feel for flying a modern jet. They consist of two devices, a sidestick with multiple buttons and a throttle controller. On the sidestick, you can control the following operations: individual weapon selection, A-A/A-G weapons mode, speed brakes and the trigger.

Throttle and afterburner

The throttle controls your powerful Pratt and Whitney F100-PW-200 afterburning engine. You'll need to have good control over your throttle during takeoff, landing and fighting. The throttle is controlled by [+] and [-] keys on the top row of the keyboard and on the numeric keypad. As you press the [+] key, the throttle increases. The [-] key decreases the throttle. You read the current state of the throttle on the RPM Gauge.

The F-16 has an afterburner (AB) with five afterburning stages. You engage the afterburner with the [/] key on either the keyboard or the numeric keypad. When you engage the afterburner, your RPMs go immediately to 100% MIL power, no matter what the previous setting was. The [>] key advances the afterburner stage, while the [<] key decreases the afterburner stage.

You can determine the status of the afterburner by looking at the MIL/AB Indicator. When it says MIL, you are using your normal engine at some percentage of full MIL thrust. When you engage the afterburner, the light changes to AB1 since you've entered the first afterburner stage. This light will change to AB2, AB3, AB4 or AB5 as you increase the stages. Pressing the [/] key again will take you out of burner and back to MIL power from any afterburner stage. The MIL/AB Indicator will then read MIL.

Making a turn

Turning is very easy in the F-16. To turn, you bank the plane in the direction you want to turn by moving your stick to the right or left. If you move the stick to the left, your plane will bank to the left. The more you move the stick, the more you will bank. You will see the horizon move in the opposite direction of your bank. For example, if you bank to the left, the horizon will tilt down to the right.

When you bank your plane, you will begin to turn in the direction of the bank. You will notice that if you simply move your stick to one side, you will bank, but your nose will also drop and you will begin a descending turn. If you want to simply bank without dropping, you also need to add some backward pressure to the stick as you bank to a side. Use the horizon as a guide and keep your nose on it as you turn. You will need to adjust the back pressure on the stick to keep your nose on the horizon. Back pressure on the stick not only keeps your nose from dropping, but it also increases the speed of your turn. Be aware that a sharp turn will increase your G load.

If your airspeed is below 450 knots (kts), you can also use your rudders to help turn. Use the [[] and []] keys for left and right rudder respectively. When you use your rudder to turn, the plane will turn without banking at all. You can increase the control and degree of turn by using a combination of stick and rudder. The rudders engage just below 450 kts, but their effect is minimal at this speed. As your airspeed decreases, the rudders begin to have more effect. Around 200 kts, the rudders are quite effective.

Weapons selection and firing

Depending on your targets and your intention, you will view and select different weapons systems and accessories through your Stores Management System. You will be able to tell which weapons you have selected by looking at the Stores Control Panel (SCP) and at the HUD. Each will give you information about the currently selected weapons.

Air-to-air

To cycle through the air-to-air weapons in the SCP, press the Enter key. Each time you press it, a new air-to-air weapon will be selected on the SCP display. The top line of the SCP shows the mode (in this case it will say A-A for air-to-air), the number of missiles loaded on your F-16, and the missile type. For example, a typical selection will read: A-A 2 AIM120. This means you are in air-to-air mode, and have two AIM-120 radar-guided missiles selected. You don't have to arm individual missiles. The Fire Control Computer takes care of that for you.

The HUD also changes mode when you select a new air-to-air weapon. The HUD mode indicator shows the number of weapons available and the type. The Aiming Reticle also helps you see which weapon you have selected. Its size depends on the type of missile you select. It will be large for AIM-120s, medium for AIM-9Ms and small for AIM-9Ps. If you go to guns, the Aiming Reticle disappears and you get the M61 Aiming Funnel.

The Fire Control Computer also gives you a clear signal when you have locked on to a target with your missiles. When you are locked on and the missile is tracking, the Aiming Reticle in the HUD will blink and the target diamond will attach itself to the Target Designator Box. It will also blink. At the same time, you will hear the tone from the seeker head of your Sidewinder.

Just because you have good tone from the seeker head doesn't guarantee that your missile will hit its target. There are many conditions you must meet to have your missile in parameters, and even then, an enemy pilot will take a variety of measures to spoof your missile. See **Section XII: Advanced Fighter Tactics** to get a better understanding of how to score with your missiles.

Air-to-ground

To cycle through the air-to-ground weapons on board, press the Backspace key. The currently selected weapon will show up on the SCP. The top line will read A-G for air-to-ground, followed by the number of bombs or missiles and weapon type. A typical top line might read: A-G 4 AGM-65D. This means that you have four AGM-65D Maverick air-to-ground missiles selected.

The firing cues for your air-to-ground weapons vary with the weapon. You will find more information about using your air-to-ground weapons later in this section.

Head-Up Displays (HUDs)

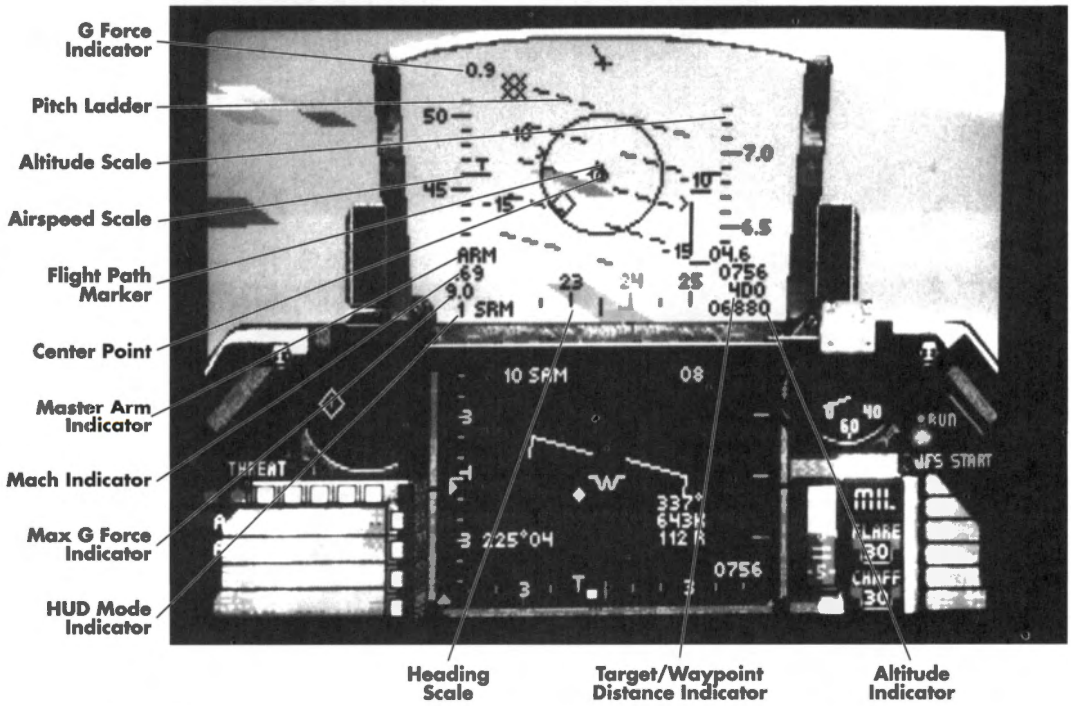
The HUD is the most important instrument you will use in *Falcon 3.0*. It is a piece of glass just inside the canopy upon which is projected targeting data for your weapons systems and information on your current altitude, speed and heading. It also shows distance to waypoint, the current G force on your aircraft and a host of other invaluable data. The value of the HUD is that this information is projected through the pilot's line of sight, so you don't have to look down into the cockpit to get critical flight or tactical information. During a "fur ball" (a frantic

combat engagement), moving your eyes from the outside environment to the inside of your cockpit can be fatal. Things just happen too fast. When flying and fighting, you'll find that most of your attention is focused on the HUD.

There are a number of different HUD modes, and their characteristics will change depending on which weapons system is currently active (see the Stores Control Panel for more information on your active weapons system). There is also a special HUD mode designed for use with landing. This is known as the ILS HUD, and it is described at the end of this section. Unless otherwise noted, these descriptions are for the Model A HUD.

HUD basics

The following displays are common to every HUD mode.



Airspeed Scale

The Airspeed Scale is located on the left-hand side of the HUD and displays your current true airspeed (TAS) in tens of knots. For example, the number 40 would indicate that your F-16 is flying at 400 kts TAS. The hash mark with the "T" above it, located about halfway up the scale, is where to read the TAS. If you are flying with the Model C HUD, you will simply see the current airspeed displayed as a single value on the left-hand side of the HUD under the letters SPD.

Altitude (ALT) Scale

The Altitude Scale is located on the right-hand side of the HUD and measures your current altitude above sea level (ALT) in thousands of feet. This differs from the Altitude Indicator (see below) because the Altitude Indicator displays the altitude above ground level (AGL). You read the ALT by viewing the hash mark about halfway up the scale. If you are flying with the Model C HUD, you will simply see the current altitude displayed as a single value on the right-hand side of the HUD, under the letters ALT.

Altitude (AGL) Indicator

The Altitude Indicator is located in the lower right-hand corner of the HUD and is used to measure your current altitude above ground level (AGL) in feet. It differs from the Altitude Scale because the Altitude Scale shows your altitude above sea level (ALT). For example, if you are flying over mountainous terrain, the Altitude Scale may show 3,000 feet, but the Altitude Indicator may display only 450 feet. This means that while you are 3,000 above sea level, because of the mountain's altitude, you are only 450 feet above the ground.

You will want to pay special attention to the Altitude Indicator when you are flying low-level missions. If you make the mistake of relying on the Altitude Scale, you may end up as a smoking hole in the landscape.

The altitude that is displayed in the various outside views, like the Track View, is always altitude above ground level. You need to know how far you are above the ground to keep from crashing, especially if you like skimming roads and buildings while flying in the outside views.

Center Point

The Center Point is located in the direct center of the HUD and is used as a reference point for other moving indicators such as the Flight Path Marker and Pitch Ladder.

Flight Path Marker

The Flight Path Marker displays changes in your flight direction. It's in the shape of a circle with three spokes representing your wings and tail fin. When you make directional adjustments to the aircraft, the Flight Path Marker will move to show you the direction you are currently heading. If you then let go of your stick, the Flight Path Marker will slowly drift back to the center of your HUD.

G Force Indicator

The G Force Indicator is located just above the Altitude Scale and displays the amount of gravity forces (Gs) you and your plane are sustaining at the current time. For example, if the reading shows 2.5, your body is feeling the pressure of 2.5 times regular gravity. Your G Force Indicator will read 1.0 when you are flying straight and level. By varying the maneuvers of your aircraft, you can experience both positive and negative Gs. For more information on G forces and their effects on a pilot's body and the plane itself, see **Section XI: Aerodynamics and G Forces**.

Heading Scale

The Heading Scale is located on the bottom of all A-A HUD modes and at the top of all A-G HUD modes. It displays your current heading in tens of degrees and is read by viewing the hash mark in the middle of the scale. Headings are as follows: 0° = North, 90° = East,

180° = South and 270° = West. If you are using the Model C HUD, the heading will appear as a single value under the word HEADING, at the bottom of the HUD.

If the HUD is damaged, you will need to refer to the compass on the Left View of your cockpit to get heading information.

HUD Mode Indicator

The HUD Mode Indicator in the last line on the left side of your HUD is used to display your current HUD type (A-A/A-G/ILS). From this designator and the Stores Control Panel, you can determine your presently selected weapon system. Following is a list of the HUD modes and their corresponding weapons/guidance systems:

A-A HUD modes:

- SRM (Short Range Missile): AIM-9P or AIM-9M Sidewinder missile.
- MRM (Medium Range Missile): AIM-120 AMRAAM.
- DGFT (Dogfight): M61A1 Cannon.

A-G HUD modes:

- CCIP (Continuously Computed Impact Point): Mk82/82HD/83/84 iron bombs, CBU-84 cluster bomb and LAU 5003A rocket launcher.
- E-O (Electro-Optical): AGM-65B TV-guided Maverick missile and GBU-15 guided bomb.
- A-G (Air-to-ground): AGM-45A Shrike and AGM-88A HARM anti-radiation missiles.
- I-R (Infra-red): AGM-65D infrared-guided Maverick missile.
- DUR (Durandal): BLU-107/B Durandal demolition bomb.
- STRF (Strafe): M61A1 Cannon.

The other possible HUD mode is ILS. This will only appear if you have engaged the Instrument Landing System before runway approach.

Mach Indicator

The Mach Indicator is located just below the Master Arm Indicator and shows the current TAS as a percentage of Mach 1, the speed of sound.

Master Arm Indicator

The Master Arm Indicator is located in the lower left-hand corner of the HUD and is used to tell the pilot that the current weapons system is ARMed and ready to fire. Since there is no Master Arm Switch in *Falcon 3.0,* the Master Arm Indicator will always display ARM.

Max G Force Indicator

The Max G Force Indicator is located in the lower left of your HUD, just below the Mach Indicator. It displays the highest amount of Gs you have pulled since takeoff. It is automatically set to 0 (zero) at the beginning of every mission.

Pitch Ladder

The Pitch Ladder is the set of lines running through the middle of the HUD. These lines indicate angle of climb or dive and also the angle of roll of your plane. (Angle of roll is how much your plane is turning relative to the horizon line.) As you climb or dive, these lines will move accordingly. The lines of the Pitch Ladder are oriented to match the horizon line (and

the artificial horizon on your radar). As you bank, the lines of the Pitch Ladder will roll on the HUD to show you the orientation of the horizon.

The angles on the Pitch Ladder are in five degree increments. An angle of climb (a positive number) is shown with a solid line, while an angle of dive (a negative number) is shown as a dashed line. If you pull high Gs, your Pitch Ladder may move around your HUD, even to the point of disappearing for a moment.

Target/Waypoint Distance Indicator

The Target/Waypoint Distance Indicator is located in the lower right-hand corner of all HUDs, just above the AGL Indicator, and is used to determine distance to your current target or next waypoint. The number before the "D" indicates how many miles it is to the current A-G target or upcoming waypoint. The number after the "D" shows the number of the current waypoint on your flight route. You can change the current waypoint number by pressing Shift B or Shift V. This will force other planes on your flight (and your plane as well, if you are in autopilot) to head directly for the next or previous waypoint respectively.

If your radar is currently locked onto an air-to-air target, you will see a distance-to-target indicator directly below the Altitude Scale. Normally the two lines below the Altitude Scale read as xxxx, but when you lock on to a target, they show the distance to the target (in tenths of a nautical mile) and the closure speed with the target. This information is also displayed on your radar, although the HUD distance reading is more accurate since it displays the distance to the nearest tenth of a nautical mile.

If you are using the Model C HUD, the target distance, closure speed and altitude above ground level will be displayed in this same area, but will be labeled with R (for Range), C (for Closure) and A (for AGL).

Waypoint Caret

The Waypoint Caret appears on your HUD on the heading scale as an inverted V. This caret will be somewhere on the scale and indicates the direction to steer to head toward your current waypoint. If the caret is to the right of the HUD, you need to steer to the right. As you do, the caret will move towards the center of the HUD. When the Waypoint Caret is centered in the HUD on the heading scale, you are on the correct heading to your waypoint.

HUD Warnings

There are a couple of special case HUD indicators that only appear when you are in immediate danger. These indicators are explained below:

Fuel warning

The word "FUEL" will appear in the center of the HUD when your on-board computer determines that you only have enough fuel to return to your home base. In addition, you will see a display in the bottom right of the HUD that reads, for example, Fuel 12. This means that you have 1,200 pounds of fuel remaining.

Arrowheads

A pair of arrowheads will appear in your HUD when you are in danger of colliding with the ground. They will begin at either side of the HUD and move towards the center of the HUD. The closer they are to the center, the greater the danger of ground collision. If the arrowheads begin to flash, you need to pull up immediately or else you will crash into the ground.

A-A Weapons HUD mode

You will see additional symbols and information on the HUD when you are in an air-to-air weapons mode. The symbols will vary with the weapon you have selected. In all cases you will see the following:

Target Designator (TD) Box

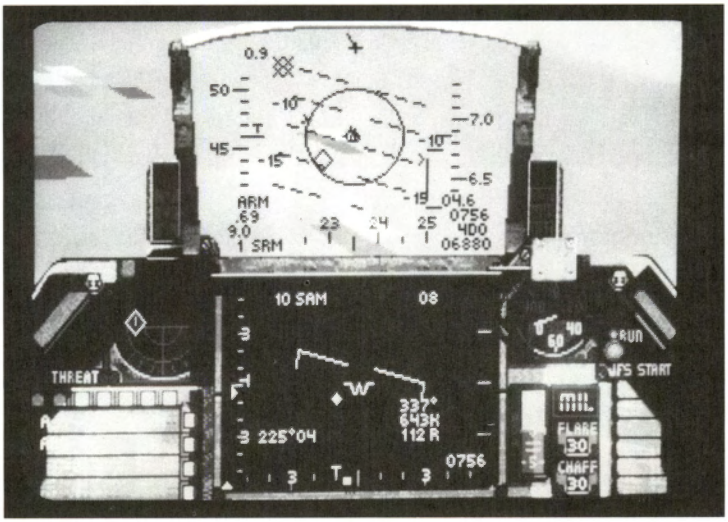
The TD Box is a small square that appears on the HUD when a target has been locked up with radar and is positioned in front of you. The TD Box provides you with a significant advantage because it tells you where to look to see the aircraft in space, even if it isn't close enough to be visible. If you continue to head towards a target marked in the TD Box, the TD Box will surround and stay with the target when it becomes visible, as long as it is within the view of your HUD.

Target Locator Line/Diamond X

When a target moves off the HUD, the TD Box disappears and is replaced by the Target Locator Line and the Diamond X symbol. The Target Locator Line is drawn from the small plus symbol at the top of the HUD (the target locator origin) to the edge of the HUD in the direction of the tracked aircraft. If you follow the Target Locator Line off the edge of the HUD, it will point in the direction to look for the tracked aircraft.

The Diamond X indicator is another indicator to help you locate a target that moves off the HUD. It appears on the edge of the HUD where the TD Box vanished. The Diamond X indicator is used to give you a horizontal or vertical vector to the target. For example, if the target disappeared off the left side of the HUD, the Diamond X indicator will appear somewhere on the left edge of the HUD. If you project a line horizontal to the bottom of the HUD from the Diamond X into space, it will intersect the target.

By using both the Target Locator Line and the Diamond X, you can precisely locate a target even if it is off the HUD.



5 Mile Radar Ranging Scale

The 5 Mile Radar Ranging Scale is a vertical scale to the immediate left of the altitude scale. It has a tick mark at the top and the bottom of the scale, where the top mark indicates five (5) nautical miles and the bottom mark indicates zero (0) nautical miles. When the tracked target gets within five miles, a caret will appear on the left edge of the scale at the top. As the target's distance is reduced, the caret will move lower on the scale. You can use this as a visual cue for missile ranging without taking your eyes off the HUD.

Aiming Reticle

The Aiming Reticle is the circle in the center of the HUD that indicates the optimum position for a good missile kill. Your target should be within the Aiming Reticle before you fire your missiles. The Aiming Reticle will differ for each type of missile you use. The smallest reticle is used for the rear-aspect AIM-9P Sidewinder missile. The medium reticle is used with the all-aspect AIM-9M Sidewinder missile, and the large reticle is used with the AIM-120 AMRAAM radar-guided missile. You can also look at the HUD Mode Indicator and the Stores Control Panel to clue you in on which missile you have selected.

There are several symbols associated with the Aiming Reticle:

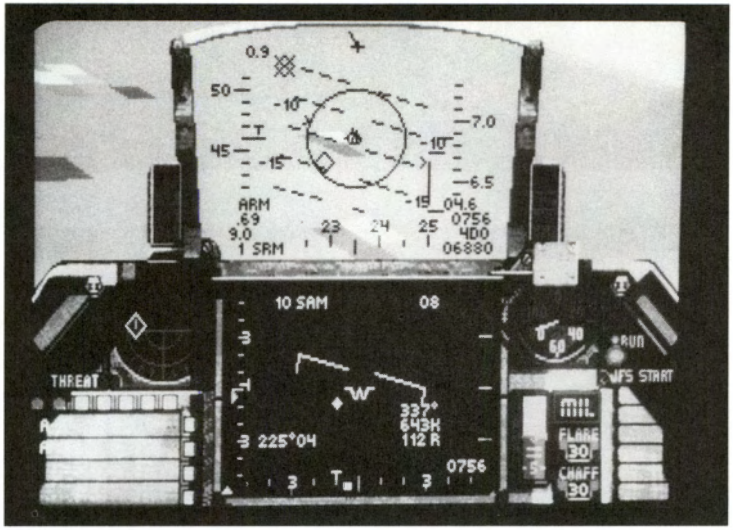
Aspect Angle Caret

The Aspect Angle Caret is a small caret that is drawn along the outside of the Aiming Reticle. The caret is always pointing in toward the center of the circle. The aspect angle is an important value that represents a relationship between you and the enemy plane. It is used to determine the intent of the enemy plane and for determining if you are within the proper envelope for missile firing.

As a brief guide, if the caret is at the bottom of the circle pointing towards the top of the HUD, the enemy is moving away from you in the direction pointed to by the caret. In other words, if the caret is at the 4 o'clock position, the target is moving away and to your left. If the caret is at the top of the circle, the target is moving toward you. You can confirm this by checking the closure rate on your radar. For the rear-aspect AIM-9P, you want to have an aspect angle of 60° or less (between 4 and 8 o'clock on the Aiming Reticle).

Distance Ranging Scale

The distance ranging scale is drawn on the circle of the Aiming Reticle. It is another distance-to-target indicator. It appears as a "gap" in the circumference of the circle. This gap appears at the top of the reticle and moves counter-clockwise as the target gets closer. If you use the image of the circle as a clock, the top of the circle represents 12,000 feet. As the indicator moves to the 9 o'clock position, it means that the target is 9,000 feet away. Six o'clock represents 6,000 feet and so on. If you were using this scale to judge the distance for firing an AIM-9P missile, which has an optimum range of about two miles, you would want to fire when the scale reads about 10 o'clock, which is approximately 10,000 feet.



DGFT (Dogfight)

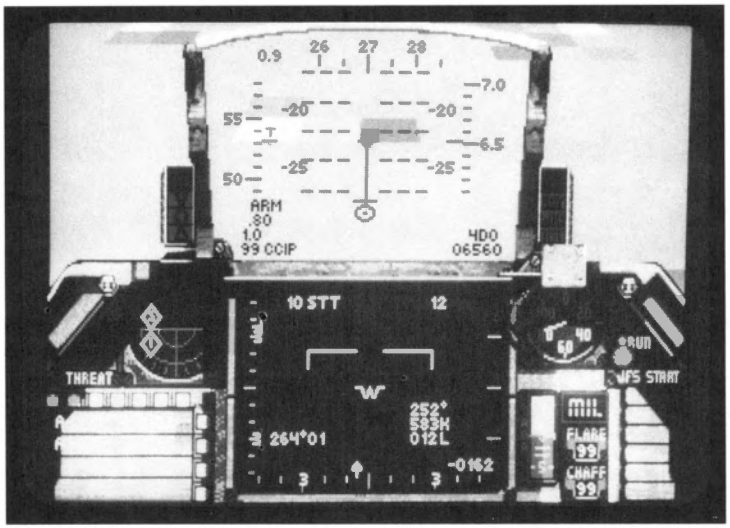
This mode is operative when you are using your M61A1 internal cannon. When you select this A-A HUD mode, you will be presented with a funnel device that shows the path of your bullets. Your objective is to get the wingtips of the enemy plane within the boundaries of this funnel before you shoot. Remember, you need to pull lead and keep the enemy plane toward the small end of the funnel.

A-G Weapons HUD mode

Like the air-to-air HUD modes, air-to-ground weapons have their own special symbols that appear on the HUD to help you deploy your weapons. These are described below. Another difference you'll notice is that the Heading Scale moves from the bottom of the HUD to the top of the HUD. This gives you an uncluttered view to the ground below.

CCIP (Continuously Computed Impact Point)

This HUD mode is used for Mk82, Mk82HD, Mk83, Mk84 iron bombs, CBU-84 cluster bombs and the LAU 5003A rocket launcher. For every weapon except the LAU 5003A rocket launcher, the CCIP display gives you a special bombsight known as the CCIP pipper. This bombsight consists of a vertical line drawn from the target locator origin, which ends with a circle with a dot in it. This is the infamous "death dot," and you place it on the target you want to hit.



Once the dot is over your target, designate it by pressing the Spacebar. The line extends both up and down on the HUD. You will see a horizontal line cross it at the top and in the center of this line. As you near the target, the top horizontal line will move down the HUD. When it reaches the position of the center horizontal line, the bombs are automatically released. You may manually release (or pickle) your bombs by pressing the Spacebar again after you have designated the target.

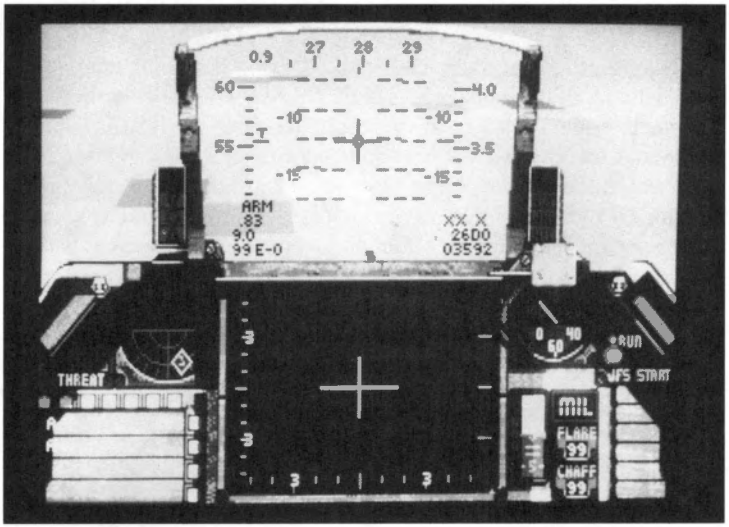
To clear a designated target, press the X (clear lock) key.

With the LAU 5003A rocket launcher, you will see a small aiming pipper in the HUD but no moving death dot. A small horizontal bar will appear above the pipper when you are within range of your target. Each time you press the Spacebar, you fire a rocket.

E-O (Electro-Optical)

This mode is used with the AGM-65B TV-guided Maverick missile and GBU-15 guided bomb. Cross hairs appear in both the HUD and the REO when you select either of these weapons. The cross hairs on the HUD will automatically lock onto targets within range. When either of these weapons locks on to a target, the cross hairs will move on the HUD and a magnified image of the target will appear in the REO. You can manually switch targets by pressing the T key. Fire the missile or guided bomb by pressing the Spacebar.

Once you're locked on and fire the weapon, it is self-guiding. You can lock on to another target without worrying about your previous missile. A distance-to-target read-out will also appear on the HUD above the waypoint read-out, showing your distance in feet to the locked-on target.



A-G (Air-to-Ground)

This HUD mode is used for the AGM-45A Shrike and AGM-88A HARM anti-radiation missiles. These missiles will detect the radar emissions of a ground SAM or AAA site and lock on to its radar. Then they follow the radar beam in and destroy the site. These weapons operate like the Maverick missile. They are fire-and-forget — once you've fired them, they are self-guiding.

The difference between them is that the Shrike missile will only lock on to a continuous wave radar whereas the HARM missile will lock onto either a pulse-doppler radar or a continuous wave radar.

I-R (Infrared)

This HUD mode is used exclusively for the AGM-65D infrared-guided Maverick missile. This missile is similar to the AGM-65B TV-guided missile except it uses infrared light to track and lock on to its target. It operates identically to the E-O HUD mode weapons.

DUR (Durandal)

This HUD mode is used exclusively for the BLU-107/B Durandal anti-runway demolition bomb. It operates exactly like the CCIP mode above.

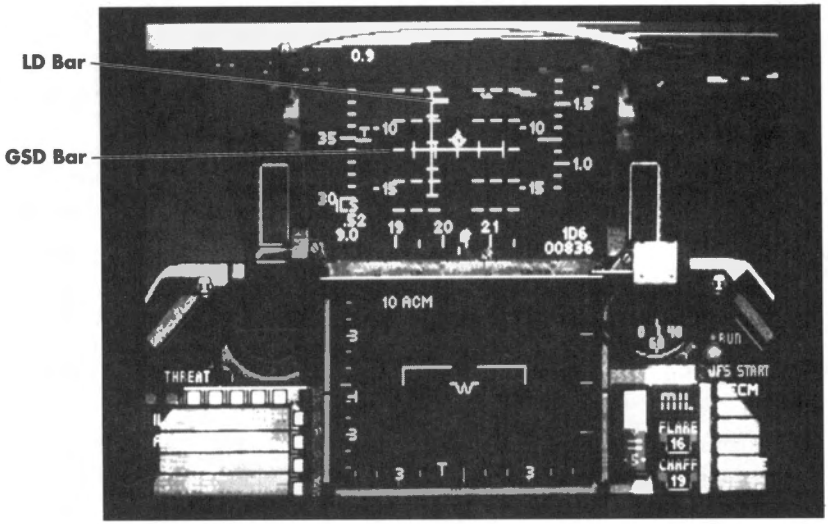
STRF (Strafe)

This HUD is only used for the M61A1 Cannon when you are trying to shoot at ground targets. It has a pipper that moves around the HUD. Its speed varies depending on your angle of flight. Bullets from your gun will travel toward this pipper.

ILS HUD mode

The ILS (Instrument Landing System) HUD mode is a non-combat HUD mode used as an aid in landing. It is particularly useful in bad weather or at night. While you won't run into bad weather in *Falcon 3.0,* you will want to rely on the ILS during night landings. The ILS only works on runways that are equipped with an ILS transmitter. Not all runways have an ILS system. If a runway doesn't have ILS, you will have to rely entirely on your eyes for landing. Of course, you can always turn on the autopilot and let your F-16 land itself, but no self-respecting Viper driver would do that under normal circumstances!

Call up the ILS HUD mode by pressing the \ key.



The ILS works by projecting a beam along the runway. The beam is picked up by the F-16, and your relationship to this beam is reflected on the ILS needles on the HUD. The two scales, represented by the needles, are the Localizer Deviation Bar and the Glide Slope Deviation Bar.

The Localizer Deviation (LD) Bar is the vertical bar that indicates whether you are to the left or right of the runway. This bar always maintains its vertical orientation but will move to the right or left. It moves in the direction that you need to go in order to line up with the runway. For example, if the LD Bar is to the right of the HUD, the runway is to your right. When you steer to the right, the LD Bar will move toward the center of the HUD.

The horizontal bar is the Glide Slope Deviation (GSD) Bar. It indicates if you are above or below the optimal glide path. It always retains its horizontal orientation but will move up or down the HUD. If it is above the Center Point of the HUD, then you are above the recommended glide slope and should lower your nose. As you descend, the GSD Bar will drop towards the center of the HUD.

When both scales form a perfect cross in the center of the HUD, you are "on the beam." "Fly the needles" by steering in the direction of the intersection of the two needles.

If you are off the Localizer by more than 45°, the ILS needles will be displayed as dotted lines.

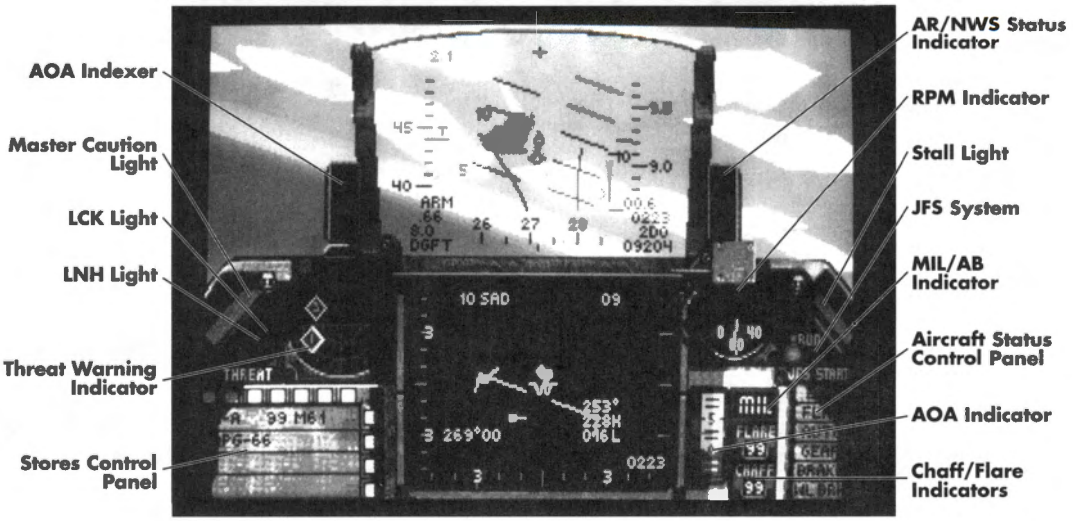
For more information on landing, see Lesson 4 in **Section V: Air Combat School** or see the detailed instructions on landing later in this section.

Front/Left/Rear/Right/Up Views

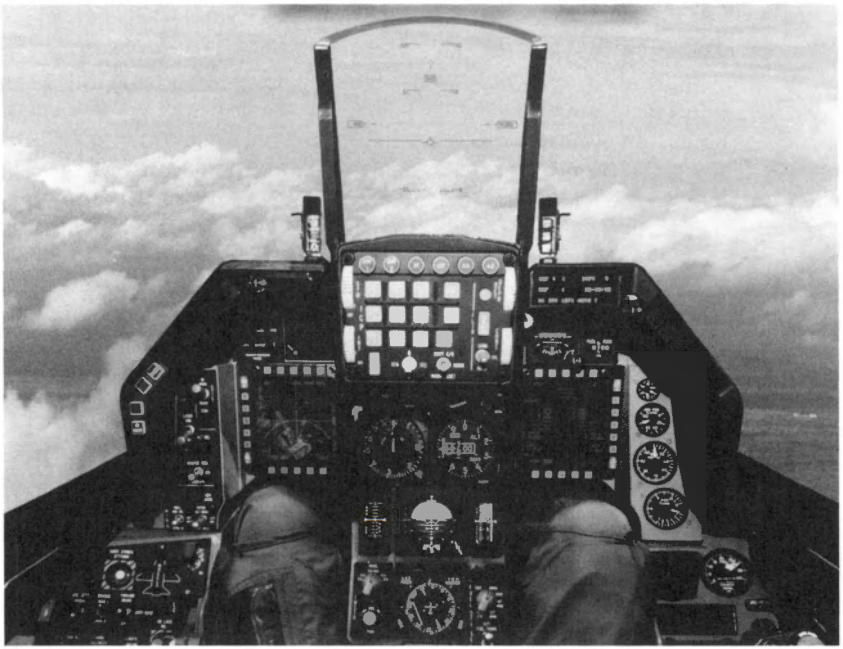
There are five views available from the inside of the cockpit. These are Front View, Left View, Rear View, Right View and Up View. They correspond with looking in each of these directions from within the cockpit. Each view (except Up View) has an upper view and a lower view. The upper view generally gives you a better view outside the cockpit — useful when you need to track an enemy visually. The lower view will let you see important instruments and controls inside the cockpit. You toggle each view between upper and lower by pressing the [Scroll Lock] key. Each side view can independently be up or down. For example, you may look out the right side in upper view, hear a caution message from your Voice Message System, and then press the [Scroll Lock] key to look at the lower Right View so that you can see your caution lights. Switching the Right View to lower doesn't affect the state of the views in any other direction. If the left side view was in upper view, it remains in upper view until you explicitly change it.

Front View

Press the [3] key (or [1] on the numeric keypad) to switch to the Front View. The Front View contains the most important instrumentation in your F-16, including the HUD, REO Display and the Threat Warning System. In combat, you will want to refer to this view to obtain better situational awareness.



When you look up the Front View with the Scroll Lock key, the HUD remains in view but the REO and other lower cockpit instruments are not visible. However, you can see an area above the HUD that was not visible before. This view is very good for following enemy aircraft that are within visible range, particularly if you are on their six in a tight turn.



Following is a description of the instruments in this Front View:

Master Caution Light

When this light is illuminated, it indicates that your aircraft has been damaged. You should immediately look to the Right View to see which caution lights are illuminated. See the Caution Light Panel section for more details on what these lights indicate.

Threat Warning System

The Threat Warning System warns you of incoming airborne threats. Its two primary warning instruments are the Threat Warning Indicator and the Threat Warning Panel.

Threat Warning Indicator

The Threat Warning Indicator displays the relative location of airborne radar emitters (enemy aircraft, SAMs, radar-guided missiles) to your F-16. The indicator is arranged in a 30-mile-radius god's-eye view, with the nose of your plane facing "up" the screen. Any blips that appear in the top hemisphere of the screen are in front of you, and any that appear in the bottom half are behind you. Likewise, blips to the right are to your right and vice-versa.

This is a passive receiver system and only illuminates if an enemy radar is directed at you. However, when you are in SAD radar mode, you will see every aircraft within 30 miles on your TWI, whether they are painting you or not.

Three different types of blips can appear on this screen. These are described below:

- Diamond – This indicates that an enemy aircraft is within 30 miles of your present location.
- Large green square – This indicates that a radar installation within 30 miles is painting you with its radar.
- Small green square – This indicates that an active-homing radar-guided missile has been fired.

You will see a number within the TWI blip. This indicates the type of radar that is painting you. The radar types and their corresponding numbers are:

Air-to-air radar

Number	Radar Type
1	Multiple tracking, look-down shoot-down radar
2	Single target tracking radar
3	Continuous wave radar
4	Targeting radar
5	Attack radar
6	Early warning (EW) radar

Air-to-ground radar

Number	Radar Type
1	Continuous wave/doppler radar
2	Pulse-doppler radar

Threat Warning Panel

This display, located in the upper left-hand corner of the instrument panel, displays two lights essential to the health of you and your F-16. These are the Lock-on (LCK) and Launch (LNH) lights.

The Lock-on (LCK) Light tells you when an enemy plane or missile has achieved a radar lock on your plane. It will illuminate and will also be accompanied by a high-pitched audio cue. When you see this light, check the Threat Warning Indicator to see whether you have a SAM or radar-guided missile chasing you. It is highly recommended that you activate your ECM pod (if available) and initiate evasive maneuvers to shake the lock.

If the Launch (LNH) Light flashes, it means that an A-A missile or SAM (either shoulder-launched or truck-mounted) has been launched. The Threat Warning Indicator and your eyes will tell you what direction the threat is coming from. As with a lock-on, you should immediately activate ECM and fly unpredictably to shake the incoming SAM or A-A missile.

AOA (Angle of Attack) System

The F-16's Angle of Attack (AOA) System is primarily used in conjunction with the Instrument Landing System (ILS) as an aid in landing the plane. Proper AOA is essential for landing, so these gauges are invaluable when approaching your runway.

The AOA System consists of two gauges on the Front Panel: the AOA Indexer and the AOA Indicator.

AOA Indexer

This gauge, just on the left side of the HUD, indicates how you should fly your plane so you have the proper angle of attack (landing approach angle) to the runway. It consists of three lights that graphically display your AOA:

When the top light is lit, your AOA is too high because your airspeed is too low.

When the middle light is lit, your AOA is acceptable for landing.

When the bottom light is lit, your AOA is too low because your airspeed is too high.

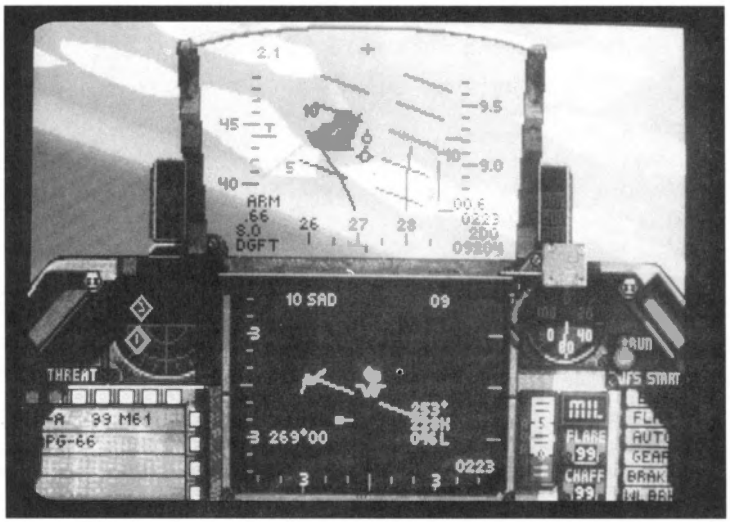
AOA Indicator

This gauge, located just to the right of the REO duplicates the AOA Indexer's function, but displays your F-16's angle of attack in numerical format. This allows you to be more precise in your AOA calculations. An AOA of 10–13° is necessary for landing your plane.

You can find instructions on landing your F-16 later in this section.

Stores Control Panel (SCP)

The SCP is the pilot's indicator of what weapon is currently loaded and available to fire. To change weapon selection, use either the Backspace key to select one of the air-to-ground weapons or the Enter key to select one of the air-to-air weapons. Use the \ key to select ILS from the SCP.



The first line in the SCP indicates what general type of weapon you have loaded (either "A-A" or "A-G" for air-to-air or air-to-ground respectively), then the number and type of that weapon. The number and type of weapon that is displayed is dependent on what weapons were loaded onto your aircraft before takeoff. However, regardless of your weapon choices, you will always have your built-in M61A1 cannon.

The second line in the SCP indicates whether you have your radar turned on or not. If the letters "APG-66" are *not* displayed on this second line, your radar is either turned to Standby or it is inoperable. To turn the radar back on (if not damaged), press the [R] key.

If you want to see a list of the weapons you have on board, press the [V] key repeatedly to cycle through the complete armament stores on your F-16.

Air Refuel/Nose Wheel Steering (AR/NWS) Status Indicator

Located just to the right of the HUD, the AR/NWS Status Indicator consists of three lights described below:

RDY (Ready) Light

The RDY Light comes on while you are on the ground and indicates that your landing gear is operational and not damaged. This light will remain on as long as your gear is undamaged or until you retract your landing gear.

AR/NWS (Air Refuel/Nose Wheel Steering) System Light

This light, which is displayed as "WHS," illuminates to indicate that your F-16's NWS System is activated and operational. When the light turns on, this means that command has been switched from the ailerons to the nose wheel so that your plane can taxi out and steer on the runway. As you initiate the JFS System, the NWS System will be activated. While on the ground, you steer with the rudders.

At 70 kts ground speed, the AR/NWS System Light will go out. This indicates that control has been given to the ailerons. The NWS System will not actually disconnect until the plane is airborne, when the Disconnect (DISC) Light illuminates.

DISC (Disconnect) Light

The DISC Light will turn on as soon as your F-16 has left the ground. It indicates that the NWS System has been disconnected and that control of the plane has been returned to the ailerons, so the plane can maneuver from side to side. This light will remain on until the landing gear has been raised.

This indicator also serves as a reminder to raise your landing gear with the [G] key.

IMPORTANT NOTE: Never exceed a ground speed of 200 kts with the landing gear down or your Nose Wheel System and your aircraft will suffer severe damage.

RPM Indicator

The RPM Indicator displays the percentage of thrust you are currently applying to your F-16's engine. You can increase or decrease this percentage by using the [+] and [−] keys respectively. When in the simplified flight model, this percentage is directly related to your speed in knots (displayed on the HUD). In the other flight models, your true air speed (TAS) is modified by lift, drag and atmospheric conditions.

When initiating takeoff, your F-16 will begin to roll at 40% RPM and the Wheel Brakes should be disengaged at approximately 60% RPM by pressing the [W] key. Delaying this release could cause damage to your NWS System or your Wheel Brakes. Increase thrust to 100% for takeoff and invoke the afterburner (with the [/] key) if your aircraft is carrying a heavy payload. You can find more information about takeoff later in this section.

The terms RPM and thrust can be used interchangeably.

Jet Fuel Starter (JFS) System

The JFS System consists of two lights that display the current condition of the F-16's engine. These two lights are described below:

JFS Run Light

The JFS Run Light will turn red and remain lit as long as the engine is engaged. If your engine is destroyed in battle, this light will turn green, but you'll have more important things to worry about than this light.

JFS Start Light

The JFS Start Light turns red upon primary ignition of the engine (when you initially press the [+] key while on the runway). The light will remain red until the F-16 reaches 60% RPM, when the light will turn green (off) and the main engine takes over. It will remain off during normal operation of the airplane, even if the plane drops below 60% RPM. The only time the light will illuminate (red) again is if the engine is shut off (0% RPM) and then restarted.

Stall Light

When the Stall Light (located near the upper right edge of the glareshield) turns on, it indicates that you have a stall condition present. Any number of things could have brought on the stall, but the most likely reason is that there is not enough airflow passing under your wings. This is usually caused by two conditions: sharp maneuvers at high altitudes where there is less oxygen or flying with your airspeed too low. The best way to recover from a stall is to nose forward into a dive until you recover enough airspeed to resume normal flight. Be sure you have enough altitude for this maneuver.

Military Power/Afterburner (MIL/AB) Indicator

This display indicates whether you are using Standard Power (MIL) or Afterburner (AB) to propel your F-16.

Standard Power is any normal power produced by the engine from 0–100% RPM. The term for reaching 100% thrust (when not in Afterburner mode) is known as Military Power. When in Standard Power mode, this MIL/AB Indicator will display "MIL."

Afterburner is a form of super acceleration utilized primarily for increased speed during takeoff and dogfighting. It is achieved by injecting fuel into the jet exhaust, which is subsequently ignited by the high temperature. You can light your afterburner by pressing the [/] key. This will bring you to 100% RPM and then engage the afterburner. The MIL/AB Indicator will now display "AB1," indicating that your plane is in afterburner stage 1. There are five different afterburner stages ("AB1" through "AB5"), each higher stage increases speed by pouring more fuel into your F-16's jet exhaust. You can increase and decrease the afterburner stages by pressing the [>] and [<] keys respectively. To drop out of afterburner back to 100% Military power from any afterburner stage, press the [/] key again.

REMEMBER: Your afterburner uses an enormous amount of fuel, so be sure to keep your eye on the fuel gauge (Left Lower View). In addition, the afterburner is a favorite attraction of heat-seeking missiles, so don't light your afterburner if you have one on your tail.

Chaff/Flare Indicators

These indicators keep track of the number of chaff packets and infrared flares you have remaining on board. Chaff and flares are used as a diversion for radar tracking and heat-seeking missiles. Your F-16 is always initially equipped with 30 packets of chaff and 30 infrared flares.

Chaff Indicator

This indicates the number of chaff packets you have left to use. Chaff are packets of tiny pieces of foil designed to fool radar-guided SAMs and radar-guided A-A missiles. They operate by deflecting radar waves aimed at your aircraft. To dispense a packet of chaff, hit the [Ins] key (or [0] on the numeric keypad).

Flare Indicator

The Flare Indicator tells you how many infrared flares you have remaining. Flares are designed to confuse heat-seeking missiles since they produce a hot infrared source that attracts those missiles away from your plane. To drop a flare, press the [Del] key (or [.] on the numeric keypad). Remember that using your afterburner creates a tremendous amount of heat, so dropping flares with your afterburner on will not be very effective.

Aircraft Status Control Panel

On the far right-hand side of the Front View there are a number of lights that remind the pilot about the current status of his aircraft. These lights illuminate when the item in question is in use, and are described in detail below:

ECM Status Light

The ECM Status Light toggles on when you engage your ALQ-131 ECM (Electronic Countermeasures) Pod by pressing [E]. Since the ECM pod is an optional piece of equipment, it will only be present if you request it when loading your weapons. The ECM pod is used to foil ground-based radar, SAMs and the on-board radar of enemy aircraft. Because ground and air-based radar can pick up ECM emissions, you should only use ECM when an enemy aircraft or a SAM has acquired a lock on your plane.

FLAP Status Light

The Flap Status Light toggles on when the wing flaps have been engaged using the [F] key. The wing flaps are used to slow the F-16 down while landing. You can also use the flaps in conjunction with the speed brakes (see the Brake Status Light) to help reduce speed.

WARNING: Never lower your flaps at speeds over 400 kts. This will cause your flaps to become permanently inoperative.

AUTO Status Light

The Auto Status Light toggles on when you engage the automatic pilot (autopilot) by pressing the [A] key. The autopilot will then immediately begin to follow the flight route you set when planning your mission. Your plane will also instigate the specific waypoint action ("LOITER," "ESCORT," etc.) that you set on the flight route.

However, if there are enemy planes in the immediate vicinity, your plane will attempt to engage the nearest aircraft targeted on your REO. (To change the targeted aircraft, press the [T] key.) It will even fire a missile if it obtains a missile lock on an enemy aircraft. Of course, any true-blue Falcon pilot won't be using this in actual combat.

GEAR Status Light

The Gear Status Light turns on when the landing gear on your F-16 is in the down position. This is achieved by pressing the [G] key. Immediately after takeoff, you should always raise the landing gear by pressing the [G] key again. Failure to do so could cause serious damage to the landing gear and may force you to make a belly landing. Your landing gear should only be lowered when approaching the runway at a slow speed. You can confirm that the gear is down by looking at the Landing Gear lights in the left lower cockpit view.

BRAKE Status Light

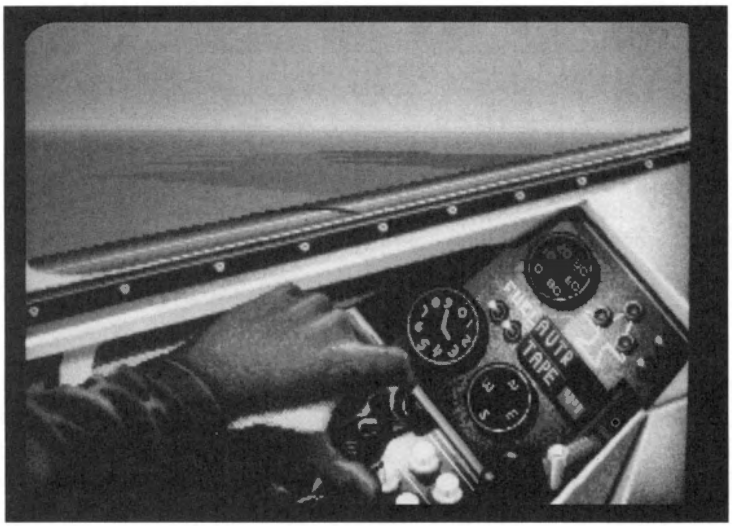
The Brake Status Light turns on while you utilize the speed brakes by pressing the [B] key. The speed brakes are used to temporarily slow the plane while still keeping the same amount of thrust on the engine. The brakes are useful when engaging enemy planes, because you can use them to slow you on certain maneuvers, then regain your original speed within seconds. You can also use the speed brakes in conjunction with lowering the throttle to help land the plane. Pressing the [B] key toggles the speed brakes on and off.

WL BRK Status Light

The Wheel Brake Status Light toggles on when you engage the wheel brakes by pressing the [W] key. The wheel brakes are used to slow you down during landing and anchor the plane after landing when it has finished rolling on the runway.

Left View

Press the [4] key (or [7] on the numeric keypad) to change to the Left View. The lower Left View contains a number of important gauges and lights that can be utilized if you have HUD failure or require specific information not found on the Front View. These instruments are described on the next page:



Fuel Indicator

The Fuel Indicator shows you how much fuel you have remaining in both the internal tank and any external tanks you may have loaded prior to takeoff. This gauge is measured in hundreds of pounds of fuel. Check this indicator periodically to ensure you have sufficient fuel for your current mission. In addition, if the word "FUEL" appears on your HUD, check here *immediately* to determine how much fuel you have remaining. If you find you have very little fuel left, you may have to abort your mission and return to your airbase.

Fuel will be drawn from any external fuel tanks first, as indicated by the long gray hand on the indicator. The small white hand corresponds to your internal fuel tank and will not move until you have exhausted all the fuel from your external tanks. The internal tank holds approximately 6,950 pounds of fuel while the capacity of external tanks depend on what size tank(s) you have loaded on.

Landing Gear Lights

These three lights illuminate when you have your landing gear down. If you press the G key and these lights do not turn on, your landing gear has been damaged and you will have to attempt a belly landing. The most common way for the landing gear to become inoperable is because it was not raised upon takeoff and thus broke during high-speed maneuvers.

Airborne Video Tape Recorder (AVTR) Panel

The AVTR Panel allows your F-16's on-board video to record your combat action for later review. Complete details about the AVTR and the Air Combat Maneuvering Instrumentation (ACMI) pod can be found in **Section X: ACMI**. The AVTR Panel consists of two indicators: the AVTR Status Light and the AVTR Tape Indicator.

AVTR Status Light

When the AVTR Status Light is on, you are recording replay data to your AVTR. You can turn the AVTR on and off by pressing Ctrl R.

AVTR Tape Indicator

This green bar is located below the AVTR Status Light and is used to indicate how much time you have left on your continuous replay. The bar will tick down from right to left when you turn on the AVTR. If it reaches the far left, the tape is full and any new data recorded will overwrite the beginning of your replay. You need expanded memory in order to use the AVTR. If you don't see the green bar in the AVTR Tape Indicator, you will not be able to record flight data.

Backup Airspeed Indicator

The Backup Airspeed Indicator shows your current airspeed in tens of knots.You can use this Indicator to monitor your airspeed if your HUD gets knocked out in combat.

IFF Light

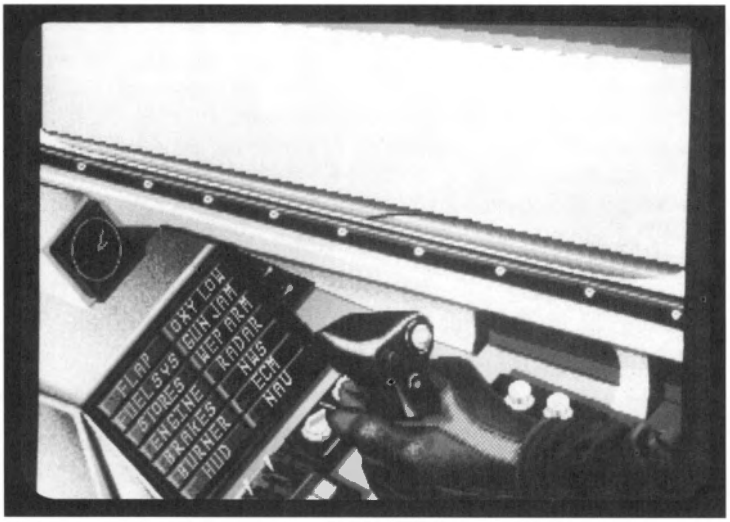
The IFF (Identification Friend or Foe) gives you a visual cue as to whether or not the plane you've got a radar lock on is a friendly or an enemy. Press the N key, and if the light illuminates, the aircraft you've locked onto is a friendly. After about 10 seconds, the IFF Light will turn off. If you have your sound turned on, this light will be accompanied by a high-pitched squawk.

Compass

The Compass gives your current heading and complements the Heading Scale on the HUD. It measures your heading by compass point rather than degrees. The conversion is as follows: N(orth) = 0°, E(ast) = 90°, S(outh) = 180° and W(est) = 270°. Use the compass to check your heading if your HUD has been knocked out by enemy fire.

Right View

Press the [6] key (or [9] on the numeric keypad) to look at the Right View. The lower Right View gives access to the on-board Clock and the Caution Light Panel. If the Master Caution Light on the Front View illuminates or you hear your Voice Message System (VMS) say "WARNING" or "CAUTION" repeatedly, check this view to see which system(s) have been damaged.



Clock

This is an analog display of the present game time (as compared with real-world time). The simulation takes place in a world with a twenty-four hour day. Missions start at certain times and the clock will let you know what time of the day it is in the simulation. The dial is displayed in standard 12-hour mode.

Caution Light Panel

One or more of the 14 caution lights will illuminate if your aircraft sustains damage. Each of these lights indicate that the system in question is inoperable and will require repairs when your plane has touched down at your airbase.

IMPORTANT: These lights have a different function than the Aircraft Status Lights on the Front View. The Aircraft Status Lights indicate whether or not certain systems on the aircraft are activated, while the Caution Lights illuminate when certain systems are damaged.

FLAP Caution Light

The Flap Caution Light indicates that your wing flap mechanisms have been damaged and are frozen in their current state. If your flaps were open (i.e. the Flap Status Light was on) prior to the damage, your flaps will be stuck in that position. Your plane will have less maneuverability and will be unable to achieve maximum velocity. If the flaps were frozen in the closed position, your plane will be harder to land because the flaps are used to reduce speed.

Recommended action: Land as soon as practical if you have suffered other major damage. It is possible to fly with this system inoperable, but it is not recommended.

FUEL SYS Caution Light

When the Fuel Sys Caution Light illuminates, it indicates that you have a leak in your fuel system. This light only informs you that there is a leak, but not the severity of that leak. Check the Fuel Indicator on the Left View and monitor the amount of fuel that is being lost. If the leak is severe, you may be forced to turn home or land immediately.

Recommended action: Land as soon as practical, especially if you have taken other damage. Use your best judgment; if the fuel leak is slow, you may be able to continue with your mission. However, if you notice the amount on your Fuel Indicator decreasing quickly, you may be forced to land your plane immediately (on a road or flat surface) or eject from your plane.

STORES Caution Light

The Stores Caution Light indicates that you are unable to launch or jettison any external stores you have loaded on your F-16. This includes all A-A and A-G weapons, external fuel tanks and ECM pods. If you are planning on engaging enemy aircraft, you will need to switch to your M61A1 Cannon.

Recommended action: Because this damage affects all of your weapons (save for your internal gun), it is recommended that you return to base or assist your wingman in completing your mission if you have not completed the mission. If you have already completed your assigned mission and are nearly home, this light is not as crucial.

ENGINE Caution Light

The Engine Caution Light indicates that your engine has been damaged beyond repair. Engine shutdown causes your engine to drop to 0% RPMs, and your airspeed will begin to decline. Once you obtain a low enough airspeed, your plane will drop into a flat spin.

Recommended action: Engine damage is the most severe type of damage your plane can incur. If you are at a low altitude, you may want to try to "dead-stick" land the plane. If you do try a dead-stick landing, you'll only have one chance at it. Your best course of action when the engine shuts down is to level the plane out, then immediately eject (by hitting the Ctrl E key combination three times).

BRAKES Caution Light

The Brakes Caution Light indicates that your speed brakes have been damaged and are stuck in their current position. If your speed brakes were open (i.e. the Brake Status Light was on), your speed brakes will be frozen in that position. Since speed brakes are used to reduce velocity, your plane will be less maneuverable and you will be unable to accelerate to top speed. If your speed brakes are stuck in the closed position, your plane will be more

difficult to land. This damage is similar to having flaps damage (see the Flap Caution Light above).

Recommended action: Land as soon as practical if you have suffered other major damage. It is possible to fly with this system inoperable, but it is not recommended.

BURNER Caution Light

When the Burner Caution Light illuminates, it indicates that your burner has been damaged and is no longer operational. Your plane will immediately drop from any afterburner stage it was in previously to 100% standard power (MIL). Afterburner damage means that you will have a difficult time escaping from an area quickly or completing high-speed maneuvers.

Recommended action: It is up to your best judgment; if you feel you will need to use your afterburner on your mission, you may wish to return to your airfield and have the damage repaired. Otherwise, you can continue with your mission if you feel you won't need your afterburner.

HUD Caution Light

The HUD Caution Light will come on when your HUD has been completely knocked out. Your viewscreen will no longer display any HUD information, so you must rely on the secondary instruments in the Left View. When your HUD goes out, you have very little information on your plane's current status (altitude, degree of climb or dive, etc.). Other than engine damage, this is the most serious form of damage your plane can take.

Recommended action: Land as soon as possible to make repairs. Your plane is not totally useless, but without the vital HUD information, your plane will be nearly crippled in a dogfight. Landing will also be difficult, since you will no longer have the ILS HUD to guide you down your runway.

OXY LOW Caution Light

The Oxy Low Caution Light illuminates when enemy gunfire pierces your canopy. This damage causes a drop in cabin pressure and will limit your maximum ceiling to 10,000 feet. Flying above this ceiling will cause you to blackout, even if you are flying straight and level.

Recommended action: If you are above 10,000 feet when this damage occurs, pull into a dive immediately and drop below this ceiling. If you are engaged in a dogfight, be sure not to cross this ceiling. In addition, high-speed, high-G maneuvers can cause you to blackout at lower Gs than normal. It is recommended that you return to base as soon as practical to make repairs.

GUN JAM Caution Light

The Gun Jam Caution Light indicates that your M61A1 cannon is jammed and no longer functional. When this light illuminates, only your internal gun is damaged; any remaining stores (both A-A and A-G) are not affected. You will need to switch to your other weapons (if you have any remaining) for combat purposes.

Recommended action: Because this damage does not affect your missiles or bombs, it is not as severe as when the Stores Caution Light or the Wep Arm Caution Light comes on. You only need to land if you plan to engage in a dogfight and your A-A missiles are expended.

WEP ARM Caution Light

The Wep Arm Caution Light illuminates when your arming mechanism has been hit and is no longer functional. This means that you will be unable to arm *any* A-A or A-G weapons. Any cluster bombs, iron bombs and rocket launchers will still operate properly. However, you will need to switch to your M61A1 gun for a dogfight or strafing.

Recommended action: This damage severely hampers your ability to dogfight and to complete an A-G mission. If you are currently on a mission requiring A-G missiles, you will need to either head for home or attempt to cover your wingman while he completes the mission. Usually, the best action is to land at your airfield as soon as practical to make repairs.

RADAR Caution Light

The Radar Caution Light turns on when the radar display of your REO is no longer operational. You will no longer be able to achieve a radar lock on A-A or A-G targets and will be unable to determine the exact position of enemy aircraft and ground targets. Heat-seeking missiles will still have the ability to lock-on, however. In addition, you will need to rely on the Pitch Ladder of your HUD to orient yourself to the horizon. You will still be able to navigate because this does not affect the map display of your REO.

Recommended action: If your mission requires you to destroy a ground target, this is still possible but only through visual sighting and release of your weapons. Air-to-air combat is much more difficult because you have lost the ability to use your radar-guided missiles (if any). If your mission is to fly CAP and you have little or no M61A1 ammo remaining and no heat-seeking missiles, the best decision is to land as soon as possible.

NWS Caution Light

The NWS Caution Light will come on when your Nose Wheel Steering System has been damaged. There are three typical causes for this damage: not following required takeoff procedures (i.e. not raising your landing gear upon takeoff), landing too hard on the runway, and being hit by enemy gunfire. When the NWS System is damaged, you will have a difficult time steering the plane once it has landed on the runway. This could lead to more severe damage and increased repair time if the plane manages to roll off the runway.

Recommended action: Although this damage is major when you are attempting to land, it does not affect the handling or performance of your F-16. Because of this, it is not necessary to land for repairs right away. Just be sure to remember that this damage has occurred when you are preparing to land and try to land as smoothly as possible.

ECM Caution Light

The ECM Caution Light will illuminate when your ALQ-131 ECM pod has been destroyed by enemy gunfire. You will no longer be able to engage your ECM pod to spoof enemy missiles and radar. If you did not load an ECM pod prior to takeoff, this light will never turn on.

Recommended action: If your mission involves attacking a SAM site or a heavily guarded airbase, you may want to abort your mission and return to base for repairs. However, if you feel that you can accomplish your mission without an ECM pod, that is your prerogative.

NAV Caution Light

The Nav Caution Light will light up if the map display on your REO is no longer operational. In addition, you will be unable to see the Waypoint Caret on the HUD. Without the map, you will have to rely on visual spotting of terrain features to determine your position in the area; however, you will still be able to use your autopilot to fly you to your waypoints. In addition, you will still be able to lock onto targets and determine their position if the radar display of your REO is still functioning.

Recommended action: If you have few waypoints set prior to initiating your mission, the loss of the REO's map display will be minor. This is because you can engage your autopilot to follow your planned route in and out of the target area. If you manage to get lost, you can use the enclosed Navigational Maps of the area and look for major features as an aid in guiding you to your airbase.

Rear View

Press the [5] key (or [3] on the numeric keypad) to switch to the Rear View. There are no lights or indicators in this view, but it is useful for scanning your rear 45° for enemy planes.

Up View

Press the [U] key to switch to Up View. This view gives you another angle to view the action if you are inverted or trying to scan a plane flying overhead. There are no instruments in this view, and it is difficult to fly in for prolonged periods of time.

Voice Message System (VMS)

In addition to the displays and indicators on the various instrument panels, there is another system in the F-16 that is used to warn of impending danger. This is the Voice Message System (VMS), affectionately known as "Bitchin' Betty." The VMS uses a female voice to warn the pilot about hazardous conditions that exist or could exist in the aircraft. The VMS messages are listed below by priority of occurrence, with explanations following:

- PULLUP-PULLUP-PULLUP-PULLUP – This message is activated if you are in immediate danger of crashing into the ground. Usually this involves diving toward the ground with a large angle of descent or high airspeed. In addition to th audio cue, your HUD will display two "arrowheads" rapidly converging towards the center. The closer the arrowheads are to each other, the closer you are to the ground. If the arrows flash, it indicates immediate danger. This VMS warning will silence when you take action to correct this problem (i.e. pulling back on the stick to correct your descent angle).
- WARNING-WARNING (pause) WARNING-WARNING – This message is activated after any warning light illuminates on the glareshield. It usually means a major failure has occurred in your aircraft (such as an engine failure).
- CAUTION-CAUTION – This message is activated after the Master Caution Light illuminates on the glareshield. Its intent is to inform you that one of the Caution Lights has lit up on the Right View. Once you look at the Right View, this message will silence.

Wingman messages

You will hear messages from your wingman, other allied pilots, and from the AWACS plane during a campaign or Red Flag mission. Sometimes they will be in response to an inquiry or command from you and other times they will just let you know what they are doing. These messages will only come from the other pilots in your flight, and they are not random messages. They indicate actions and observations from your wingmen that they want you to hear.

You will hear these messages if you are using a Sound Blaster card, an Ad Lib card, or the IBM PC speaker. You must have expanded memory to hear these sounds.

This is a list of some of the messages you may hear and what they mean.

- Negative. Pigeons to home plate – From AWACS. You have tried to advance your waypoint past the last setting (your home base).
- Kilo Mike Alpha – A message from your wingman if you ask him to do something really stupid, like "Break Low" when he is flying at 100 ft AGL.
- I'm picking up a spike – Your wingman is detecting another plane or ground unit with its radar aimed at you.
- Stranger – An unexpected friendly aircraft is in the area.
- Unable – Unable to comply with your command.
- Copy fence check – Your wingman has made sure all his weapons and systems are ready for combat.
- Be advised, I've gone winchester – Your wingman is out of A-A/A-G weapons.
- Copy disengage, will resume – Will disengage and resume formation.
- Clean, clear, and naked – Nothing on radar, nothing visual, and nothing on the Threat Warning Indicator.
- Fox one – Your wingman is firing an AIM-120 radar-guided missile.
- Fox two –Your wingman is firing a AIM-9P Sidewinder missile.
- Fox two mike – Your wingman is firing a AIM-9M Sidewinder missile.
- Atoll! Atoll! – A rear-aspect heat-seeking missile has been fired at your wingman.
- Magic! Magic! – An all-aspect heat-seeking missile has been fired at your wingman.
- Apex inbound! – An Apex passive radar homing missile is inbound.
- Guns! Guns! Guns!– Your wingman is firing his M61A1 Cannon.
- Flame out – Your wingman has been hit and has engine damage or is totally out of fuel.
- Bandit! Bandit! – Enemy aircraft sighted. This message is accompanied by info on its direction.
- Singer high! – A SAM has been launched.
- Request you check joker – Your wingman is running out of fuel and wants to let you know that you should be aware of your own fuel situation.
- Be advised. Fuel is low – Your wingman has only enough fuel to return to base. Any action other than returning to base could be cause for a flameout.

If you are getting overwhelmed by radio chatter, you can tell all your wingmen to shut up by pressing Shift R.

Radar/Electro-Optical (REO) Display

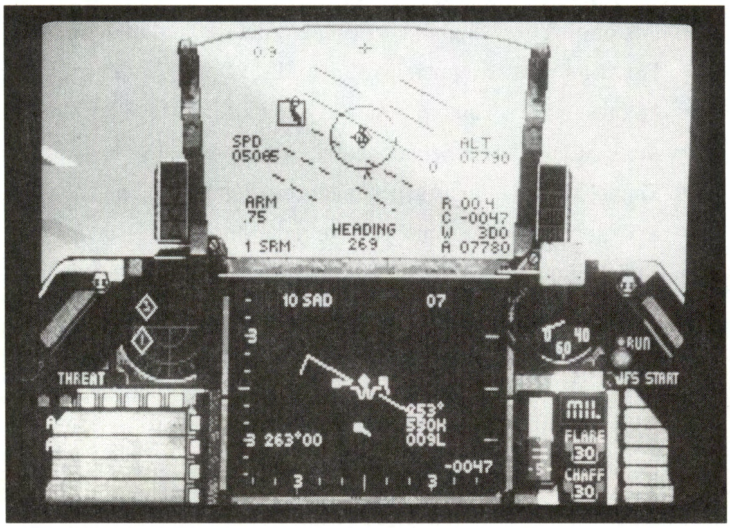
The F-16 uses the Westinghouse APG-66 pulse-doppler "look-down" radar for both air-to-air and air-to-ground detection of targets. This is a small, highly effective radar unit that will give you significant advantages against an enemy that is closing on you at a distance. *Falcon 3.0* simulates both air-to-air and air-to-ground modes of this radar. Since the real radar is quite complex to use, we give you three levels of radar simulation. SAD mode is the simplest (and least realistic) mode and gives you a 360° view of all aircraft around you. SAM mode is more like the real Situation Awareness Mode found on the APG-66, but the operation is simplified. For those of you who want a real challenge, the HFR mode gets you close to the real thing. When you learn the HFR mode, you'll appreciate the skill required of a real F-16 pilot! These three modes are described below.

Situation Awareness Display - SAD

The radar images in SAD mode, as well as in the other modes, are displayed on the REO as long as your radar is turned on. You can verify your radar is on if the second line of the Stores Control Panel reads APG-66. If the radar is off (in Standby mode), press the R key. Pressing the R key while the radar is on toggles it to Standby mode.

SAD mode is extremely useful for good situational awareness. Situational awareness is the ability to create a mental image of all the threats in the 3-D environment. SAD mode gives you general information about each aircraft that appears on the radar. You can also select individual targets and receive more specific information about the selected target.

SAD mode gives you a "god's-eye" view of your world. Your position is located in the center of the radar display screen, represented by the small F-16 icon, and the radar displays the 360° world around you. Any airborne aircraft appear on the radar as green squares.



The radar range can be either 10, 20, 40 or 80 nm (nautical miles). In SAD radar mode, the Fire Control Computer will calculate the best range for you. The current radar range is displayed in the upper left edge of the REO. Immediately to the right of the range you'll see SAD, which is your radar mode. You will see every target that is in the air within the radar range you have set. For example, if the radar is at 20 nm distance, you will see every aircraft in the air within 20 nm. Aircraft more distant than 20 nm will not show up.

You can estimate the distance of each aircraft by its distance from the center of the REO. For example, if you are in 40 nm range, the radar covers a range of 20 nm in each direction from the center. A blip that appears halfway between you and an edge of the REO would be 10 nm from you in the direction he appears on the REO. If your distance range was set at 20 nm, a blip in the same position would be 5 nm from you.

The radar shows you approximate altitude data of every target displayed on your radar with a color code. An orange blip is more than 3,000 feet below you. A blue blip is more than 3,000 feet above you. A white blip is within 3,000 feet of you (either above or below).

SAD mode also tells you the approximate direction of travel of each target. You will see what appears to be a tail hanging off the end of each blip. If you think of it as a vapor trail coming off the back of the aircraft, you will easily be able to determine its direction of travel. Aircraft with their tails angling out away from the center of the REO are heading directly toward you.

The radar will automatically lock on to the closest target within the range selected on the radar. A target that is locked on to is displayed as a diamond. Other targets are displayed as small squares.

There are several read-outs on the REO that give you information about the target that the radar has locked on to. The number in the upper right of the REO shows the altitude in thousands of feet of the current target. The number at bottom right shows your closure speed. It is negative if you are moving apart and positive if you are closing.

Above the closure speed read-out is a read-out stack of three numbers. The top number is the target heading in degrees, the middle number is the target speed in knots, and the bottom number is the target's aspect angle.

On the left middle of the radar screen you'll see two numbers indicating the selected target's bearing and its distance.

Other elements of the radar screen are the artificial horizon line that follows the movement of the horizon, and the radar elevation and azimuth scan bars. These are inverted Ts that move along the bottom and left edges of the REO, indicating the scanning of the radar dish. These are set automatically in SAD mode, so you don't have to worry about them.

You can easily lock on to other targets on your radar display by repeatedly pressing the [T] key. The radar will lock on to the next closest target and all the read-outs update to display information about it. By using the [T] key, you can get information about every target on your radar screen.

Situation Awareness Mode - SAM

The Situation Awareness Mode radar is close to the SAM mode in the High Fidelity Radar model, but it is a bit easier to use. This is a very useful radar mode because it gives you a good overview of the combat arena and also allows you to get specific information on individual bogeys.

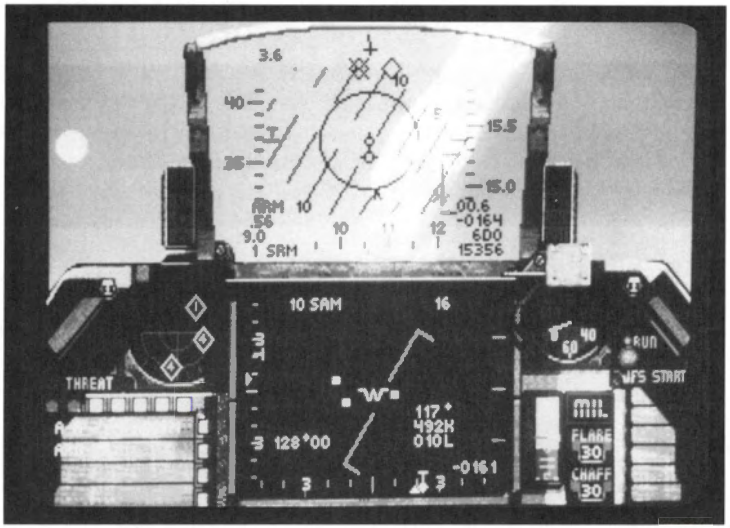
In SAM mode, the radar scans a cone 120° horizontally and 120° vertically in front of you. You will only see targets on your radar that are within this cone. The targets appear as green squares on the radar screen.

Like SAD mode, your radar range is automatically selected by your Fire Control Computer. The radar range is displayed in the upper left corner followed by the word SAM. Any target outside of this range will not appear on the radar screen. In SAM mode, your position is at the *bottom* of the radar screen. If you are in 40 nm range, a blip at the top of the screen is 40 nm from you. A blip in the center of the screen is 20 nm from you. SAM radar mode will auto-range if the target goes in or out of the current range. For example, if the radar range is set at 40 nm, when the target gets to about 20 nm (and appears at the bottom of the radar display) the radar will switch automatically to 20 nm range, and the target will then be displayed at the top of the radar display. You can also toggle between the various radar ranges (10, 20, 40, 80 nm) with the F8 key.

The radar will automatically lock on to the closest target within radar range. A locked on target turns into a diamond. The SAM radar display has the same read-outs as the SAD display and they have the same meanings; however, the SAM radar display has the following additions:

The left edge of the radar display has a grid with the number 3 above and below the center of the display. This is used in the HFR model to indicate the elevation scan of the radar, but this scan is not used in the SAM radar model. However, the upper half of the left edge is used as an altitude scale. The centerline of the scale represents ground level, and each tick represents 10,000 feet altitude. Therefore, the upper "3" represents 30,000 ft. You will see two horizontal lines drawn near this edge. These represent the altitude elevation range that is set automatically in SAM mode (you must set this range manually in HFR mode!).

The antenna azimuth and elevation markers in SAM mode look like little pyramids that move along the bottom and left edges. These represent the movement of the radar antenna during the SAM sweep. The inverted T along the bottom edge of the radar screen will be positioned under the current target. This is called the Tracked Target Marker, and it will move with the current selected target. Like SAD mode, the azimuth and elevation scans are preset and you don't need to worry about them.



Use the [T] key to switch among targets on the radar screen. Each time you press [T] you will select the next closest target and all the radar read-outs will pertain to the selected target.

SAM mode is very useful in determining which bogey might be an immediate threat. You can quickly determine the distance of all the targets on the radar screen by their distance from the bottom edge of the screen. The closer they are to the bottom, the closer they are to you. You can guess their approximate distance by determining how far up they are from the bottom of the screen and multiplying this by the radar range. For example, at a 20 nm range, a blip that is 25% of the way up from the bottom of the screen would be about 5 nm from you.

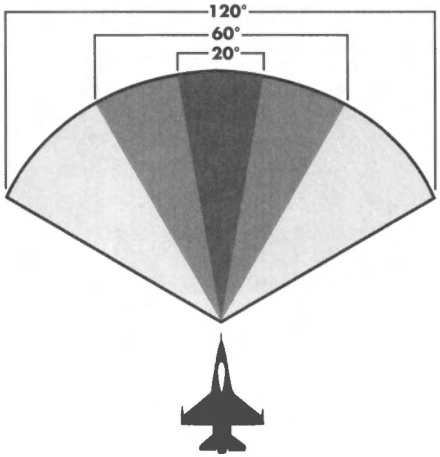
The [T] key will provide you with specific information about each target. Most important for determining immediate threat is the aspect angle. This is the bottom number in the three number stack on the right middle of the radar screen. A target with an aspect angle near 180° is heading directly toward you and is most likely a threat.

High Fidelity Radar - HFR

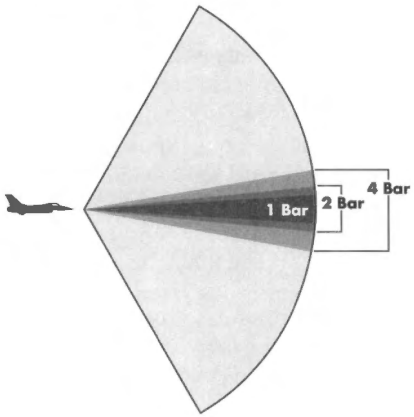
The High Fidelity Radar mode most closely simulates the working of the real APG-66 radar on the F-16. When you run HFR mode, you must manually control many aspects of radar operations. HFR mode actually consists of four separate modes which you will switch among depending on the kind of tracking and intercept you are doing. You will typically start out in NAM (Normal Air Mode), switch to SAM (Situation Awareness Mode) for details about individual targets, and then switch to STT (Single Target Tracking mode) or ACM (Air Combat Maneuvering mode) when you're ready to engage a target. In addition, you must set the range, the antenna elevation and azimuth scans, and manually select the target you want to look at. Each of these operations is described below.

Azimuth and Elevation Scans

In HFR mode, you manually select the pattern that the radar antenna will scan. The antenna scans in two directions — horizontally and vertically. The horizontal scan, (called the azimuth scan) is controlled by pressing F9. The F9 key cycles through three azimuth scan angles: 20°, 60° and 120°. You can see the change in scan angle reflected in the antenna azimuth marker (the inverted T) that appears along the bottom edge of the REO. If a target does not fall within the scanned range, it will not appear on the radar screen.



In addition, you also set the vertical or elevation scan. The radar will scan back and forth, and either stay on the same line or move vertically after each scan. Select the elevation scan by pressing F10. The F10 key will cycle through either 1 bar, 2 bars or 4 bars of elevation scan. In 1 bar mode, the radar scans left and right and stays on the same vertical line. In 2 bar scan, the radar scans to the right, drops down vertically a few degrees, scans left, moves up a few degrees, and continues this pattern. In 4 bar scan mode, the antenna scans right, drops, scans left, drops again, scans right, drops, scans left, and then moves up to the original scan line.

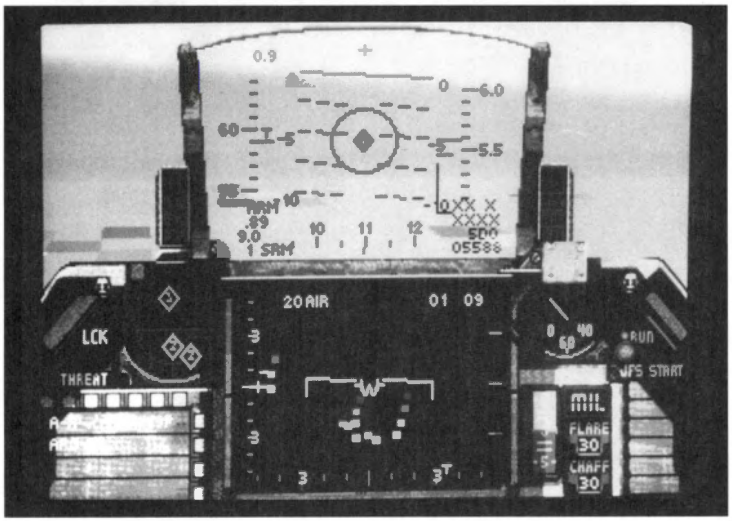


When you cycle through the elevation scan, the elevation ranges that the radar is scanning are displayed as two numbers in the upper right corner of the radar display. The first number is the lower elevation limit, and the second number is the upper limit. For example, if the read-out shows 05 25, this means that the radar is scanning an altitude of 5,000 feet to 25,000 feet. Any targets above or below this range will not show up on the radar.

Target blips are updated each time the radar scan hits them. If you are in 4-bar/120° scan mode, you will cover the largest range of space in front of you, but it will take four or five seconds to update each target. If you want continuous information about a target, you will need to narrow the radar scan to hit the target more often.

Target history

HFR mode has a target history feature built in. Each time the antenna scans a target it displays as a square green blip. The next time the antenna scans the target, assuming the blip has moved, it is painted on the screen in a new position. But the radar keeps the last three positions of each target on the screen, fading each blip over time. The older the blip, the more faded its image. This feature lets you determine how quickly a target is closing or moving away and the relative direction the target is moving. Just look at the trail made by the history blips to get an idea of what the targets are doing.



How to use NAM mode

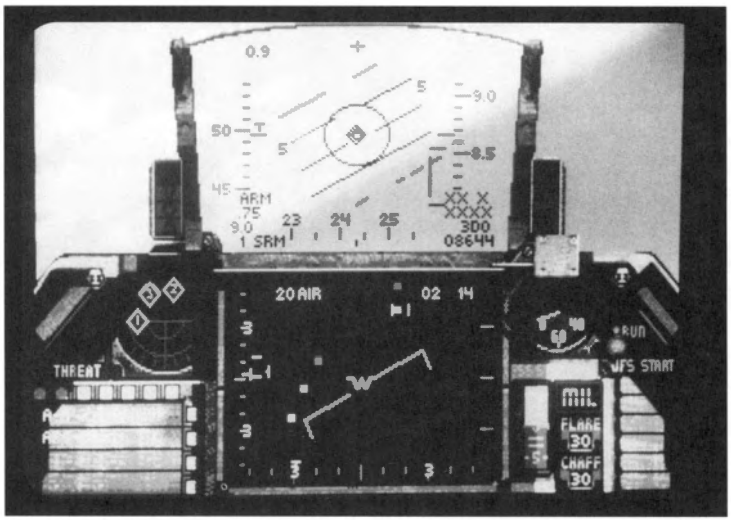
You can enter NAM mode manually by pressing F5. NAM mode defaults to a range of 20 nm. Use F8 to cycle through different radar ranges. When you are in NAM mode, you will see any targets within the radar scan and distance appear as square blips. In NAM mode the only read-outs on the radar screen are the distance range in the upper left corner and the elevation range in the upper right corner. Because you have not locked on to a particular target, you don't see the other read-outs. However, you can get quite a bit of information about targets in NAM mode.

You can determine approximate target distances by the blip's position from the top of the screen. The distance from the top to bottom of the screen represents the range shown in

the upper left corner. For example, in 40 nm range, a blip at the top of the screen is 40 nm away and a blip at the bottom of the screen is on top of you. If a blip is 25% of the way down from the top of the screen, it is approximately 30 nm distant. The target history feature can give you approximate direction and closure information about each blip.

Acquisition Corral and Search Target Altitude Bar

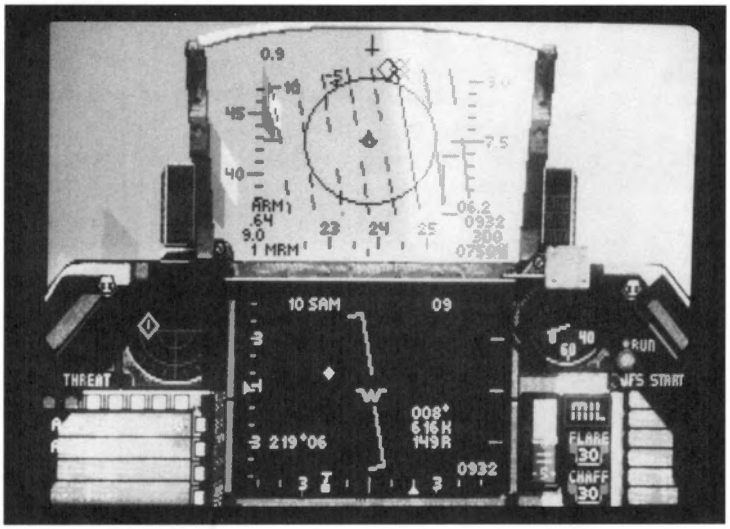
In order to select a target for more information, you need to move the Acquisition Corral on to the target blip. The Acquisition Corral consists of two parallel, vertical lines. By pressing the [T] key in NAM mode, you cycle the Acquisition Corral to each target on the radar screen. As soon as the Acquisition Corral is placed over a target, another item will appear on the radar screen. This is called the Search Target Altitude Bar. It is a vertical bar that appears next to the left edge of the screen. The Search Altitude Bar is used to determine the approximate altitude of the target in the Acquisition Corral. You read the altitude information from the upper half of the scale on the left edge of the screen. The center tick on the screen is 0 feet, and each subsequent tick represents 10,000 feet. The "3" represents 30,000 feet. There is a small dot in the center of the Search Target Altitude Bar, and the target's altitude is read on the scale across from this dot. By moving the Acquisition Corral on to each target with the [T] key, you can very quickly get an idea of the altitude of each target.



Situation Awareness Mode (SAM)

You can get the next level of detailed information about a target in SAM mode. In this mode, you can lock on to a target to get detailed information about it, and still have all the other targets within your scan range appear on the radar screen as they would in NAM mode.

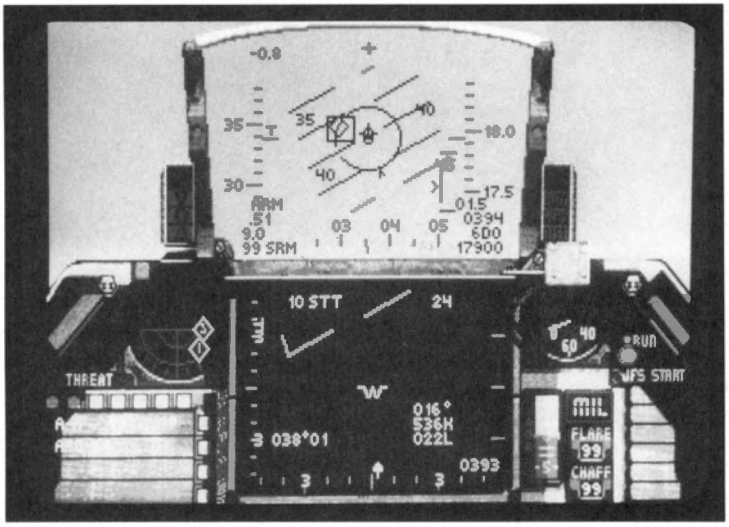
Switch into SAM mode by placing the Acquisition Corral on a target and pressing the [Z] key. This locks up the target within the Acquisition Corral and all the radar read-outs become active for this target. It also changes the target from a blip to a diamond. If you want to break lock on this target and go back to NAM mode, press the [X] (break lock) key. Otherwise, press the [T] key to cycle the lock to each of the targets on the screen. Each of them will show up as a diamond on the REO.



Besides giving you a good overall awareness of what is going on in the sky, SAM mode keeps you more invisible to the enemy pilot's Threat Warning System. Because you are scanning them briefly with your radar, the enemy doesn't get as clear an image of you on their Threat Warning Indicators.

Single Target Track Mode (STT)

Once you've identified a target you believe is hostile, you might want to lock him up for real. Lock up the target in SAM mode so that he appears as a diamond and then press the [Z] key again. This switches the radar to STT mode. All other blips disappear, and the radar antenna is locked on the target. You get continuous updates in the read-outs, but the enemy may receive a warning that you are painting him with your radar. You trade off continuously updated information for "visibility" to the enemy.



Air Combat Maneuver mode (ACM)

ACM is a special radar mode that automatically locks up the closest target within the radar's scan. ACM mode defaults to a 10 nm range, so you will see and lock up targets that are an immediate threat. If you bank and come in range of another target, ACM mode will automatically lock it up. ACM mode is essentially the same as STT mode, but the range will always be 10 nautical miles and targets will lock up automatically. You will see the radar mode switch from ACM to STT as soon as the target is locked up. Select ACM mode by pressing F6.

IFF (Identification Friend or Foe)

IFF is a special method of identifying if a radar return is coming from a friendly aircraft or a hostile one. You interrogate the currently locked-on aircraft by pressing the N key. This sends a special signal to the selected aircraft which produces a response from its transponder. If it is a friendly aircraft, its transponder "squawks" back, indicating it is a friendly. If you do not get a squawk, you should assume that the guy is a hostile. If you turn all sound off, you can see if the aircraft is friendly by looking at the IFF Light on the Left View.

IFF works in all radar modes.

REO navigation map

The REO map is another navigation tool you can use through the Radar/Electro-Optical Display. You can switch to this map by pressing the C key. When you want to return to the radar, press the C key again.

The map will display a small regional map of the area with your aircraft as a small red "+" sign. It will also display your home airbase as a dark red "x" and your next waypoint as a small green triangle.

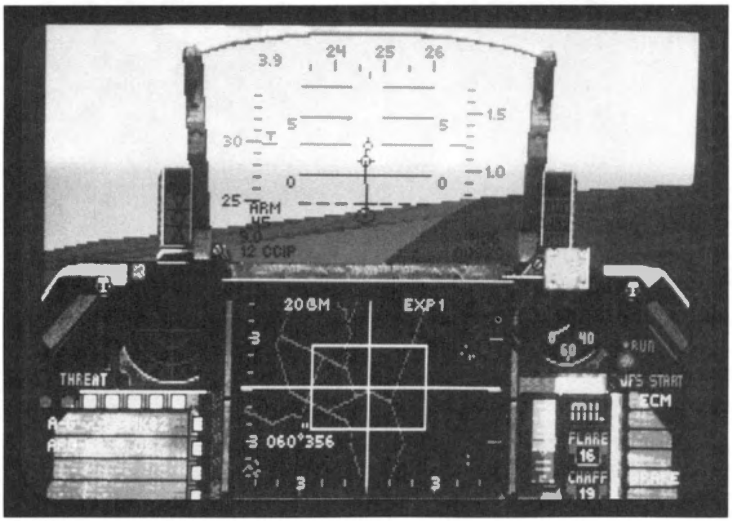
Ground Map mode

Ground Map mode is an air-to-ground radar mode. This radar mode is used to determine your position over terrain, to spot landmarks like roads, rivers, lakes, buildings and bridges, and to help you locate your targets. Switch to Ground Map mode by pressing F7. You can exit Ground Map mode and return to your previous radar mode by pressing the F7 key again.

Ground Map mode has a fixed range of 20 nm, but it has five levels of zoom. When you select Ground Map mode, the radar will scan the terrain in front of you and display a representation of it on your radar. You can identify some features by color and shape. For example, bright green lines are rivers and dim green lines are roads. Buildings will appear as dots until you get very close. You can also identify runways from ground map mode.

The square in the center of the radar display is your guide for zooming in. If you press the F1 key (zoom in), the area inside the square will fill the entire radar display. Normal ground map mode is 1 to 1. You can zoom in with 2x, 4x, 8x or 16x magnification. Press F2 to zoom back out. You read the expansion value in the upper right corner of the radar screen.

You can move the zoom rectangle around in the radar display to zoom in on areas that are not directly in the center of the display. Use the Shift key in combination with the movement keys (I, J, K and L) to move the zoom rectangle to a new position. There are nine possible display positions: three across and three down. Once you position the zoom rectangle on the area of interest, press the zoom in key to see it in more detail.



If you have selected a target in the waypoint screen, the target bearing and distance will appear in the lower left quadrant of the radar display. In addition, it will appear with a diamond or have cross hairs over it on the radar when it becomes visible.

Press the Y key to toggle off roads and rivers in the Ground Map mode. This may substantially speed up performance.

Outside Views

Falcon 3.0 provides a number of views that give you a spectacular view of the action from outside the cockpit. These views are mostly useful for sightseeing, quick reconnaissance, and reviewing previous missions. You may also be able to use these views for combat, but in general, the outside views aren't designed for combat.

When you are in any of the outside views, you can rotate the view horizontally and vertically and you can also zoom in or zoom out.

Track View

Track View positions a camera behind your aircraft at a fixed distance. You can use the zoom keys and the rotation keys to view the outside world from any position. To get into Track View, press the [9] key on the top row of the keyboard.

If another aircraft is within visual range of your craft while in Track View (or any outside view), the view will automatically change to show both your aircraft and the other aircraft and will continue rotating to keep both aircraft in view at the same time. If there are several aircraft within visual range, you can change which plane is kept in view with your F-16 by pressing the [T] key.

Chase View

The Chase View is much like the Track View, but the view from the chase plane is not locked tightly to your F-16 like the Track View is. The Chase plane will lag behind and then catch up to your plane as you maneuver.

To evoke Chase View, press [0] on the top row of the keyboard.

Missile/Enemy View

There are some unique views in *Falcon 3.0* that give you a visual perspective from the point of view of a missile you have just fired or from the enemy target that the missile is heading for. Once you have fired a missile, switch to Missile/Enemy View by pressing the [Q] key. It works slightly differently depending on whether you are attacking an airborne target or a ground target.

For airborne targets, the first time you choose Missile/Enemy View, you get the Missile View. You are directly behind the missile heading towards your target. If you press [Q] again, you will be switched to Enemy View. This shows you the missile coming toward you from the enemy's point of view. Pressing [Q] again puts you into Target View, which shows the enemy target in a view similar to Track View. From Target View you can actually watch your missile hit the enemy plane — if the bandit is not completely destroyed, you'll see it nose over and head, smoking, toward the ground where it will explode in a grand fireball! Once a missile or enemy plane crashes, you are switched back to Track View.

You may also switch directly into Target View by pressing [Q] once you have locked up an enemy on radar, without firing a missile.

If you are firing an A-G missile, [Q] works like the first two modes in A-A. The first time you press [Q] you are behind the missile heading for your target. The second time you press it, you see the missile coming at you from the ground target's perspective.

Satellite View

The Satellite View gives you a top-down view of your aircraft as seen from a satellite high in the sky. You can zoom in quite close or zoom out to check out the landscape directly under you. By using the rotate keys, you can change the Satellite View to view from any angle and position. Enter the Satellite View by pressing the [1] key on the top row of the keyboard.

Ground View

The Ground View is the opposite of the Satellite View. It looks straight up from the ground at your aircraft. By using the rotate keys, you can change the Ground View to view from any angle and position. Select the Ground View by pressing the [2] key on the top row of the keyboard.

Wingman View

You can get an interesting perspective by switching to the Wingman View. This is a view of your plane from your wingman's position. Switch to the Wingman View by pressing the [7] key. If you are flying in a multi-plane formation, the Wingman View is from the pilot listed as 1ST WING in the Armament screen. (Click the button labeled F-16 in the Armament screen to see the names and numbers of your wingmen.) If you repeatedly press the [7] key, you will switch views among each of the wingmen in your multi-plane formation.

Rotation and Zoom

One of the things that makes the outside views so interesting is the ability to change the fixed point of view by zooming and rotating. Zoom in by pressing the [F1] key. Zoom out by pressing the [F2] key. To rotate to the left, press the [F3] key. To rotate to the right, press [F4]. To rotate up, press [Shift][F3]. To rotate down, press [Shift][F4].

Normal rotation is relatively fast. To slow down the rotation, hold down the [Ctrl] key as you press the other keys.

When you rotate a view around the X or Y axis, the center of rotation is around the plane you are viewing (your plane or your wingman's plane).

Outside views in ACMI

In addition to the outside views during normal flight, you can also switch to the same outside views when reviewing a video tape of your mission in ACMI. While the VCR has buttons for rotation and zooming, you can use the key combinations described above to change outside views. See **Section X: ACMI** for more information about ACMI.

Padlock View

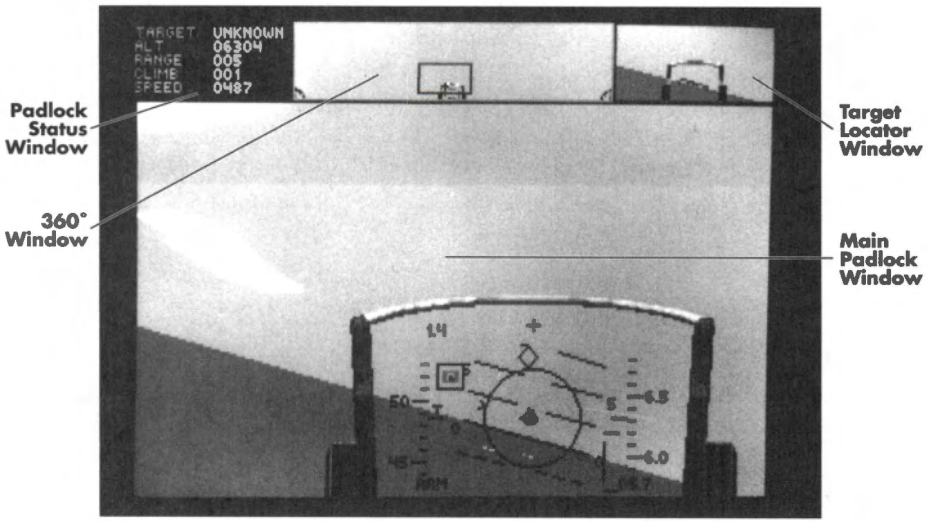
Padlock View is a view unique to *Falcon 3.0* that will enable you to track an enemy aircraft as it enters visual range. Padlocking a bandit is fighter pilot slang for keeping a visual lock on the aircraft, and Padlock View lets you do just that. When you go into Padlock View, it will center on the nearest visual threat and follow the aircraft wherever it flies. Your HUD appears in Padlock View in the correct position when the tracked aircraft flies in front of it, and you can lock on weapons and fire them from within Padlock View.

Switch to Padlock View by pressing [8] on the top row of the keyboard or [*] on the numeric keypad.

When aircraft are identified

Aircraft are identified in Padlock View when they come into visual range. If there are more than one aircraft in visual range, you can switch among them by pressing the [T] (Target select) key. Padlock will switch among every plane within visual range, including friendly planes. When there are no aircraft visible, Padlock View will return to looking forward with the HUD visible.

There are four visual parts of the Padlock screen. They are described below.



Padlock Status Window

This section is located in the upper left of the screen and displays five variables. The first identifies the target. When you get close enough to identify the target visually, Padlock View will help you confirm your tally ho by identifying the kind of aircraft you are padlocked on. For example, the Padlock View may tell you the aircraft you are looking at is a MiG-29. When no aircraft are visible, the target is identified as NONE. When a target isn't close enough to identify, the target is listed as UNKNOWN.

The four remaining variables display your own aircraft's current altitude, the distance to the target, your climb angle in degrees, and your airspeed. You may need to refer to these variables as you fly in Padlock View. Some of this information is available on your HUD in the Main Padlock Window; however, you will only be able to see the HUD if no aircraft are being tracked or if the tracked aircraft is directly in front of you.

Main Padlock Window

This section of the Padlock screen is the largest and displays the view as you look outside your cockpit and follow the padlocked aircraft. This view will smoothly follow the padlocked aircraft wherever it flies. The only time you will break padlock is if the aircraft flies under your F-16 or it goes beyond visual range. When that happens, the Padlock View switches to any another aircraft, if it is visible. if no aircraft is in sight, the Padlock View finally returns to the forward view, encompassing the HUD.

When an aircraft becomes visible in the Main Padlock Window, a small colored square will be drawn around it to help you spot it. Normally the square is red. If your radar is locked on to this target, however, the square will turn green. If you break radar lock, it will turn back to red. If your radar is locked on a target, may want to try to maneuver so that he comes up in your HUD. You will then be able to fire missiles at him while in Padlock View. However, it's a good idea to use the Padlock View to check your six for another enemy. While you're busy setting up one bandit for a missile shot, another could be ready to waste *you*.

360° Window

The top middle section is the 360° Window. This is a full 360° fish-eye view which shows the HUD in the center and the rear of your aircraft split between the two sides. A red rectangle (known as the Targeting Rectangle), superimposed on the 360° Window, indicates where the Main Padlock Window is looking in the 360° world. The red cross in the Targeting Rectangle indicates the relative position in the outside view of the target you are padlocked on.

If the Targeting Rectangle is near the HUD, the Main Padlock View is looking toward the front. If the Targeting Rectangle is midway between the HUD and one half of the seat, you are padlocked looking out one side of the aircraft. If the Targeting Rectangle is at either edge near the split seat, you are looking backwards. When your Padlock View looks directly behind you, you will see the tail of your aircraft float in and out of view as appropriate.

Target Locator Window

The upper rightmost section of the Padlock screen displays the Target Locator Window. This window displays an artificial horizon which is very useful since it is quite easy to become disoriented while keeping your eyes on the enemy. You don't want to fly into the ground because you're watching a bogey out the right side of your aircraft.

You will see a HUD superimposed over the horizon because it is showing you the horizon from the point of view of looking forward in the cockpit (there is an artificial horizon bar drawn on the HUD which parallels the movement of the horizon). However, if the aircraft you are tracking is behind you, the word REAR will appear at the top of the Target Locator Window to remind you that the bogey's on your six.

You will also see a Target Locator Line drawn on the HUD. You can use this line to help you steer toward your target. If you can bring the nose of your aircraft on the target by following this line, you will see the HUD appear in the Main Padlock Window with the target marked in a target designator box on the HUD. If you switched out of Padlock View to Front View, you should see the same target in the HUD in exactly the same position. See Lesson 8 in **Section V: Air Combat School** for additional information about the Padlock View.

Takeoff

This section will cover the basic settings and parameters that you need to be aware of during takeoff. For a more detailed description of takeoff, see Lesson 1 in **Section V: Air Combat School**.

Pre-flight cockpit check

You'll want to do a quick check of the cockpit instruments before takeoff.

Left View

- Check your fuel state. Be sure you have enough fuel for the mission you are planning.
- Unless you specifically want to record your takeoff, make sure that the AVTR is off.
- Since you are on the ground, your landing gear will be down. Make sure the Landing Gear Lights show green.

Right View

- Be sure that no caution lights are lit.

Front View

- Set up your radar to the range and mode you want. You may choose to turn your radar to standby once you've set it up. Press [R] to toggle radar from on to standby.
- Verify your weapons store by pressing the [V] key to view all on-board stores.
- Set up the HUD mode you want by cycling through your weapons with the [Enter] or [Backspace] keys. The selected weapon will be shown on your stores control panel.
- Make sure that your jamming pod (if you have one) is off so you don't alert the enemy to your presence.

Once you have gone through your pre-start checklist, you are ready to power up your engine.

Takeoff

Initiate your Jet Fuel Starter system (JFS) by pressing the [+] key and spool your engine up to 60% RPM. You will see the JFS light turn green as the RPM gauge moves to 60%.

Throttle up to 100% MIL power. If you are carrying a heavy load or want to execute a combat takeoff, engage the afterburner (press the [/] key).

Watch your airspeed on the left side of the HUD. As you reach about 155 kts, pull back lightly on the stick. You will leave the ground. You can monitor your altitude above ground level by looking at the value at the bottom right side of the HUD. Never exceed 200 kts on the ground.

As soon as you are airborne, retract your landing gear by pressing the [G] key. Verify that the gear is up by looking at your Left View. The green gear lights should be off.

Your angle of climb should nominally be about 20° to 30°. You can verify this by looking at the Pitch Ladder in your HUD. If you are carrying a heavy load, you may not be able to obtain this degree of climb.

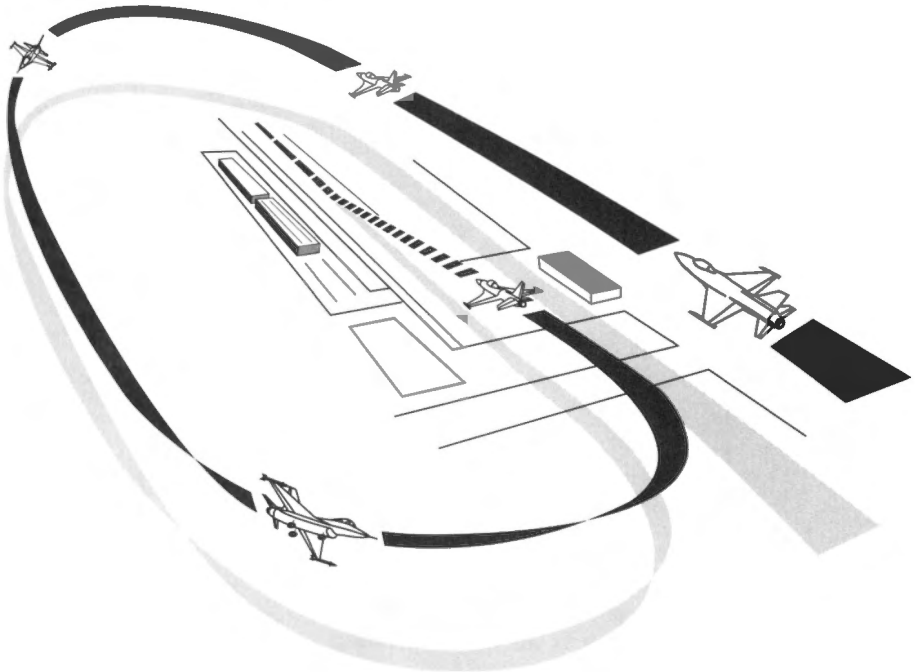
Level out when you reach the altitude you desire. If you engaged your afterburner on takeoff, disengage it by pressing the [/] key.

Landing

This section provides a brief overview of landing. For more detailed instructions, see Lesson 4 in **Section V: Air Combat School**.

To get ready for landing, switch to the ILS HUD mode by pressing the [\] key. Use the ILS bars to help you line up with the runway. Make sure that the vertical bar (the Localizer Deviation Bar) is centered in the HUD. If it is not centered, bank in the direction of the bar. For example, if the LD Bar is to the right of the Center Point, bank to the right. The LD Bar will move toward the Center Point of the HUD. When it reaches the Center Point, level out. Use your rudders to make fine adjustments to your heading.

Start your approach so that you are lined up with the runway about six to eight miles out. You are going to make a classic racetrack landing: pass over the runway, do a 360° turn, and land. If you've got serious damage or are flying on fumes, you may want to do a straight-in landing instead.



Set your waypoint to your airbase to determine your distance. The distance to waypoint on the HUD is displayed under the altitude scale. The waypoint read-out shows the distance in nautical miles followed by a "D" and the waypoint number. The waypoint to your home airbase is usually the last waypoint set into your navigation system. Use the Shift B and Shift V keys to change your waypoint. Depending on the level you have set for World Detail, you may be able to see the runway at approximately two miles out. Use the LD Bar and your eyes to line up properly.

Try to be at an altitude of approximately 6,000 ft when you reach the six mile point. This is known as the outer marker. The Glide Slope Deviation Bar will be below the Center Point of the HUD at this time. Your airspeed should be around 300 kts.

As you continue toward the runway, your GSD Bar will ascend toward the center of the HUD. Keep the approach of 1,000 ft for each mile from your airbase. When you are about one mile from the runway, you should be at about 1,000 ft AGL. Continue to descend and pass over the runway at 300 to 400 ft. Continue past the end of the runway at this altitude and start a left-hand 180° turn until you are flying back the way you came. Your airspeed will drop during this turn. Keep it at about 250 kts.

Lower your landing gear during the downwind leg. Be aware that the gear will produce extra drag so you may have to compensate with a slight increase in throttle. Keep your altitude at about 300 ft and your airspeed at about 250 kts. Watch the runway in your Left View. When you pass the beginning of the runway again, do another 180° turn. Give yourself enough room for the base leg turn. If you keep your bank angle the same as it was for the initial break, you will line up perfectly with the end of the runway.

During your final approach, watch your AOA indexer, located to the left of the HUD. The center circle should be illuminated, indicating that your AOA is correct. If the top triangle is lit, you are coming in too slow. If the bottom triangle is lit, your approach speed is too fast. You want to control your speed and thus your AOA with a combination of throttle, flaps and speed brakes. Your angle of attack will increase as you lower your speed and you want it to be between 10 and 11° at an airspeed of about 190 kts. Be sure not to slow below about 155 kts or you will be in danger of stalling.

Try to touch down near the end of the runway so you'll have plenty of room to land. You want to put the nose dead center on the runway if possible because, if you land off center, you might be in danger of running off the runway. You have some steering control after you slow down, but if you are too far off center, abort the landing and go around again.

As soon as you touch down, drop your throttle to 40% RPM and hit your speed brakes. When your airspeed drops below 70 kts you will have steering control via the Nose Wheel Steering system. Use your rudders to keep your plane dead center on the runway. Drive your Falcon to the end of the runway. When you come to a complete stop, set your wheel brakes. To end the simulation after landing, press the [Esc] key and choose End Mission from the FILE menu.

If you have to abort because your landing set up isn't the way you want it, don't try to be a hero and land anyway. You'll probably crash and burn, which won't look impressive on your record. Go around again. Eventually you'll get it right.

Menu bar

The menu bar gives you controls over various aspects of the simulation. You can get to the menu bar once you are airborne by pressing the [Esc] key. All menu bar settings (except Scale) are saved from game to game. The configurations you set from the Menu bar stay in effect from mission to mission and override any settings you have made in the Configuration screen. However, the settings in the Configuration screen are used by *Falcon 3.0* each time you run *Falcon 3.0* from DOS.

Using the menus

If you are using a mouse, position the cursor on the menu item and press the button to drop the menu down. Then drag the pointer down the menu to select an individual item. Some menu items have secondary menus that will pop out when you select them. To select an item from the secondary menu, drag the pointer to the right to the secondary menu item.

If you are using the keyboard, you can select menus and items directly by pressing the letter that is underlined in the menu.

FILE menu

The FILE menu is primarily where you end your mission or exit *Falcon 3.0.* The following items are on the FILE menu.

Return to Game

The Return to Game item closes the menu bar and returns you to the simulation at the exact spot and time you where at when you pressed the Esc key. Any other options you have changed will take effect when you return to the game.

End Mission

End Mission ends the current mission. If you finished by landing, you are taken to the debriefing screen. (In Instant Action, you are shown your scores.) If you choose End Mission in the middle of a game, the simulation randomly determines if you survive the mission. You can try to choose End Mission to get out of a hairy situation, but that doesn't guarantee you'll make it back in one piece!

Abort Mission

Abort Mission ends the current mission and returns you to the War Room. Since this acts as if the mission never occurred, use the End Mission option instead if you want this mission to count.

Replay

Replay gives you an instant replay by playing back your video recording for the mission you are flying. The playback starts from the point where you turned on your AVTR to the point where chose Replay. If your AVTR has not been turned on, this option will not be selectable.

Quit to DOS

This menu item quits *Falcon 3.0* and returns you to the DOS prompt. You are first asked to confirm that you want to quit.

CONTROL menu

The CONTROL menu lets you switch between the keyboard and joystick to control the F-16 sidestick. You will primarily choose Joystick from this menu to calibrate your joystick.

Keyboard

This option selects the keyboard to be your flight control device.

Joystick

This option selects the Joystick to be your flight control device. This option should be used for any joystick you are using save for the ThrustMaster. The ThrustMaster needs to be selected in the Configuration screen.

Default: This takes the default calibration setting for your joystick.

Recalibrate: This brings you to a calibration sequence to adjust your joystick for flight.

OPTIONS menu

The OPTIONS menu allows you to change the physical parameters of *Falcon 3.0.*

Sound

The Sound menu items control the background sound you will hear while flying. Background sounds are engine sounds and the Sidewinder growl. With this menu option, you can hear engine noise, Sidewinder noise, both or neither while flying.

All Off: This setting turns off all background sounds.

Engine: This setting provides engine noise as the only background sound available in the game. All sound effects can still be heard.

Sidewinder: This setting gives you the Sidewinder growl when you have an AIM-9P or AIM-9M selected and it is tracking a heat source. This lets you know that the Sidewinder is locked on to an aircraft. Engine sound is not produced with this setting.

All On: This setting gives you a combination of engine noise and Sidewinder growl. When this option is turned on, you will get all the possible sounds available in *Falcon 3.0.* This sound option is recommended for use with a sound card.

World Detail

These settings determine the level of detail displayed in the world. The higher the level of detail, the more realistic the world looks but the more processing power it takes. If the display is refreshing slower than you would like, reduce the level of world detail. This will increase the smoothness of flying.

Maximum: This setting shows the most detail. 3-D terrain is displayed with the greatest detail over the largest area.

High: This setting shows more detail. 3-D terrain is displayed with greater detail over a larger area.

Medium: This is the in-between setting for detail. You'll get 3-D terrain, but it is displayed in minimum detail and over a small area.

Minimum: This setting shows the least detail and will give you the smoothest display. At low setting, there is no 3-D terrain.

Terrain

The terrain setting determines whether the topographical terrain is displayed or not. The display of terrain takes up quite a bit of processing power and will slow down the smoothness of the display. If you are engaged primarily in air-to-air combat, you may want to turn off the terrain to increase the frame rate, which will give you a smoother display. This setting overrides the Minimum World Detail setting. For example, if you set World Detail to Minimum and then turn on Terrain, you will get 3-D terrain (similar to Medium Detail).

On: When set to On, the terrain is displayed.

Off: When set to Off, no terrain is displayed.

Collisions

This setting determines whether collisions are possible with other planes and buildings.

On: When set to On, you will crash if you collide with anything.

Off: When set to Off, you may fly into anything, except the ground, without consequence.

Change scale

This item determines the size of aircraft and moving ground objects. Because aircraft are relatively small, if the setting is at 1x (which is real size), most aircraft will be invisible until they are within a couple of miles. Even then, they will appear as dots until they are within less than a mile. Set the scale to 2x or 4x if you want to be able to see aircraft before they are right on top of you. This setting doesn't affect how soon your radar will detect other aircraft.

1x: This setting displays aircraft and moving ground objects at normal size. They will be hard to see until they are right on top of you. This is the way it really is, and if you want a challenge, keep the scale set to 1x.

2x: This setting doubles the apparent size of all aircraft and moving ground objects. You will see them sooner, but enlarging objects doesn't give you a bigger target to hit. This is the default setting.

4x: This setting quadruples the apparent size of all aircraft and moving ground targets. You will be able to see aircraft and other objects from quite a long ways off with this setting.

8x: This setting increases the apparent size of all air targets and moving ground targets by a factor of eight.

Clouds

This option allows you to turn on or off the cloud cover in the simulation. Turning the cloud cover off will increase the speed of your game.

On: When set to on, clouds will be displayed at the appropriate altitude.

Off: When this option is off, you will never see any cloud cover.

Horizon

This option will turn the gradient horizon on and off in the simulation. As with the Clouds option above, turning this option off will increase the speed of your game.

On: When set to on, a gradient horizon will be displayed.

Off: When this option is off, there will be no banded horizon.

SECTION

IX

CONFIGURATION

Configuration introduction

You can adjust certain game features and customize your hardware options in the Configuration area. For example, if you recently installed a sound card, you could enter the Configuration area and change the settings to whatever you need. There are two sections in the Configuration area, System Setup and Difficulty Levels. These are described in brief below:

The System Setup section lets you customize things such as what you are going to use to fly your plane, what sound card you have, and if you want music. The Difficulty Levels section allows you to change variables relating to flying: flight model, amount of armament, effectiveness of weapons, etc. It also has a Realism Value to gauge your setting against others. In Instant Action, the Realism Value is multiplied by your base score to get your total score.

The third part of this section will discuss your sound options: what sound boards you have (if any), how to change the options to achieve maximum effectiveness from your board, and the system requirements needed to hear some of the sound effects.

Controls

Throughout the Configuration screens, you can use either the mouse or the keyboard to make your selections. If you're using the keyboard, the Tab key will move you from category to category, the arrow keys (↑, ←, →, ↓) will move to different selections and the Enter key will select a specific option. Clicking on one of the top row icons will also change the option below.

Along the top of both the Difficulty Levels and System Setup sections, there are a number of buttons described below.

Difficulty Levels/System Setup button

In the Difficulty Levels section, this button will read "System Setup." In the System Setup section, this button will read "Difficulty Levels." Select these buttons to switch between the two Configuration sections.

Cancel button

This button will cancel any changes you have made to the current screen and then will return you to the War Room.

Restore button

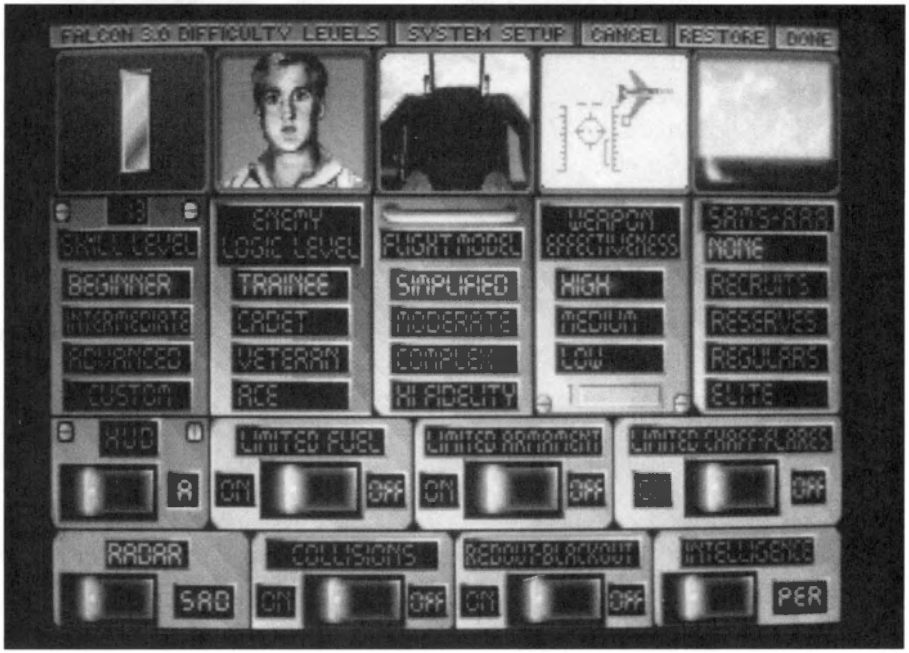
This button will return all the settings on the screen to the way they were when you entered. You can then begin anew to adjust the settings.

Done button

When you are finished with a particular section and want to keep the changes, the Done button will return you to the War Room with all of your changes saved.

Difficulty Levels

This screen allows you to adjust all the variables that relate to flying your aircraft and how certain items work in a campaign setting. To use this screen, simply choose a base Skill Level and then tinker around with the different variables until you find the one you want to play in.



Realism Value

The number just above the Skill Level options represents the current realism value, in which 1 is the easiest and 100 is the hardest level of play. This number will change as you adjust the options on this screen.

Skill Level

The Skill Level options simply change the other settings on this menu to reflect a pre-assigned default for different skill levels. You can then adjust one or more other options to customize flying on your ability level.

Beginner – This setting changes the other options to reflect an introductory level of play. We recommend using this option for your first few times playing *Falcon 3.0*.

Intermediate – This setting will change the rest of the options to a medium level of play.

Advanced – This setting will change all other options to reflect a high level of difficulty. NOTE: This option will change the Radar option to HFR (High Fidelity Radar). If you are unfamiliar with the complexities of High Fidelity Radar, you may want to switch this setting to either SAD or SAM.

Custom light

When you adjust any of the options on this screen from the Skill Level defaults, the Custom light will illuminate.

Enemy Logic Level

This set of options allows you to adjust the flying ability of enemy pilots as well as the enemy commander's tactical ability in a campaign. These options are incremental; if you set the Enemy Logic Level to Veteran, you may encounter pilots of Trainee, Cadet and Veteran abilities.

Trainee – This is the easiest logic level. Enemy pilots will only make maneuvers in the horizontal axis of 6 Gs or less. Enemy commanders may not always choose the best initial strategy and may make tactical mistakes on the battlefield.

Cadet – Enemy pilots will make some simplified maneuvers in the vertical axis, and may make maneuvers of 7–8 Gs. Enemy commanders will choose the best initial strategy most of the time but may still make some tactical errors in battle.

Veteran – With this logic level, enemy pilots will be able to perform all maneuvers in the vertical axis and will be able to pull 9+ Gs. Enemy commanders will always choose the best initial strategy and will occasionally make some tactical mistakes on the battlefield.

Ace – This is the hardest logic level. Enemy pilots will expertly perform all maneuvers in both planar axes and will regularly be able to pull 9+ Gs. Enemy commanders will always choose the best initial strategy and will rarely make tactical errors in battle.

Flight Model

The Flight Model setting allows you to choose how realistically your plane will handle in flight. The Flight Model variables include such factors as lift, drag and weight, dive and climb performance as well as roll rate. If you are new to flight simulators, we recommend starting out with the Simplified flight model.

Simplified – This flight model has been designed with the novice in mind. The controls are similar to an arcade game, since the amount of throttle is directly related to airspeed and wind drag is nonexistent. This is the least realistic of the four flight models.

Moderate – This is the medium flight model, and factors in such things as lift and drag. The handling capabilities are not as realistic as in the Complex or Hi Fidelity flight models.

Complex – The complex flight model is the most realistic flight model you can have without a math coprocessor.

Hi Fidelity – Designed for use with a math coprocessor (80x87), this flight model is based on an F-16 simulator designed for the Air National Guard. *NOTE: The HF flight model requires a math coprocessor to run. If you don't have a math coprocessor, you will be restricted to the Complex flight model.*

Weapon Effectiveness

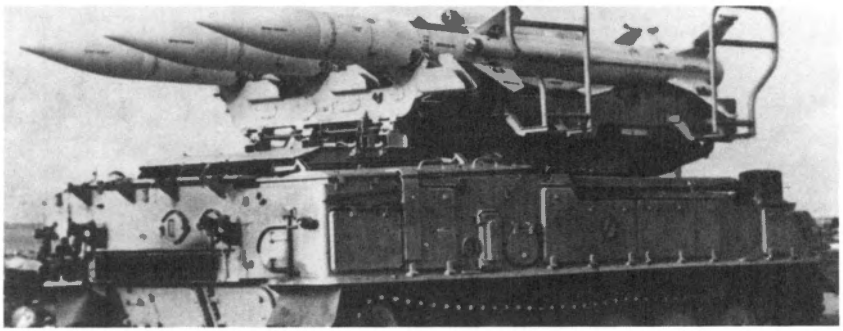
This option allows you to choose how accurately you must fire your missiles and bombs to hit your intended target. The higher the effectiveness, the farther away you can be from your target (building, plane, etc.) and still hit it. The destructive power of each missile or bomb has will remain constant throughout these three options.

High – This is the least realistic of the three options. High effectiveness allows you the flexibility to hit within 40 feet of your target and still damage it.

Medium – Medium effectiveness allows you to hit the target within 20 feet and damage it.

Low – This is the most realistic of the three options. With Low effectiveness, you must actually make contact with your target in order to damage it.

SAMs-AAA



This option allows you to adjust enemy SAM and AAA activity. There are four levels, each of which controls how often SAMs and AAA will fire and how effective their shots will be. Note that if you turn this option to None, your own SAMs and AAA will still be operable.

None – This option turns off all enemy SAMs and AAA. The weapon launchers will remain on the ground, but they will never launch or fire.

Recruits – SAMs will fire rarely, and with little effectiveness; AAA cover will be light.

Reserves – SAMs will fire with some regularity and be moderately effective; AAA cover will be just about average.

Regulars – SAMs will fire regularly, and with above average effectiveness; AAA fire will be heavy.

Elite – SAMs will fire regularly and at long range and almost always hit you; AAA fire will be dense.

HUD

The HUD (Head-Up Display) option allows you to choose between the two different HUD modes available. These are representations of the HUDs for the F-16A and F-16C. The C option is much simpler to read and use and includes some visual cues to help you out. The A option has an analog Altitude Scale, Heading Scale and Airspeed Scale. Most of the discussion in the manual will be in reference to the A model HUD.

Limited Fuel

This option will allow you to fly with either limited or unlimited fuel. Unlimited fuel allows you to use your afterburners as much as you want without fear of draining your fuel tanks. It also frees you from loading any external fuel tanks for a long mission. If you set this option to OFF, you won't need to worry about your fuel supply in a campaign.

Important note: If you set this option to OFF, the maximum Realism Value you can achieve is 80, regardless of what other options have been turned on.

Limited Armament

This option gives you the opportunity to fly with either limited or unlimited weapons. With this option off, every weapon is available, so you have an unlimited amount of every weapon. If you select an unlimited amount of weapons, your drag factor will be as if you have no weapons loaded (see the loading weapons part of **Sections VI** and **VII** for more details). If you set this option to OFF, you won't need to worry about your weapons supply in a campaign.

Important note: If you set this option to OFF, the maximum Realism Value you can achieve is 60, regardless of what other options have been turned on. In addition, if this is OFF, your enemy kills won't be recorded in Sierra Hotel or your pilot's records.

Limited Chaff-Flares

This option allows you to have an unlimited amount of chaff and flares instead of the standard 30 for each. If you set this option to OFF, you won't need to worry about your supply of chaff and flares in a campaign.

Radar

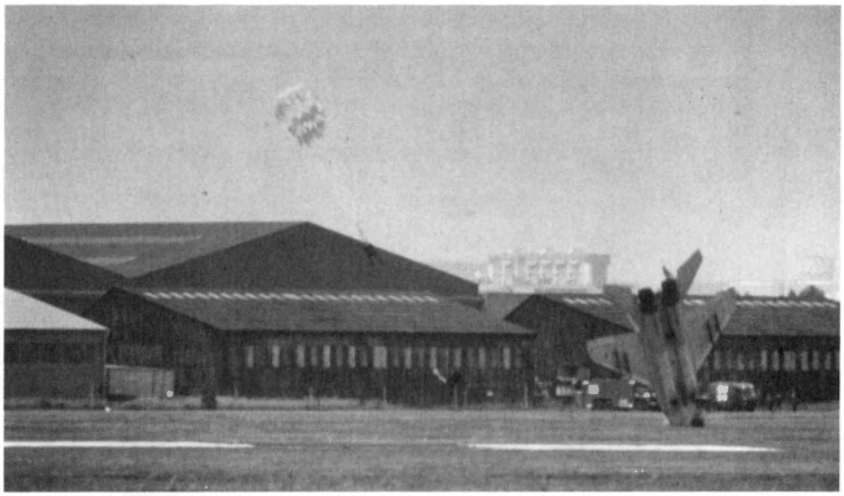
This option allows you to choose between the three different radar types available for your F-16. These three types vary in complexity with SAD as the easiest and HFR as the most complex. Each type of radar has its advantages and disadvantages, which will be briefly explained below. (For more information on each of the three radar modes, see **Section II: Instant Action** for SAD radar, **Section V: Air Combat School**, Lessons 5 and 6 for SAM radar or **Section VIII: Flight** for SAM and HFR radar.)

SAD – Situation Awareness Display. This radar mode is the simplest and easiest of the three to use. Its main features include a 360° radar scanning mode, simple lock on of enemy targets, and color-coding on the REO for the altitudes of enemy planes.

SAM – Situation Awareness Mode. This medium-complexity radar is also known as "Super SAM" radar. Its main features include an easier version of locking on enemy targets. It also has a longer radar range than SAD mode but only within a 45° cone in front of your F-16.

HFR – High Fidelity Radar. This is the most complex of the three radar modes. With this mode, you will have to manually lock on a target as well as manually switch between radar distances. It may be the most complex of the three, but it is also the most versatile because it allows you to filter radar signals.

Collisions



This option allows you to turn on or off collisions with enemy planes or ground objects. If this option is set to OFF, you will have the security of knowing you won't collide with another aircraft when roaring through a head-on engagement or crashing into a building when you execute a low-altitude maneuver. Turning collisions OFF won't save you from crashing into the ground, however.

Redout-Blackout

This option gives you the choice to turn on or off the effects of G forces on the aircraft you pilot. When this option is OFF, you can pull 9+ Gs (or -3 and below Gs) for any length of time without blackout or redout. Note that this option does not affect your wingmen (if any) on your flight or any of the enemy aircraft.

Intelligence

The Intelligence option is only used in the Campaign area. This option will show you varying levels of enemy activity, both air and ground, when you activate the Trace or Recon functions in a campaign. (See **Section VII: Campaign** for more details on Trace and Recon.)

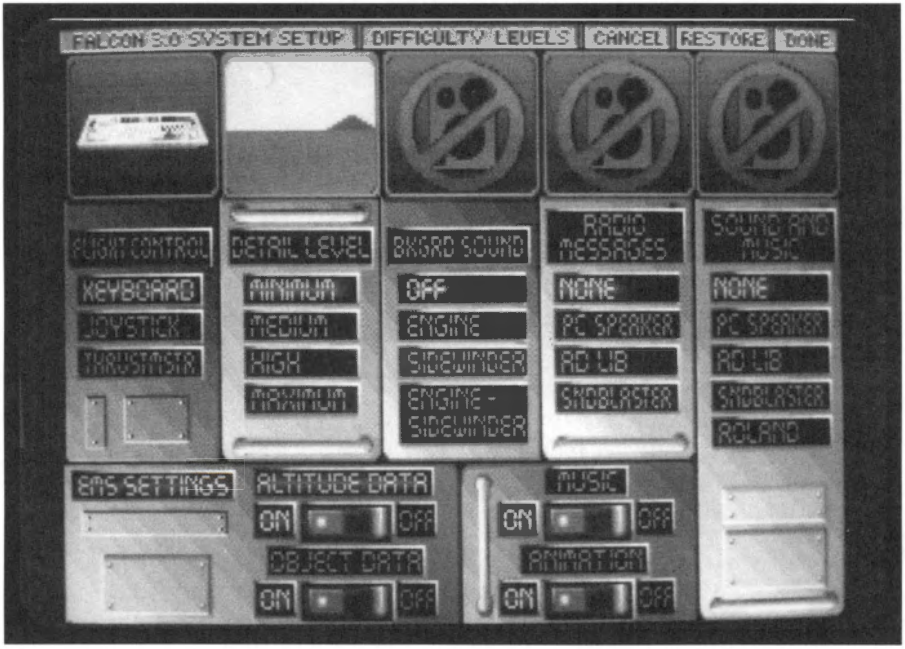
PER (Perfect) – This is the least realistic of the three options. Perfect intelligence will always display every possible unit in the viewing area.

STD (Standard) – Standard intelligence will show most of the units in the viewing area.

LIM (Limited) – This is the most realistic of the three options. Limited intelligence will only show a limited number of the units in the viewing area.

System Setup

The System Setup screen allows you to adjust variables relating to your computer, its sound capabilities and flight control devices. When you select one of the named areas, it will light up, and you will have made that selection. Most of these options have been pre-configured for you by the Install program.



Flight Control

The Flight Control choices allow you to change what device you use to fly your aircraft. Regardless of which option you choose, some flight control commands (such as Speed Brakes, Flaps, Landing Gear, etc.) may still have to made on the keyboard.

Keyboard – Select this option if you want to use the keyboard as your flight controller. This is the default selection.

Joystick – Choose this option if you plan to use a joystick to control your aircraft. This option should be used if you are using two joysticks, a joystick with a separate throttle control, rudder pedals, etc. The computer will automatically detect if you have any of these devices installed. If you have a joystick with a separate throttle control, you will need to calibrate the throttle and you will be unable to use the [+] and [−] on the keyboard as the throttle. Calibrate the joystick from the CONTROL menu on the menu bar.

ThrustMaster – Select this option to use your *ThrustMaster* joystick to control your F-16.

Detail Level

Detail Level gives you choices on how much detail you want your 3-D world to have when you are flying around in it. The program has already selected a default for this option based on the speed of your computer. If you change your Detail Level to a higher one than the computer recommends, you will experience speed degradation.

Minimum – This option has no 3-D terrain and is the fastest detail level setting of the four.

Medium – This selection has 3-D terrain in a limited viewing area.

High – This option has 3-D terrain in a larger viewing area.

Maximum – This gives you the most detail of all the selections. It has 3-D terrain in a vast viewing area.

Bkgrd Sound

The Bkgrd (Background) Sound choices allow you to adjust which background noises will play in addition to any sound effects.

Off – This turns off all background sounds. Use this option if you feel that all these noises are too cluttered.

Engine – This option provides engine noise as the only background sound.

Sidewinder – This option gives you the Sidewinder missile (AIM-9M and AIM-9P) growl when you have those weapons selected. The Sidewinder growl gives you an audible cue when you have locked onto an enemy plane.

Engine-Sidewinder – This combines the previous two options. With an internal speaker, this combination of sounds may come out too scratchy. If this is the case, we recommend selecting either the Engine option or the Sidewinder option.

In addition to the Sound Effects and Background Sound choices, you can toggle all sound on or off (when in flight) with the [S] key.

Radio Messages

See the Sound Options description later in this section for more information on how to use this option.

Sound and Music

See the Sound Options description later in this section for more information on how to use this option.

EMS Settings

The EMS (Expanded Memory System) settings allow you to place certain items into expanded memory in order to reduce disk access. However, in order to use these options, you must have an expanded memory manager (one comes with DOS 5.0 or you can purchase a package like QEMM) previously loaded into memory. If you don't have an EMS manager, you will be unable to use these options. (For more information on EMS and installation, see the **Release Notes and Communications Handbook** included in the *Falcon 3.0* box.)

You must remember that while placing these items into EMS will reduce your disk access, it will also reduce the length of your replay.

Altitude Data

This setting will put all the altitude data for the terrain into expanded memory.

Object Data

This option will place the ground objects (moving and fixed) into expanded memory.

Music

The music option will turn ON or OFF all music throughout the game. If you turn this option to OFF, you will not hear music even if you have a sound card selected in Sound and Music.

Animation

This allows you to turn off the animation sequences throughout the game. Animation sequences are found in transition areas, such as after a mission in the Campaign.

Sound options

The following describes the different sound boards that *Falcon 3.0* supports and how to achieve the maximum results from each of them. In addition, since you are able to utilize different sound options concurrently, these options will be explained in detail.

With an Ad Lib, Sound Blaster or Roland LAPC-1/MT-32 sound card, we highly recommend connecting them to a pair of amplified speakers. This will give you the full effect of our music and sound effects.

Important note: In order to hear digitized sound effects (speech from wingmen and AWACS), you need to have at least 2 MB RAM total (1 MB of expanded memory). For more instructions on how to configure your system to support Falcon 3.0 *with EMS, see the Release Notes and Communications Handbook.*

No sound board

There are a limited number of options you can have if you don't have a sound card in your computer.

You can hear radio messages through your computer's internal speaker, as well as other sound effects, but due to hardware limitations, you cannot play music through the internal speaker.

To hear digitized radio messages through your internal speaker, select the PC SPEAKER option from both the Radio Messages menu. You can also choose to hear sound effects through your internal speaker by selecting PC SPEAKER from the Sound and Music menu.

Ad Lib card

If you have an Ad Lib (or compatible) sound card, we highly recommend connecting the card to a pair of amplified speakers.

For digitized radio messages through your Ad Lib card, you need to select AD LIB from the Radio Messages menu.

You can play music and sound effects through your Ad Lib card by selecting AD LIB from the Sound and Music menu. You will also need to have the Music switch set to ON if you want to hear music.

Sound Blaster card

With a Sound Blaster (or compatible) sound card, we highly recommend connecting the card to a pair of amplified speakers.

For digitized radio messages through your Sound Blaster card, you need to select SNDBLASTER from the Radio Messages menu.

You can play music and sound effects through your Sound Blaster card by selecting SNDBLASTER from the Sound and Music menu. You will also need to have the Music switch set to ON if you want to hear music.

In addition, if you have a Roland sound card as well as a Sound Blaster, you can hear radio messages through the Sound Blaster and sound effects/music through the Roland. Simply select ROLAND from the Sound and Music menu and SNDBLASTER from the Radio Messages menu.

Roland card

The Roland LAPC-1 or MT-32 sound card is the only one of the three sound cards that can be used in conjunction with another sound card. If you have a Roland card and a Sound Blaster, you can play sound effects/music through the Roland and radio messages through the Sound Blaster. As with the Ad Lib and Sound Blaster sound cards, we strongly recommend using amplified speakers with the Roland card.

You cannot hear digitized radio messages through the Roland card; however, you can hear them through your computer's internal speaker or a Sound Blaster card. This way, you can hear sound effects/music through your Roland and radio messages through a different source.

To hear radio messages through your computer's internal speaker, select PC SPEAKER from the Radio Messages menu. For radio messages through a Sound Blaster card, select SNDBLASTER from the Radio Messages menu.

You can play music and sound effects through your Roland card by selecting ROLAND from the Sound and Music menu. You will also need to have the Music switch set to ON if you want to hear music.

SECTION

X

ACMI

ACMI introduction

NOTE: ACMI, along with some other game features, is only available if you have expanded memory (EMS) on your system. See the **Release Notes and Communications Handbook** *for more information on using EMS.*

ACMI (Air Combat Maneuvering Instrumentation) has been designed so you can review your combat missions in order to analyze your strengths and weaknesses on the battlefield. To help you review, ACMI has two major modes: Replay mode and ACMI mode.

Replay mode looks and functions exactly like a home VCR and can play back the action from any vantage point. This mode is useful for showing dramatic combat situations, but there may be times when you need to want a more tactical view of an engagement. This is where ACMI mode comes into play.

ACMI mode shows all aircraft, ground units, missiles and bullets in a 3-D wireframe environment. The altitude, speed and heading of every aircraft can be displayed with altitude and contrail lines. This information can be used to analyze how aircraft perform in different situations.

In both modes, you have the ability to frame forward, fast forward or skip to any point in the mission tape. You can also view the action through any of the nine standard views or or from an independent camera's-eye view.

How to get here

You can access ACMI from three areas: in the War Room, while flying, or from Debriefing. To enter ACMI from the War Room, simply select the ACMI monitor, third from the bottom left. While in the simulation, select Replay from the GAME menu. (When you select Replay from the menu bar, you can view only the current mission tape.) From the Debriefing in the Red Flag or Campaign, select the button labelled ACMI.

How to save ACMI info

Before using the ACMI, you will need to save some in-flight mission data. This is done with the AVTR (Airborne Video Tape Recorder) on your F-16.

When you are flying and are ready to start saving data, press Ctrl R. Your AVTR will continue to save data until its memory becomes full or you turn it off by pressing Ctrl R again. The amount of data the AVTR can save at one time depends on how much EMS you have. Each megabyte of EMS available will give you about 20 minutes of replay.

Immediately after ending the mission, you will be prompted to enter a filename for the replay tape. This will save it to disk for later review.

AVTR Status Light

To check if your AVTR is on, switch to the Left View. The AVTR Status Light is just below the Landing Gear Lights. If it displays "ON," your AVTR is recording the action.

AVTR Tape Indicator

Below the AVTR Status Light is the AVTR Tape Indicator. This is a bar that indicates how much tape time (which depends on the amount of EMS left) you have remaining. After you turn on the AVTR, the green bar will begin to tick down from right to left. When the bar completely disappears, the tape is full and the replay data will start to overwrite the beginning of your tape. Pressing Ctrl S will save all data currently in EMS to disk and then reset the AVTR Tape Indicator to zero.

Replay indexes

Whenever you turn off the AVTR by pressing Ctrl R a second time, this segment of the tape is marked with an *index*. Each tape is composed of one or more indexes. When you have finished flying the current mission, all the indexes will be combined into one tape. Since you cannot have more than one mission per tape, after you stop flying, your tape is complete and no more indexes can be added.

Using index markers, you can play your mission tape in chronological order or skip to a certain section of the tape. You can both make your mission tape more dramatic and save on EMS by turning on your AVTR only when you are in a dogfight or approaching your mission target.

Loading a replay

If you're entering ACMI through the War Room or Debriefing, the first thing you'll see is the Load/Save dialog box. This is where you select a replay tape to load. The keyboard commands for selecting a tape are:

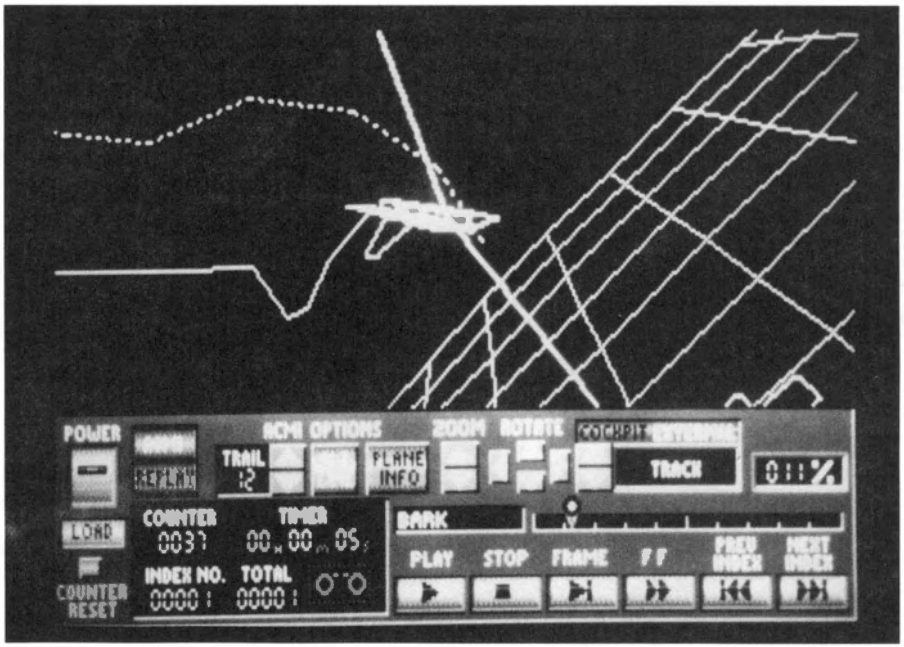
- L Load a tape
- S Save a tape
- ↑ Move up one tape
- ↓ Move down one tape
- PgUp Previous page of tapes
- PgDn Next page of tapes
- Esc Cancel and return to previous area
- Tab Will erase filename and allow new name

Once you have selected a tape to view, you will be in Replay mode.

To save part of a replay while flying around, hit Ctrl S. This will bring up the Load/Save dialog box. Here, the Erase AVTR button will clear your AVTR of all replay information and allow you to begin the replay from scratch.

Standard controls for ACMI/Replay

There are a number of controls and displays on the Control Panel that are common to both ACMI mode and Replay mode. You can either use the mouse to press the button on the Control Panel or use the equivalent keyboard command. These controls are arranged spatially around your computer's keyboard in roughly the same pattern as on the Control Panel.



Power

This button returns you to the screen you came from (War Room, the simulation, Red Flag, or Campaign). The keyboard equivalent to this button is the Esc key.

Load

This button brings up the Load/Save dialog box and gives you the opportunity to view a different tape. The keyboard equivalent is the L key.

Counter Reset

This will reset the counter on the left side of the Control Panel to 0000. Press C to reset the counter.

ACMI/Replay

These two buttons switch between the two different viewing modes. The keyboard equivalent is the Tab key.

Counter

This fluorescent green LED display shows the current position of the replay tape.

Timer

This LED indicator shows the current time of your tape in hours, minutes and seconds.

Index No.

This indicator, below Counter, displays the current index number.

Total

To the right of Index No., this read-out shows the total number of indexes in your tape.

Tape Status Indicator

This light, to the right of Total, will flash as the tape is played.

Zoom

When you are in an external view, you can zoom in and out with these buttons. The keyboard equivalent to these buttons are the F1 and F2 keys.

Rotate

When you are in an external view, you can rotate around your aircraft with these buttons. Press F3 to rotate left and F4 to rotate right. To rotate up and down, use the F5 and F6 keys.

View Selection

These buttons let you select the viewing mode. Press Cockpit to switch to views inside the cockpit; press External to change to the outside views. Then press the up and down arrows to toggle through the different view options.

The keyboard equivalents are similar to ones inside the simulation: [1] for Satellite View, [2] for Enemy View, [3] for Front View, [4] for Left View, [5] for Rear View, [6] for Right View, [7] for Wingman View (if applicable), [8] for Missile View, [9] for Track View and [0] for Independent View.

Independent View

This outside view allows you to view the action from any vantage point. When in this view, the following keys (in addition to the rotate keys) are applicable:

[↑]	Move eye position forward	[↓]	Move eye position backwards
[←]	Move eye position left	[→]	Move eye position right
[PgUp]	Move eye position up	[PgDn]	Move eye position down

Replay %

Above Next Index, this read-out displays the percentage of the entire tape. Note that the Replay % is not based on the total time of the tape. See the Tape Scale description for more details.

Tape Name

Above the Play button, this window displays the eight-character filename for the current tape.

Tape Scale

The Tape Scale, to the right of the Tape Name, shows the tape's position as a percentage of the total number of indexes on the tape. The left side of the scale represents the beginning of the tape, while the right side is the end. You can drag the tape indicator to any position on this scale to view the action starting from that point.

The Tape Scale has been divided into as many parts as you have indexes on the tape. For example, if you have four indexes on the tape, the first 25% of the Tape Scale will be Index 1, the second 25% of the tape will be Index 2 and so on. Since indexes can be of different lengths, you may have sections of your tape that seem to move quickly, while others may move slowly (e.g. Index 1 may be 10 minutes, while Index 2 may be 10 seconds).

To move the tape indicator with the keyboard, press the [P] key. Then use the [;] and ['] keys to move the tape indicator left and right. When you have the indicator in the position you want, press the [P] key again to start the tape playing.

Play

Select this button to play the tape. The keyboard equivalent for Play is the [V] key.

Stop

Use this button to stop the tape at the current position. This is more akin to a Pause button since it freezes the action temporarily. Press [B] to stop the tape.

Frame

The Frame button is used to advance one frame at a time. Holding this button down will frame forward rapidly. The keyboard equivalent is the [N] key.

FF

You can use this button to fast forward through the tape. The tape will continue to fast forward until you select the Play, Stop or Frame keys. Press [M] to fast forward.

Prev Index

Use this button to move to the previous index on your tape. The keyboard equivalent is the [<] key.

Next Index

This button is used to move to the next index on your tape. Press [>] to advance to the next index.

Hide control panel

To hide the control panel (and thus get a larger viewing area), hit the [Enter] key.

Replay mode

As mentioned previously, Replay mode is very similar to a standard VCR. You can watch your action from all the standard views in addition to the independent view. You can use Replay mode to see what errors you may have made in reading your instruments and learn from that experience. Replay mode is probably most useful for showing off exciting footage of an aerial engagement to your friends.

ACMI mode

The ACMI mode has been designed to review your combat engagement so you can tactically analyze your performance. ACMI mode is set in a 3-D wireframe environment where you can see the path of every plane and missile. This mode is primarily used to review your maneuvers and tactics so you can improve on them.

ACMI options

There are also a number of special features that can be used only in ACMI mode, which are listed below:

Trail

The two buttons to the right of Trail shorten or lengthen the colored contrails coming from each plane's wings. Contrails trace an aircraft's path and show yaw, pitch and roll. An aircraft's right wing has a green contrail, and its left wing has a red contrail. Press [[] to increase the contrail length and []] to decrease the length.

Alt Line

When the altitude line is turned on, it will show a line extending from the center of all planes and missiles to the surface of the terrain. This is useful for gauging distance from the earth and for judging relative altitudes of aircraft. Press either the Alt Line button to the right of the Trail button or press F7 to toggle the altitude line on and off.

Plane Info

Selecting this button will bring up a series of numbers next to each aircraft within viewing range. These numbers are the number of the aircraft (ID), the aircraft's altitude (A), speed (S) and heading (H). The aircraft you actually flew will always be aircraft #1. Press either the Plane Info button to the right of the Alt Line button or press the F8 key to display the Plane Info window. You can move forward through the different planes by pressing the F9 key and backward with the F10 key. Yellow info indicates friendly aircraft, while brown info indicates enemy aircraft.

Using the ACMI

To study a dogfight, locate that segment on the tape. Start the tape replay, lengthen the contrails and play the tape. Stop the tape at the end of the engagement. You can then examine the flight path more closely using the independent outside view. After grasping the action as a whole, step through it at a few frames at a time to see the relative timing of the maneuvers of the different aircraft and missiles.

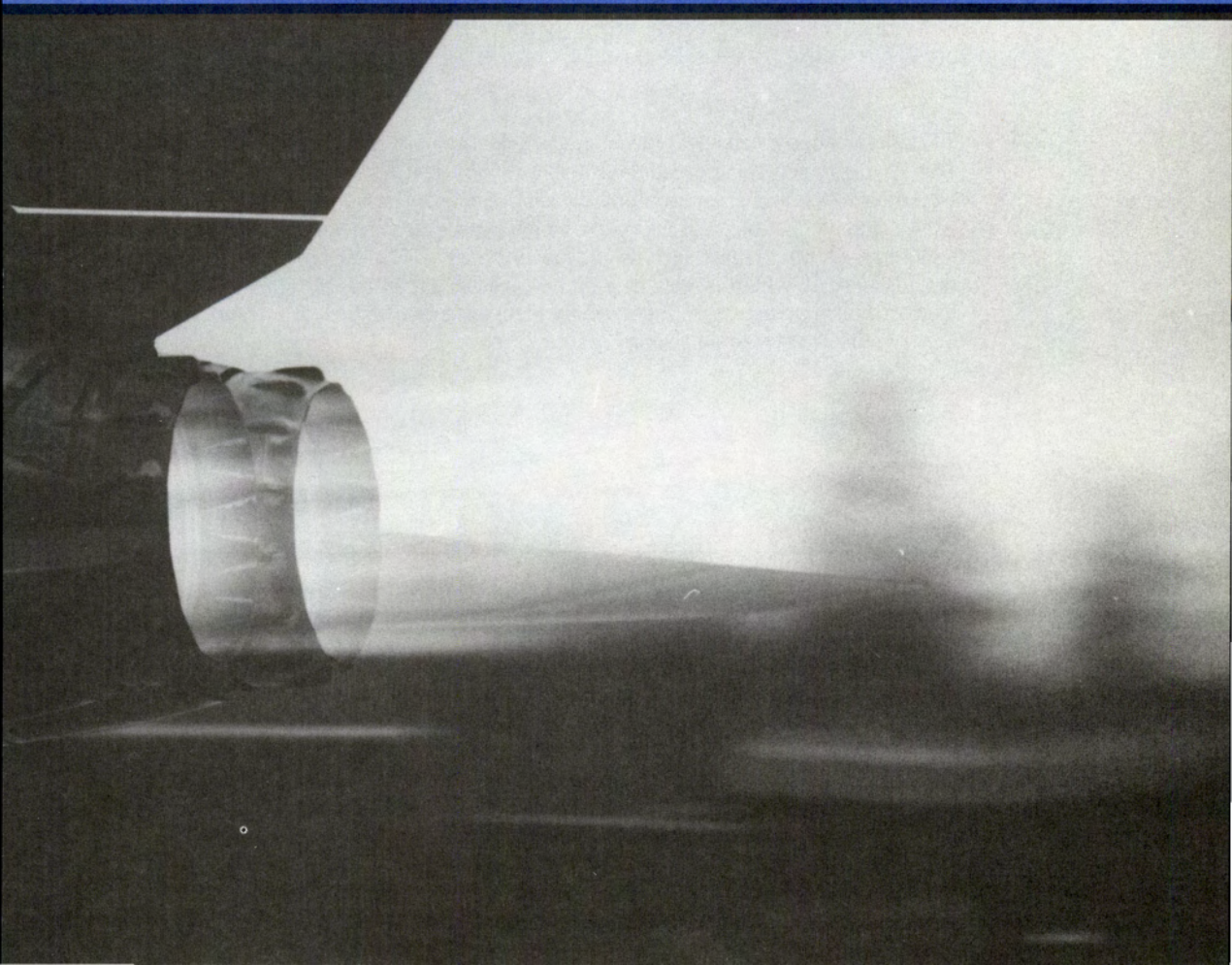
Since the contrails extend from the aircraft's wingtips, you can see how an aircraft reacted in a situation. Twists in the contrails indicate rolls, bends signify turns. In addition, whenever you have a radar lock on an enemy aircraft, a yellow line will extend from your aircraft to the enemy aircraft.

If you have trouble identifying an object in the 3-D wireframe mode, switch to Replay mode for a better view.

SECTION

XI

AERODYNAMICS AND G FORCES



Aerodynamics and G forces introduction

If you want to take advantage of *Falcon 3.0's* realism, it is useful to have a basic understanding of aerodynamics and G forces. They are both accurately simulated in *Falcon 3.0*, and you can rely on their influence as you can in the real world.

Aerodynamics refers to the physics of flight: the forces that produce, affect and control flight. The most important forces for pilots are thrust, lift and drag.

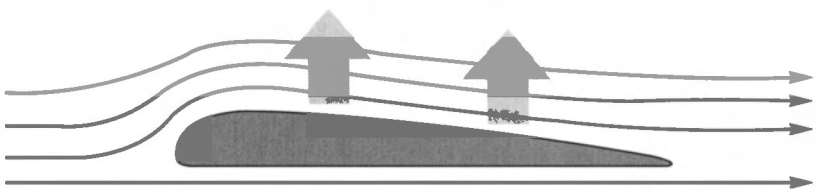
Thrust

Thrust is the force that moves an object, such as an aircraft, along a specific path. It is the force that overcomes the inertia of an object due to gravity and the resistance of an object moving through air. In aircraft, thrust comes from propellers or jet engines. The force of thrust of an aircraft will have a direct bearing on its speed.

You may hear the phrase "thrust to weight ratio" in discussions of jet fighter aircraft. This refers to a ratio between the thrust of the jet engine and the weight of the aircraft. All other things being equal, an aircraft with a thrust to weight ratio greater than one (1) can propel itself straight up against the force of gravity. The F-16, with its 25,000 pounds of afterburner thrust, has a thrust to weight ratio of 6.2 to 1.

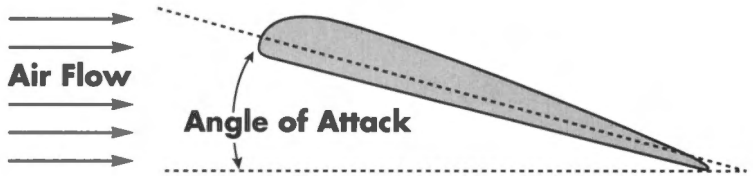
Lift

Lift is the seemingly magical force that enables modern aircraft to stay in the air. It is possible due to several interesting principles of physics. When air moves quickly over an arched surface, the air pressure above the surface drops. The wing on an aircraft has a cross-section shaped like the diagram below, which causes air to speed up as it passes over. As the air speeds up, the pressure drops above the wing. The air pressure under the wing remains normal, which is now at a higher pressure than the air above the wing. This difference in air pressure produces a force in the direction of the low pressure area. This is the force that creates lift in a wing.



The size, shape and thickness of a wing all determine the amount of lift it will produce. Other factors that affect lift are the velocity of the air moving past the wing and the air pressure or density of the air.

Lift is also directly affected by the angle that the wing cuts through the air. This angle is known as the angle of attack (AOA). As the angle of attack increases, so does lift. However, a high angle of attack may interrupt the flow of air over the wing and cause a stall. This kind of stall is almost impossible in an F-16 because the flight control computer will never let the pilot fly with an AOA greater than 25°, which is where a stall would occur in a stock F-16A.



While you don't have to worry about AOA and stalling, your ability to control the AOA is particularly important when landing an aircraft. You can find out more about AOA and landing in **Section VIII: Flight**.

Drag

Every time we have movement through the air, we come upon the problem of drag. Drag is the resistance of the movement of an aircraft. While air is invisible, it is not without weight, mass and inertia. An aircraft moving at Mach 2 is pushing aside an enormous volume of air at a very high rate, and this air pushes back in the form of drag.

There are three main types of drag that affect the performance of an aircraft.

Induced drag

Induced drag is the most important form of drag, if for no other reason than it occurs *as a result of the force of lift*. Lift is possible when a wing moves through the air at a positive angle of attack. However, a wing at a positive angle of attack collides with the air it is moving through, creating a backward force. This backward force is called the induced drag force. Since it is a direct function of lift, it is almost always present when flying an aircraft. If you unload your aircraft by pushing the nose down, you will counter the force of lift and, as such, induced drag will also be gone. The rest of the time, induced drag plays a part in the aerodynamics of your craft.

Induced drag is built into the flight model in *Falcon 3.0,* and you don't need to worry about it in any particular way. It helps create the "feel" of the flight model.

Skin friction or parasitic drag

Skin friction drag (also called parasitic drag) is a simple kind of drag that results from wind resistance to the rough surfaces, bumps and protuberances of an aircraft. When you load up your F-16 with weapons, jammers and fuel tanks, you are complicating the aerodynamic beauty of the basic F-16. This creates drag. In *Falcon 3.0,* each type of store has an associated drag factor you must consider when your configure your bird. This drag will affect your flight performance and may limit the number of Gs you can pull.

The drag factor for your plane is displayed on the armament screen, and it changes as you add or remove stores to your aircraft. The drag factor will affect the "feel" of flying your plane. The more drag you have, the more "sluggish" the plane will feel. In addition, greater drag increases fuel consumption, affects acceleration, and degrades maneuverablilty. You may have to engage full afterburner to take off with a full load due to weight and drag influences. When you fire your weapons or jettison your stores, you reduce the drag factor and its corresponding effects.

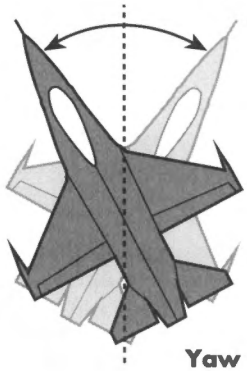
Wave drag is only found in jet fighters or supersonic aircraft. When a plane moves at supersonic speeds, it builds up a tremendous shock wave in front of it. It takes enormous energy to move through these waves, and this resistance is called wave drag. When the shock wave reaches the ground, it is experienced in the rattling form of a "sonic boom." Because the wave is always moving away from the aircraft, the pilot never hears the sound of a sonic boom, even when crossing the sound barrier.

Because of wave drag, a pilot must increase his throttle as he approaches the speed of sound and then decrease it as he passes through Mach 1. However, since wave drag is not simulated in *Falcon 3.0*, you won't have to worry about this.

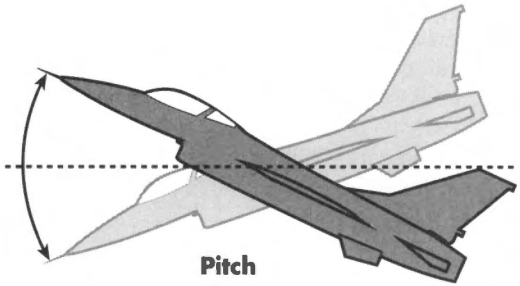
Yaw, pitch and roll

Thrust moves an aircraft through the air, and there are three axes of movement that an aircraft can travel through. The movements along the three axes are called yaw, pitch and roll.

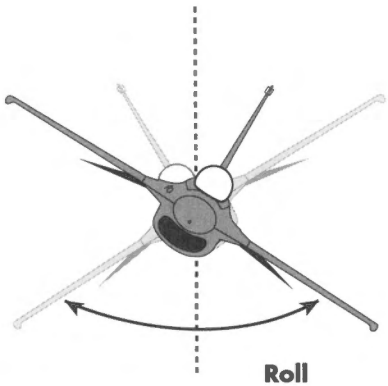
Yaw is movement around the vertical axis of an aircraft. You experience it as the nose moving left and right from your point of reference as pilot. Pitch is movement around the horizontal axis. You experience it as the nose moving up and down. Roll is movement along the long axis of the aircraft. You experience a roll by seeing the horizon rotate in front of you. These points of reference are based on the point of view of the pilot, regardless of his orientation in real space.



Yaw



Pitch



Roll

As you crank around on the stick, you will be pulling your aircraft through all three axes in various combinations. By practicing basic fighter maneuvers, you will gain a detailed understanding of movement within the three axes.

Stalling

In order to fly, an aircraft must have enough thrust to create lift. This thrust translates into a forward velocity. If the aircraft falls below a certain minimum velocity, it will not be able to generate enough lift to stay airborne. In short, it will stall.

Every aircraft has a minimum speed it needs to maintain flight. This value is called the stall speed, because a stall will occur if the plane's velocity falls below it. This value is usually associated with takeoff and landing since you cross the stall speed in both activities, but actually there are many stall speeds for an individual aircraft.

The different stall speeds depend on the air pressure (also called air density). You will encounter different air densities according to your altitude. The air pressure is the greatest on the surface and diminishes as you get higher. A plane's landing and takeoff stall speed is applicable near the surface of the earth, but at 50,000 feet the same aircraft will stall at a much different speed. For example, an aircraft with a stall speed of 125 knots at ground level may have a stall speed of 165 knots at 10,000 feet, 220 knots at 25,000 feet, and 350 knots at 50,000 feet. The stall speed increases as the aircraft goes higher because the air is thinner. Thinner air creates less lift for the same amount of thrust.

The most common forms of stall are caused by insufficient velocity or by exceeding the maximum angle of attack. There is another kind of stall called a compressor stall. The compressor blades in a turbofan engine are designed as airfoils and, like the wing of an aircraft, can be stalled if the airflow hits them above a critical angle. This kind of stall is usually associated with certain problems of the afterburner. Fortunately, this kind of stall is very rare in the F-16.

In *Falcon 3.0,* you may experience a severe stall if your airspeed drops below 120 knots while you are near ground level. If your altitude is higher, you may experience a stall at a higher speed.

How to recover from a stall

You can easily recover from a stall in the F-16. It almost does it for you. If your airspeed drops below about 120 knots, the nose of the plane will start to drop. In addition, you will see the Stall light on the right upper section of the glare screen illuminate and the stall horn will sound. This indicates that you do not have enough airspeed to maintain flight. As the nose drops, you begin to pick up speed — with more speed you regain your ability to fly. If you find yourself in a stall situation, simply drop the nose of your aircraft to pick up speed. In case of a severe stall, you may want to roll your fighter 180° before you head down so that you don't incur negative G forces (see G Forces below).

In order to recover from a stall, you need sufficient altitude since you are trading altitude for airspeed. Don't put yourself in a stall situation if you don't have sufficient altitude, or you'll end up as a colorful spot on the landscape.

As the nose drops and you begin to gain speed, gently pull the nose of your F-16 back up toward the horizon. If you pull up quickly, you may bleed off speed too rapidly and find yourself stalling out again.

In the Complex and High Fidelity flight models, the F-16 will show a noticeable difference in handling when flying near its stall speed. As you recover from a stall, be careful not to overcompensate on the stick for the sluggish handling of your aircraft.

In the Simplified flight model, you will never encounter a stall because there are no weight and drag influences. In the Moderate flight model there are some weight and drag influences; in the Complex and High Fidelity models you will encounter full weight and drag influences.

Fuel usage

The F-16A is powered by a single Pratt and Whitney F100-PW-200(3) turbofan engine which generates approximately 25,000 pounds of thrust with afterburner. This power plant is what keeps the F-16 airborne, but not without a price. The F-16 burns rather large amounts of JP-5 fuel, particularly when you use the afterburner.

Monitoring your fuel usage is critical when you fly missions (if you have selected the limited fuel option). There are many factors that affect fuel consumption, including engine RPM, altitude, aircraft weight, drag and damage. But by far the most likely cause of running out of gas is the use of the afterburner.

The afterburner can give you a great advantage in a dogfight by keeping your energy level high, but beware — it burns fuel at over three times the rate of full military thrust. When you go to burner, you are burning fuel at a rate of 860 pounds per minute! Since your internal tank only holds about 7,000 pounds of fuel, you can drastically reduce your linger time by overusing the burner.

Use your burner when you need it, but don't overdo it. There is nothing more humiliating than to hit your targets and then have to punch out because you didn't manage your fuel properly. The Air Force frowns on losing planes this way.

G forces

You can't fly combat aircraft without considering G forces. G forces are the forces of acceleration that pull on you when you change your plane of motion. They are the forces that pilots encounter when engaged in high-speed dogfighting and BFM. There are both positive and negative G forces; both can be dangerous to a fighter pilot. The force of gravity on Earth is used as a baseline for measuring these forces of acceleration.

The force of gravity when you sit, stand or lie down is considered 1 G. In normal activity, we rarely experience anything other than 1 G. But flying a combat aircraft such as the F-16 is not exactly normal. The F-16 is capable of pulling 9 Gs without even trying. But the effect of 9 Gs on your body will be significant. As you pull more Gs, your weight increases correspondingly. Your 10-pound head will weigh 90 pounds when you pull 9 Gs!

If you continue to pull high Gs, the G force will push the blood in your body towards your feet and resist your heart's attempts to pump it back up to your brain. You will begin to get tunnel vision, then things will lose color and turn white, and finally everything will go black. You've just experienced the onset of Gravity Induced Loss of Consciousness (GLOC). *Falcon 3.0* produces the experience of positive G-induced stress visually, by fading the screen to white and then black, as you increase your G load.

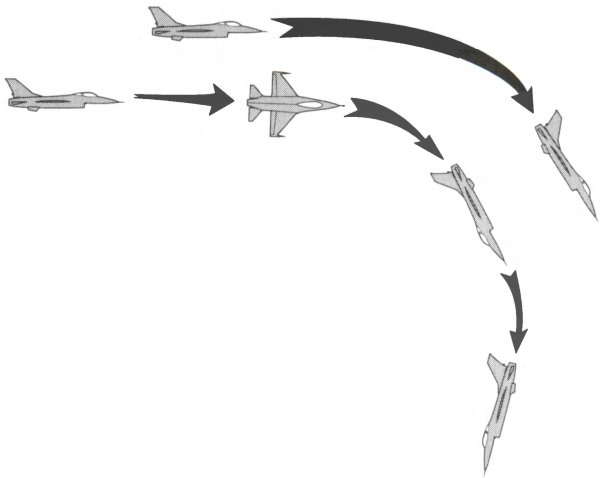
The modern fighter pilot has some aids in helping him overcome the forces of gravity he experiences from combat. The most obvious is the G suit. The G suit uses the principle of

pushing the blood back up toward the head during high G maneuvers. The British first used water bladders placed around the legs to help fight against Gs. As the pilot was pressed into his seat from high G forces, the incompressible water would push against his legs and keep the blood from pooling there. Modern G suits use compressed air to force the blood back up towards the pilot's head.

The G forces from such maneuvers as pulling out of a dive or banking sharply are called positive Gs because they increase our ordinary sense of gravity. It is also possible to maneuver in a way that produces negative forces of gravity. These are called negative Gs, and they have a very different effect on you.

If you are flying straight and level and push the nose of the plane down, you will experience your weight lessening. The harder you push the nose down, the more "weightless" you will feel. You are experiencing negative Gs. The effect of negative Gs is to push the blood up into the head, just the opposite of positive Gs. However, while the body can stand up to 9 positive Gs without severe consequences, blood vessels in your eyes will start to rupture when you apply as little as 2 to 3 negative Gs. This is known as redout. A pilot who pushes too many negative Gs will be seeing the world through bloodshot eyes. *Falcon 3.0* vividly recreates this experience visually if you push too many negative Gs.

There is a simple way to avoid negative Gs that also gives you much better maneuverability. Instead of pushing forward on the stick to dive (which creates negative Gs), roll your aircraft 180° and pull back on the stick. If you roll so that your cockpit is facing toward the ground and then pull back on the stick, you will still be diving toward the ground but will be experiencing positive Gs instead. Your tolerance is much greater to positive Gs.



Corner velocity

Corner velocity (also called corner speed or maneuvering speed) is an important value for each aircraft. It is determined by plotting the structural limitations (in G forces) against airspeed. The corner velocity is the minimum speed at which an aircraft can pull its maximum rated Gs. An aircraft at corner velocity attains maximum instantaneous turn performance.

The corner velocity for the F-16A in a stock configuration is 450 knots. This means that at 450 knots the F-16 has its best turn performance. At speeds above the corner speed, turn performance drops off.

Corner speed also affects the minimum turn radius. The size of the turn radius of an aircraft depends on the speed it is traveling. A faster aircraft requires a larger circle to turn in than a slower one. However, the turn radius isn't only a function of speed. It also depends on the number of Gs a pilot pulls during the turn. An aircraft at a constant speed will make a relatively wide circle at 1 G but will turn in a very tight circle at 7 or 8 Gs. The corner velocity is the speed that gives the optimum balance between turn rate and turn radius.

SECTION

XII

ADVANCED FIGHTER TACTICS

"A good fighter pilot must have one outstanding trait — aggressiveness."

Major John T. Godfrey, USAAF

"I never went into the air thinking I would lose."

Commander Randy "Duke" Cunningham, USN

Advanced Fighter Tactics introduction

In order to achieve victory in air-to-air combat, a pilot must be both aggressive and self-confident. These two traits interact with each other constantly. Aggressiveness drives the pilot to stay in the fight and thus achieve more self-confidence; self-confidence drives the pilot to push the limits of himself and his plane, becoming more aggressive in the process.

To be an expert in fighter combat, a pilot must know how and when to engage the enemy. This instinct, an important part of overall situational awareness, can be trained. He also needs to know how to avoid being "painted" by an enemy's radar so he can enter his target area undetected and complete his mission. To accomplish this, he must understand the two different types of ground radar and how to avoid both. Finally, the pilot needs to know what the different formations are and how they affect a mission.

This section of the manual has been broken into three major parts: Tactics, Radar avoidance, and Formations.

Tactics

This part describes modern jet air combat: Basic Fighter Maneuvers (one-versus-one air combat) and Air Combat Tactics (one-versus-many and two-versus-many air combat). Also included are descriptions of aspect angle and turn geometry, how to avoid a missile or SAM, and how to use directive commentary (giving instructions to your wingman).

Radar avoidance

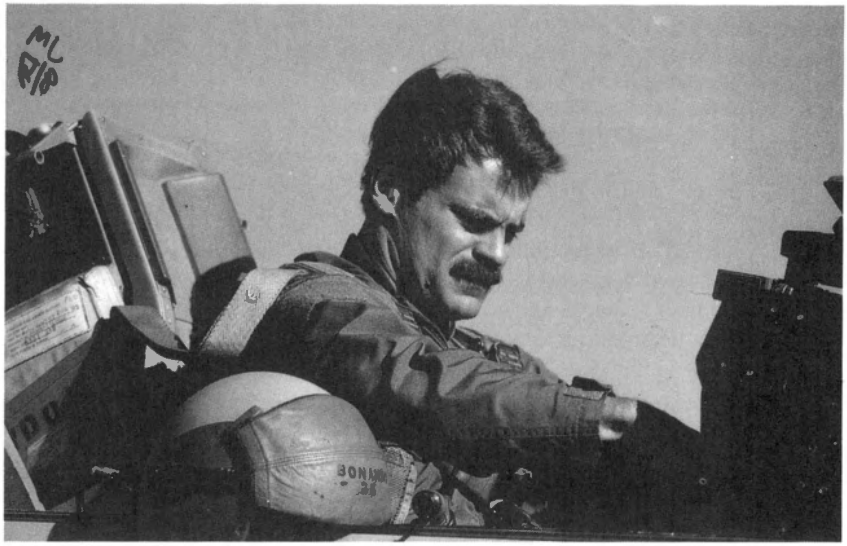
This part describes the two different types of ground radar: continuous wave/doppler and pulse-doppler. It also covers how to avoid being detected by these radars so you successfully complete your mission.

Formations

The final part deals with the various formations you can select when planning a mission. It shows what the different formations look like and gives a description of how and when to use them for certain missions.

Tactics

The following is based on part of Pete "Boomer" Bonanni's upcoming book, *Falcon 3.0 Air Combat*, published by Osborne/McGraw-Hill. Pete is a major in the U.S. Air National Guard and has flown F-4, A-7 and F-16 fighters. As of September 1991, he is stationed at MacDill AFB in Tampa, Florida, flying the F-16C.



Tactics background

The nature of air combat has remained the same since Fokkers fought Spads in air power's World War I debut. The Red Baron himself summed it up when he said, "Rove your allotted area, find the enemy and shoot him down...anything else is rubbish." These words, describing the ultimate goal of the fighter pilot, are as true today as they were 75 years ago. While the nature of air combat has remained the same, the mechanics have undergone radical change. Most of this change, surprisingly, has come about in the last 10 years because high-thrust fighters such as the F-16 entered service in large numbers and expanded the combat maneuvering envelope.

The Basic Fighter Maneuvers (BFM) that many generations of fighter pilots grew up with became obsolete with the introduction of the F-16 in the early 1980s. Fighter pilots had to change the way they thought about BFM in order to successfully employ the F-16. In the one-versus-one maneuvering environment, vertical out-of-plane maneuvers such as high yo-yos were rapidly replaced with in-plane turn circle BFM. The new maneuvers were perfected in the skies above the Nevada desert by the men of the F-16 Fighter Weapons School. In this next part, we will discuss these modern F-16 air combat maneuvers and provide you with the latest F-16 BFM techniques to help you build a solid academic foundation for performing BFM in *Falcon 3.0*. In addition, this material will open a window into the real world of F-16 air combat.

Basic Fighter Maneuvers (One-versus-One air combat)

Basic Fighter Maneuvers is the art of exchanging energy for aircraft position. Energy, in this discussion, means fighter speed and altitude. The goals of offensive maneuvering in the simulation (or the real F-16) are to remain behind an adversary and to get in a position to shoot your weapons. In defensive maneuvering, you turn your jet and move the bandit out of position for a shot on your aircraft. In head-on maneuvering, you get behind the bandit from a neutral position. When you execute maneuvers to accomplish any of these objec-

tives, you invariably bleed off or expend energy. "Pulling Gs" and turning cause all aircraft to slow down or lose altitude (or both). In this part, we will describe the geometry of the fight and the specific maneuvers needed to be a successful air-to-air Falcon pilot.

BFM is flown in the future

Many discussions of BFM describe maneuvers as if they were cards or chess pieces played sequentially in a game of move and countermove. Modern aerial warfare, however, is more accurately compared to a wrestling match. It is a fluid contest of quick reactions with both opponents executing their moves in a blur. *Falcon 3.0* teaches you to participate in this dynamic blur where there is little room for creative thought or careful analysis. Aerial combat requires immediate reaction. Fighter pilots, as a rule, are not too bright on the ground; in the air, however, we are brilliant for very short periods of time. Within seconds, a pilot must constantly go through the following basic steps:

1. *Observe* the bandit.
2. *Predict* a future position in space for the bandit based on your observation.
3. *Maneuver* your jet in response to this prediction.
4. *React* to changes in the situation as you execute your maneuvers.

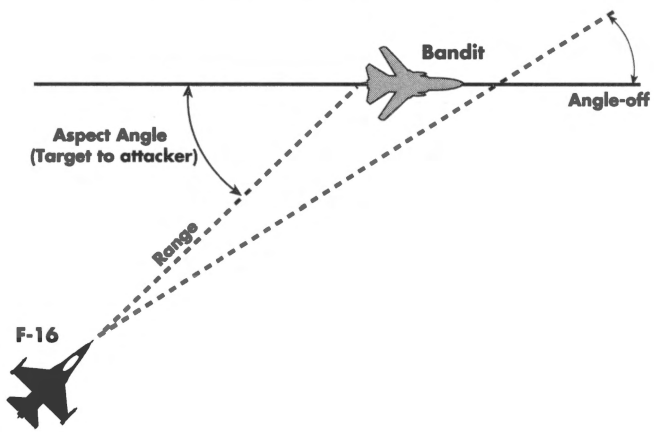
BFM is flown in the future and not in the present. You must constantly predict the bandit's future position (where he will be a few seconds from the time you observe him) and fly your jet based on this prediction.

BFM geometry

In order to perform BFM, the pilot must understand his spatial relationship to the target from four perspectives: positional geometry, attack geometry, the weapons envelope, and the control zone.

Positional geometry

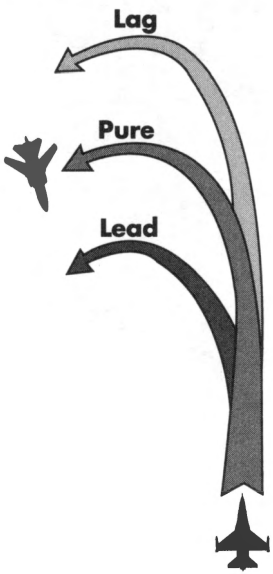
Range, aspect angle, and angle-off (also known as heading crossing angle or HCA) are terms used to describe one aircraft's position relative to another. These conditions, shown below, define the angular relation between two aircraft. This angular relationship in turn tells you how much position advantage or disadvantage you have.



- Range is the distance between your jet and the bandit.
- Aspect angle is the number of degrees measured from the tail of the target to your aircraft. Aspect angle is important because it tells you how far away you are in degrees from the target's stern, which is the desired position.
- Angle-off is the difference, measured in degrees, between your heading and the bandit's. This angle tells you relative fuselage alignment. For example, if the angle-off were 0°, you would be on a parallel heading with the bandit and your fuselages would be aligned; if the angle-off were 90°, your fuselage would be perpendicular to the bandit's.

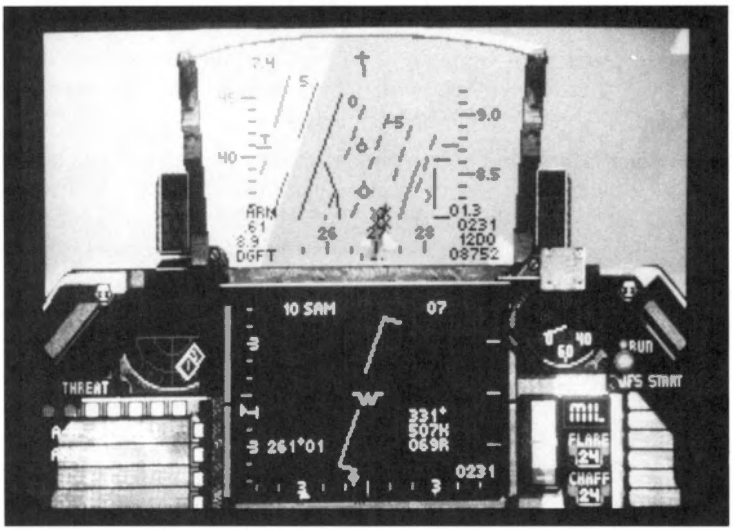
Attack geometry

Attack geometry describes the path that an offensive fighter takes as he converges on the bandit. To start an attack on a bandit, there are three distinct paths or pursuit courses that you can follow: pure pursuit, lag pursuit, or lead pursuit.

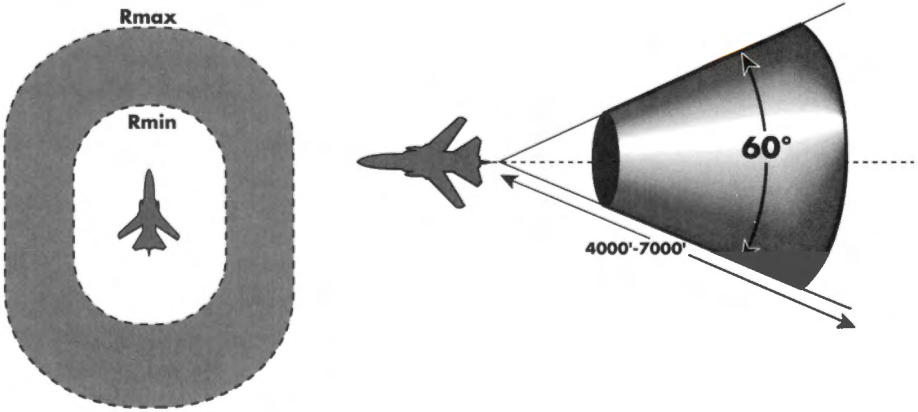


- If you are pointing directly at the bandit, you are flying a pure pursuit course.
- If you are pointing behind the bandit, you are in lag pursuit.
- If your nose is out in front of the bandit, you are in lead pursuit

In *Falcon 3.0*, you know which pursuit course you are flying by the position of the Flight Path Marker in relation to the bandit. The figure below shows a lead pursuit course. Notice the flight path marker in front of the bandit. If you were in pure pursuit, the Flight Path Marker would be directly over the bandit. If you were in lag pursuit, the Flight Path Marker would be behind the bandit.



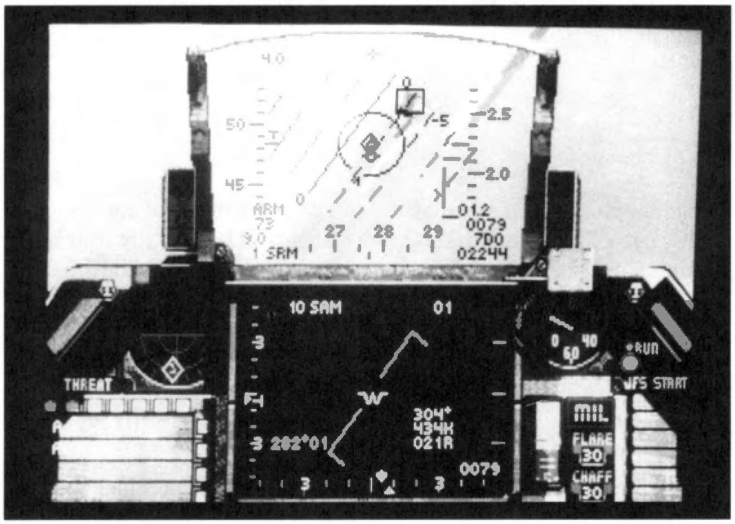
The weapons envelope



The weapons envelope is the area around the bandit where a missile or gun would connect. The envelope is defined by range, aspect angle, and angle-off; the dimensions and position are dictated by the type of weapons you are carrying. If your jet is loaded with all-aspect AIM-9Ms or AIM-120s, the weapons envelope around the bandit looks like the illustration above—a doughnut with the inside edge being minimum range (Rmin) and the outside line being maximum range (Rmax). If you are carrying a AIM-9P stern aspect missile, then the vulnerable area is shaped like a cone. These two missile envelopes are different because their seeker heads are based on different technologies. The AIM-9P's seeker head can only pick up the engine's IR energy from the rear of the target. The AIM-9M's seeker head can see the IR energy from all aspects or 360°.

The control zone

The control zone, also called the "elbow," is the place behind the bandit where you can establish a stable position from which to employ your weapons. Here, it is relatively easy to remain behind the bandit and in control. Why "elbow"? Because fighter pilots describing air combat use their hands, and the elbow of the arm that is showing the bandit's motion is in the approximate position of the control zone. In *Falcon 3.0*, this position is about 3,000–4,000 feet behind the maneuvering bandit when the bandit is at corner velocity. Corner velocity is the speed that an aircraft can turn the fastest, tightest turn; for the bandit in *Falcon 3.0*, this speed is approximately 400 knots. As the bandit bleeds off energy and slows down, the control position gets closer to him. A 200 knot bandit, for example, has a control position of 1,500–2,000 feet. At this slow speed, the bandit cannot generate a very high turn rate so you can fly much closer to it and still stay in control.

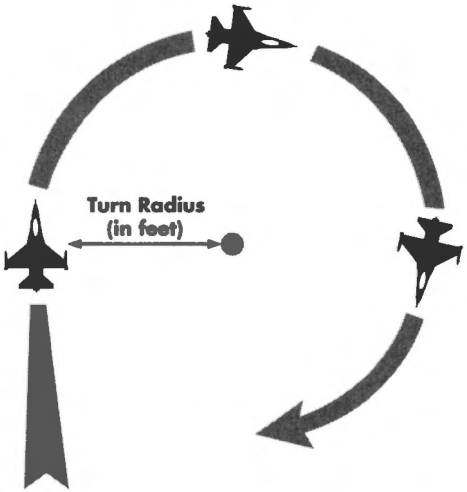


The goal of BFM is to arrive at the elbow of the bandit with 100 knots of overtaking airspeed and be within 30° of the bandit's heading (angle-off). The picture above shows the Falcon in the control position on the bandit. You will note that this position also places you in the weapons envelope for your AIM-9P.

BFM mechanics

All aircraft can execute only three basic maneuvers: roll, turn and accelerate. All other maneuvers are simply combinations of these. Roll is used to position your lift vector. The nose of the aircraft will turn in the direction of the lift vector once you put some Gs on the jet. Offensive BFM involves turning your jet to solve aspect, angle-off, and overtake problems created by the bandit's turn. Unfortunately, this is not an easy task. You must know precisely where and how to turn in order to solve these problems successfully and stay behind the bandit.

Turn rate and radius



Two characteristics of a turning aircraft that a fighter pilot must understand are turn radius and turn rate. Turn radius is simply a measure of how tightly your jet is turning. If you were looking down on the aircraft as it turned, turn radius would be the distance from the center of the turn circle to the aircraft, measured in feet.

The equation for turn radius is:

$$TR \text{ (turn radius)} = V^2/gG$$

V is the aircraft's velocity in feet/second. Little g is gravity and big G is the G force the aircraft is pulling.

It is not important to understand how to compute turn radius, but it is important to realize that velocity is squared in the equation and that the equation also includes aircraft Gs. The more Gs you pull, the tighter the turn.

Turn rate is another important characteristic of turning the jet. Turn rate tells how fast the aircraft is moving around the turn circle (how fast the plane is moving its nose). Turn rate is measured in degrees per second and is also dependent on Gs and airspeed.

$$\text{Turn rate} = K\,G/V$$

K is a constant, and big G and V are the same as in the equation for turn radius. This equation tells the fighter pilot that the most Gs he can pull, at the lowest airspeed, gives him the best turn rate. Turn rate is very important in BFM because it measures how fast you can put your nose on the bandit. Since you have to put your nose on the bandit to shoot missiles or the gun, you need a fast turn rate.

You will never master *Falcon 3.0* BFM unless you can control your airspeed. A good overall combat airspeed in the Falcon simulation is 400–450 kts. If you fly faster when you are trying to turn, your plane will have a very large turn radius and a slow turn rate. If you fly slower than 400 knots, your turn radius will be small but your turn rate will go down because you can't achieve high Gs at a slow speed.

In an A-G configuration (with bombs or Mavericks loaded) or in the presence of SAMs, you want to keep your speed up to at least 550 kts. If you start turning when you are loaded with bombs, you will soon bleed down your airspeed to the desired fighting speed of 400–450. If you are flying an air-to-air intercept and are going to turn and fight at end game, then you should enter the "merge" (within visual range or WVR) fight with your airspeed at 450 kts.

Acceleration

Acceleration is how fast you go faster. It is very important because BFM usually results in energy bleed off and a fighter must be able to regain this energy by acceleration. The best way to accelerate in *Falcon 3.0* is to light the afterburner (AB), roll the wings level with the horizon, and head for the ground in about 20° of dive.

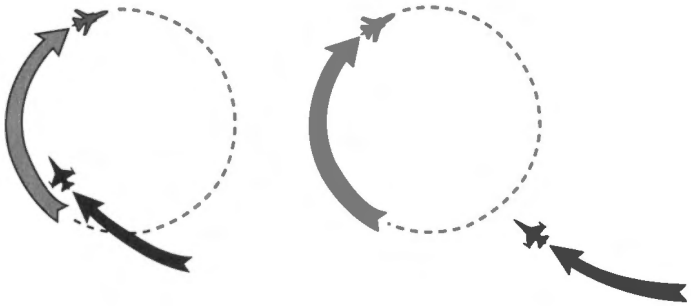
Falcon offensive BFM

This part discusses specific offensive, defensive, and head-on Falcon maneuvers. In an air-to-air fight, you are forced to execute specific maneuvers in response to the bandit. In offensive maneuvering, BFM must be performed when the bandit turns into you and creates aspect, angle-off, and range problems. The BFM that you can actually execute in *Falcon 3.0* is constrained due to limits on what you can see in the simulation. All simulations have constraints, and so does *Falcon 3.0*. The bandits in the simulation are difficult to see until they are at very close range. Outside 3,000 feet it is very difficult to tell what the bandit is doing and to judge the geometry of the fight. Because of this, most fights with the bandit result in a confusing "fur ball" of high speed passes and missile engagements at ranges greater than one mile. You know you did good when the bandit blows up, but you're not sure what happened or why. In this section, we discuss methods for going through the basic BFM steps: observe, predict, maneuver and react. We will also highlight some simulation "work arounds" that will help you execute the offensive BFM needed to win.

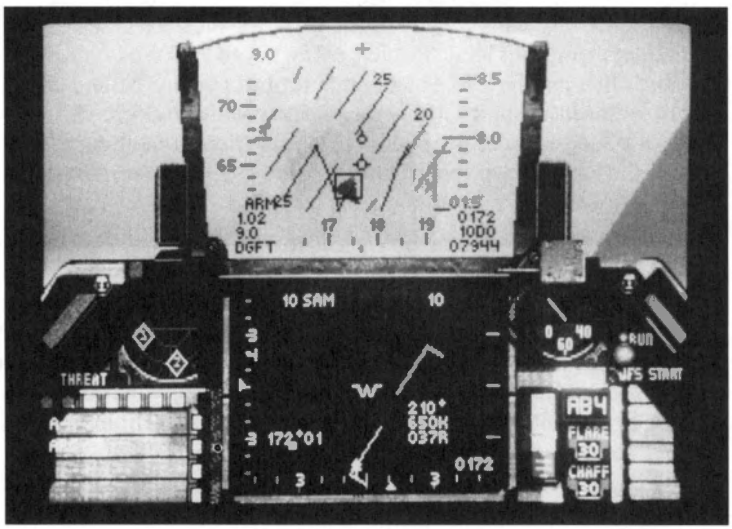
Flying to the elbow

Offensive BFM is necessary because a bandit in fear of dying will turn his jet at high Gs. To solve the BFM problems created by this turn, you must execute a turn of your own with the objective of flying your jet to the elbow. The key to F-16 (and *Falcon 3.0*) offensive BFM is knowing when and how to execute this turn. If you are behind a bandit, remember the objective is to kill him and not put on an airshow at his 6 o'clock. The first action to take when you have a bad guy in or near your HUD is to shoot something at him. If you can't shoot because the bandit starts a hard turn into you, then you must execute the following steps to get control of him and start shooting again.

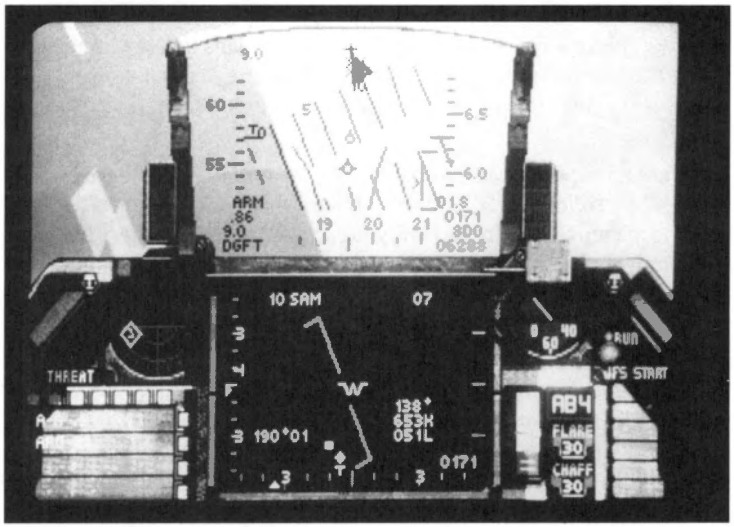
1. Use the HUD, the Radar Scope, and the Threat Indicator to observe the bandit. If you cannot determine the bandit's turn direction by looking out of the HUD, look at your Threat Indicator. There you will see the bandit moving around the circle, either right or left. At higher levels of play, you will find it increasingly difficult to use the Threat Indicator because it will only show bandits whose radars are actually "painting" you. However, *Falcon 3.0* can give you some extra help when it comes to keeping your eye on the bandit. Both Lesson 8 in **Section V: Air Combat School** and **Section VIII: Flight** have some pointers on using the Padlock View.
2. When you observe the direction of turn for the Bandit, predict his movement across the sky and start a turn in the same direction. For example if the bandit moves to the left in your HUD or on your Threat Indicator, you turn left.



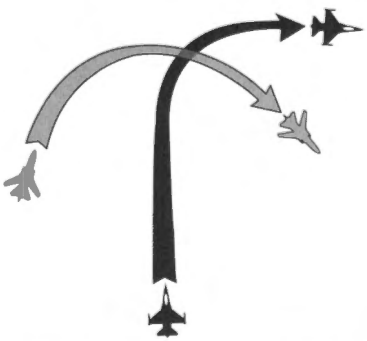
3. When you see the bandit turning out in front of you, ask yourself this question: "If the bandit keeps turning at his present rate, will his nose come around to point at me before I can close with him?" If the answer is yes, you are outside the bandit's turn circle and you are not flying offensive BFM — you are flying head-on BFM. You cannot solve aspect, angle-off and range problems when you are outside the bandit's turn circle. The reason is simple: no matter what you do, if you are outside his turn circle, he can always point at you and force a head-on pass. The illustration above shows a Falcon both inside and outside the turn circle. For now, assume you are inside the bandit's turn circle (the bandit's present turn rate will not bring his nose around to point at your jet).
4. From inside the turn circle, maneuver to place the Flight Path Marker out in front of the bandit (lead pursuit), start pulling 5–7 Gs, and adjust the airspeed to gain 50 knots of closure. (The bottom right corner of your Radar Scope shows closure.)
5. Now, you must observe the movement of the bandit in your HUD to determine how to react. The bandit will do one of three things in relation to your Flight Path Marker.



- If the bandit stays in the same spot in the HUD, you are matching his turn rate and will close the range and fly to the elbow. Just keep doing what you're doing and prepare to strike a blow. If you are armed with Sidewinder missiles, shoot. If you are "winchester" (have run out of) Sidewinders, switch to guns and fire when you are within 2,000 feet.



- If you pull the Flight Path Marker to lead and the bandit moves rapidly across your HUD and back under your nose, ease off the G and let him fly back into view. In this case, you are pulling too much lead for the bandit's present turn rate. Once you regain a "tally ho" (visual sighting), put the Flight Path Marker behind the bandit in lag pursuit. When the range closes, the bandit will start moving away from you in the direction of the turn. When this occurs, pull the your nose back to lead pursuit and again get ready for a gun shot. In both of the above cases you may pass through Sidewinder parameters.



- If the bandit moves through the Flight Path Marker and you go from lead to lag pursuit, you are not matching the bandit's turn rate and you will overshoot. An overshoot is when you fly past the bandit and are in danger of going out in front of him. The picture above shows a bird's eye view of an overshoot situation. The solution to this problem is to turn the Falcon as hard as possible and check your airspeed. If you are over 450 knots, you

will overshoot the bandit every time — remember that velocity is squared in the rate and radius equations. If you do overshoot, don't worry; keep turning in the direction of the bandit and you will get behind him.

All the above steps are designed to get you to the elbow of the bandit. You must be aware of your airspeed and closure at all times when flying these maneuvers. In the F-16, we have a saying: "Fight BFM with both hands." This means that you must not only move the stick but also the throttle when you are fighting. Failure to do so — in either the real jet or *Falcon 3.0* — will send you riding that big thrust engine right on past the bandit into a gross overshoot.

If you are an experienced simulator pilot or a non-F-16 fighter pilot, you will notice that our discussion of offensive BFM did not have a single word about high yo-yos or any other out-of-plane maneuvering. In the F-16, you can kill the bandit faster and stay out of trouble longer if you only fly lead, pure, or lag pursuit as described above.

The next section will cover what to when you've cleverly trapped a bandit at your 6 o'clock.

Falcon defensive BFM

You are not sure what went wrong, but there he is — a blood-hungry National Socialist at your 6 o'clock. Before you reach for the ejection handle, let's discuss your options in the *Falcon 3.0* simulation. Defensive BFM is a very easy concept to grasp in Falcon and in the F-16. A will to survive is the most essential ingredient needed. The geometry of the defensive fight is very simple, and the maneuvers are equally straightforward. You must be able to execute them, however, while you are under pressure and enduring the physical duress of violent, high-G maneuvering. Defensive maneuvering requires patience, stamina and optimism. Keep asking yourself, "Self, am I still alive?" If the answer is "yes" — keep fighting.

Maneuver and ECM

The first thing you need to do defensively is to create BFM problems for the bandit. You know how difficult it is to stay behind a hard-turning bandit; to give the enemy the same trouble you had, execute the following procedures for these defensive situations:

Missile Launch: Pay close attention to the Threat Indicator; if you see or hear a missile launch indication at any time during the simulation, stop what you are doing and execute the following procedures:

1. Dispense chaff and flares and turn on your jamming pod (the ALQ-131) if you have one.

   Chaff: press the [Del] key

   Flares: press the [Ins] key

   Jamming Pod: Press the [E] key

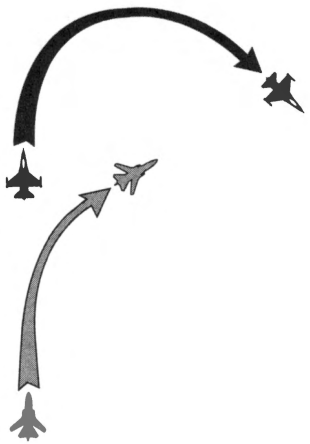
   Don't try to figure out which type of missile the enemy is firing (radar or IR). You will have plenty of time to ponder that in POW camp if your defensive reactions don't work.

2. While you are using your countermeasures, you must also put maximum Gs on your jet as quickly as possible to give the enemy missile a difficult target. Again, don't sweat which way to turn; just do it.

If you get a lock-on indication before you get a launch, dispense chaff only and turn the pod on. In this case, you have more time to maneuver the jet against the bandit.

Bandit on your six: When the bandit is at your 6 o'clock and you get a lock-on indication or no indication, look at the Threat Indicator to figure out the direction of your defensive turn. Then execute the following steps:

1. If the bandit is on the right side of the scope, turn right; if he is on the left, turn left. In the rare instance when you actually can see the bandit, turn towards him.
2. Roll to set your wings at approximately 80°–90° of bank and start a hard turn into the bandit at maximum G. Turn with as much G as the jet will give you.
3. Next, look at the Threat Indicator and note the direction of movement of the bandit.



- If the bandit is approaching your 12 o'clock position, your turn is working. You are giving him a problem he can't solve, and he is moving out in front of you. Keep turning until he gets to your nose and your radar locks on. Then you are no longer on the defensive but are probably flying offensive or head-on BFM.
- If you turn hard into the bandit and he does not move to the 12 o'clock position on the Threat Indicator, you are in for a real tussle. First, check your airspeed. (This is always a good thing to do in any air-to-air situation when things aren't going well.) If you are flying faster than 450 knots, slow down to give your jet a tighter turn circle. If you are slower than 350 knots and you are not in AB, get there by pressing the / key and then the > key to get all five stages of the AB. This might get your airspeed up to 450. If it doesn't and you still have external stores on the jet, jettison them by pressing Ctrl K. This will drop everything hanging on the jet.

Hopefully, one of the above steps will solve your problem and put the bandit moving near the 12 o'clock position on the Threat Indicator. If not, there is nothing more you can do except keep turning and hope he runs out of gas or makes a mistake. I wish I could give you a "magic move" that would put the bandit out in front of you, but unfortunately that move doesn't exist. Just remember that a MiG at 6 o'clock is better than no MiG at all to a confident and aggressive fighter pilot.

Falcon head-on BFM

This BFM is flown after passing the bandit head-on. At this point, you could keep going away from the bandit or you could turn and "duke it out" with him. If your mission is to kill the bandit, however, you have to know how to fight head-on BFM. Head-on BFM is very easy to execute but difficult to understand. The following steps will help you take a head-on situation and convert it into an offensive one.

1. Use the Threat Indicator, the HUD and the Radar Scope to point at the bandit. The goal is to place him at your 12 o'clock position.
2. When you get an in range (IN RNG) indication in the HUD, shoot a Sidewinder. If the Sidewinder doesn't work, switch to guns and shoot when you get inside two miles.
3. Stay heads up for a missile launch indication on your Threat Indicator as the bandit approaches. If you get a launch indication, respond as described in the defensive BFM section. There should be no doubt in your mind that when somebody shoots at you, you're defensive.

4. When you see the bandit fly past you or the Threat Indicator shows the bandit moving toward your 6 o'clock, start a hard turn at 5–7 Gs in the direction of the bandit. In the *Falcon* simulation, it is only important that you initiate a turn quickly after passing the bandit; it is not as important which way you turn.
5. After starting a hard turn into the bandit, keep the turn coming until you get the bandit in your HUD again. At this time, analyze the aspect angle. If it is high (above 120°), you are still in a head-on fight. Go back to step one. If the aspect angle is medium or low, you are winning the manly contest of head-on BFM. Just keep pulling hard in the direction of the bandit and you will soon be behind it.
6. Anytime you get confused, remember this: always turn in the direction of the bandit. If you can't think of anything else to do, just keep turning into him, using the Threat Indicator as a reference.

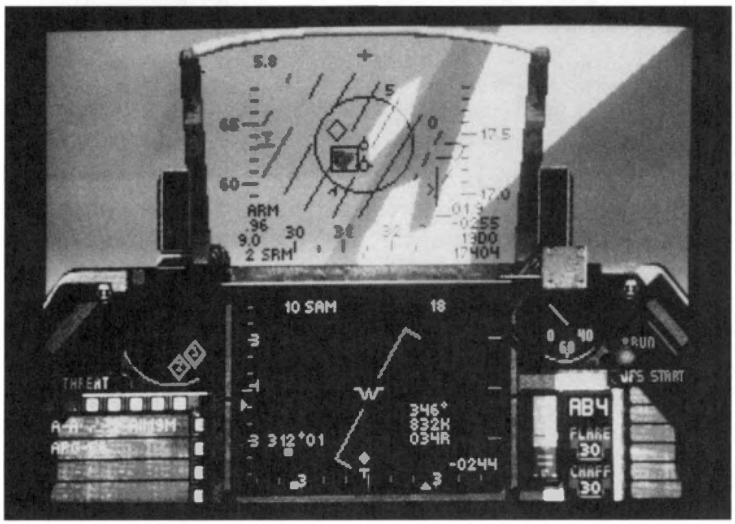
One last point about head-on BFM: you can execute a hard turn into the bandit in the vertical plane as well as the horizontal. If you go into the vertical, just remember to keep on pulling all the way through until you are pointing at him again. *You do not want to zoom the jet (go*

straight up) in an all-aspect heat missile environment. The days of zooming jets in a one-versus-one fight are over! All a bandit has to do to shoot you with an all-aspect heat missile is to point at you. When you zoom, you give the bandit your 6 o'clock. Take the advice of an experienced fighter pilot (who has been stuck a few times zooming his jet) and keep turning to drive the fight into a small circle. In an F-16 you should always drive the fight into a tight, high G circle because you can get around that circle faster than any other jet in the sky.

The goal of maneuvering in offensive, defensive and head-on situations is the same: to survive the attack of the bandit and shoot him down. To do this you need weapons.

The Sidewinder and the Gun

The Sidewinder and the gun are the two primary close-in Falcon weapons. In *Falcon 3.0*, you also have the option of loading the AIM-120 AMRAAM, which is not a close-in weapon but can be used in BFM when the bandit is trying to separate from the fight or when the range allows an AMRAAM shot. AMRAAM employment is covered in another section of this manual and in great detail in *Falcon 3.0 Air Combat.*



Sidewinders (AIM-9M and AIM-9P)

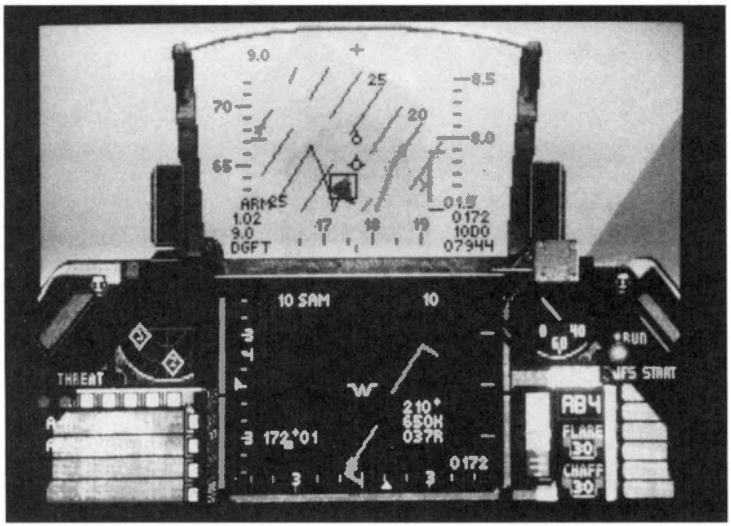
The "P" model Sidewinder is a "back shooting" (rear-aspect) weapon, meaning it is best to get behind the bandit before firing. The "M" model will let you shoot from all target aspects and is generally better against a hard-maneuvering target. In spite of these differences, the tactical strategy for both Sidewinders is the same. If you have the AIM-9M loaded, always fly with it selected. If you don't have an "M" model Sidewinder, then fly with the AIM-9P selected. If you are on an air-to-ground sortie, call up your bombs or Maverick missiles just before you use them. After the attack on the ground target, re-select the Sidewinder. When the Sidewinder is selected, the aspect caret is present in the HUD and the missile can be fired at a bandit as soon as you gain a missile lock. To shoot the Sidewinder follow the steps below:

1. Select the missile (if not already selected).
2. Fly the target into the HUD. (The target does not need to be in the missile reticle.)
3. Keep the target in the HUD and wait for a flashing diamond in the HUD and your aiming reticle flashes.
4. Note the target line of sight (LOS) rate. This rate shows how fast the target is moving across your HUD. The Sidewinder missile in Falcon usually takes about 4–7 seconds to reach the target. If you can't keep the target in your HUD that long, you will probably waste a missile if you shoot.
5. Shoot as soon as the above conditions are met!

The Gun (M61A1 cannon)

When the bandit is in close and is flashing back and forth across your HUD, draw your gun (M61A1 cannon). The gun is used when the "stress factor" is up and the chips are down. It is an all-aspect weapon that can be fired when you are in tight on the bandit and inside missile parameters (within one mile). If the LOS rate is high (as defined above), you should switch to guns and proceed as follows:

1. Select the gun.
2. Observe the bandit's movements and fly your jet so as to get your M61 Aiming Funnel moving toward the bandit.
3. Before the bandit flies into the funnel, open fire. Remember — the gun shoots unguided projectiles with a specific flight time. You must hold the target's wingtips between the edges of the funnel for the bullet time-of-flight or else you must open fire early and keep firing until you get the funnel's edges bracketing the target.
4. Since you have a very large load of 20mm cannon shells in your Falcon, shoot whenever the bandit gets close to your HUD.



Why fighter pilots were born

Flying BFM or one-versus-one air combat in the F-16 is a wonderful thing! The F-16 is a small, highly maneuverable fighter that can dominate most other jets in a fight. You must be aware, however, that maneuvering at high Gs to get to the bandit's 6 o'clock is not the objective of the fight. Fighter pilots were born to kill the enemy and to survive. To kill the enemy, you must use your weapons. The best air-to-air engagements are brutal ambushes of the enemy. One minute the bandit is flying along nice and relaxed — the next minute your missile hits him and his body parts are flying formation with pieces of his jet. A sustained maneuvering fight can be very unhealthy in modern aerial combat. As you go around and around with the bandit, other pilots are attracted to the fight like moths to a flame. You may be winning the fight you are aware of while you are losing a fight you don't even know you're in. For this reason, you should shoot every time you get in parameters on the enemy and end the fight quickly. The life you save will be yours.

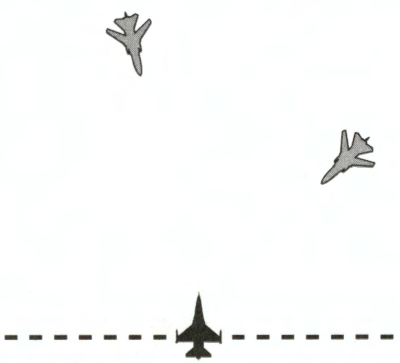
Air Combat Tactics (ACT)

Air combat tactics are used when more than two aircraft engage. All ACT is built on BFM tactics; the bottom-line in ACT is always to use your best one-versus-one tactics first — before you consider the other aircraft in the fight. For example, once you make a decision to kill a bandit out in front of you, fight your best one-versus-one offensive BFM to kill him — regardless of how many other bandits are in the area or what your wingman is doing. The crucial parts of this example (and the difficult parts of any ACT engagement) are making the decision to engage and deciding how long to stay in a turning fight. Trying to kill that bandit may be suicide if the air is filled with enemy jets and the engagement requires you to be anchored in a sustained turning fight. On the other hand, offensive BFM may require that you turn for only a few degrees to get a kill. The point is that ACT involves tactical decisions. Once these decisions are made, you execute sound BFM to carry them out.

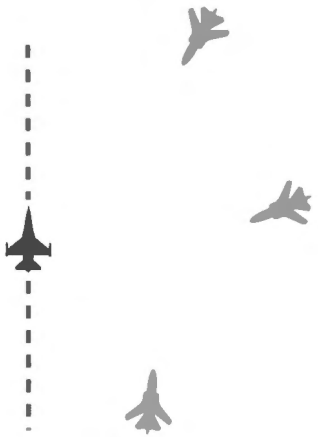
Following are some actual fighter pilot rules-of-thumb to help you in Falcon ACT engagements. Just keep in mind that ACT is only an extension of single ship BFM.

One-versus-many

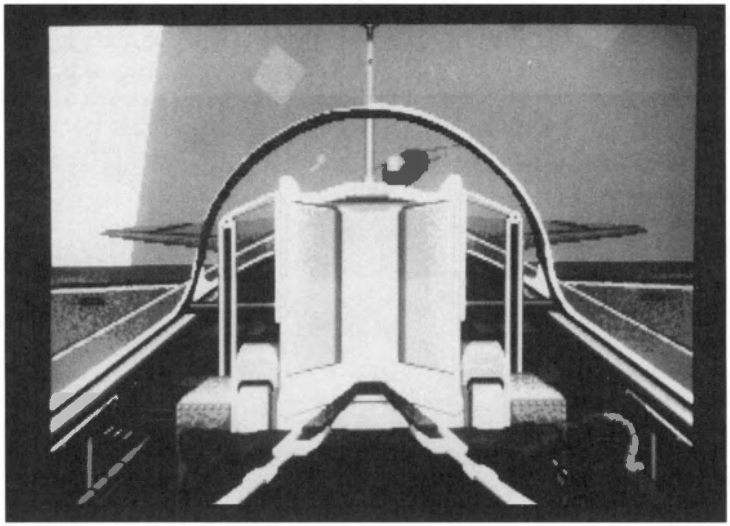
Single ship combat against multiple enemy aircraft is one of the most challenging air-to-air engagements a fighter pilot will ever face. One-versus-many tactics are difficult to execute but straightforward conceptually. We will divide our discussion of one-versus-many tactics into offensive, defensive, and head-on scenarios.



- You are on the offensive in a one-versus-many scenario if the bandits you are fighting are all out in front of your aircraft. Keeping the bandits out in front is the difficult part. It is important to shoot as soon as possible at the nearest bandit and then maneuver to stay in control of the fight. If you shoot a missile at the nearest bandit and hit him, you improve the odds and change the mind-set of the surviving enemy fighters. If you miss your shot, then the maneuvering is even more critical because you have angered them and they still outnumber you.

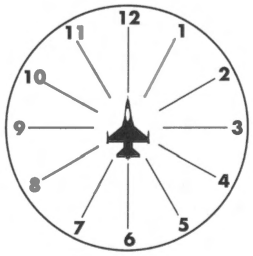


- A rule-of-thumb for maintaining control of the fight is to keep the bandits on one side of your jet. This makes it much easier to keep the bandits in sight and makes it harder for them to sandwich you. In addition, you should also try to keep all of the bandits either above or below you in altitude to make it easier to keep track of the bandits and keep you from getting trapped.



- The question may come up: "What do I do if there are more than two bandits in a fight and I do not kill one before they all see me and start a turning engagement?" The answer is simple — separate from the fight. The way to do this is to pass the bandits as close as possible at 180° of heading crossing angle at the speed of heat.

  A rule-of-thumb is that if you are alone and there are more than two bandits, do not turn more than 90° to get a shot and do not let your airspeed bleed off below 400 knots. After 90° of turn or when you are reaching 400 knots, get out of the fight. Separating from fights is an art more than a science, and it is a critical fighter pilot's skill. My book, *Falcon 3.0 Air Combat*, explains the concept of the "Escape Window" which describes in detail how to execute a fight separation under various conditions.



- A defensive one-versus-many fight starts when a bandit gets behind your 3/9 line with nose position (his nose is within 45° of your aircraft). Remember, bad stuff can happen to you when the bandit puts his nose on you within range of his weapons! When this occurs, fight your best one-versus-one defensive BFM. It makes no difference how many bandits are in the sky around you; the rule-of-thumb on defense is to fight one-versus-one BFM against the most immediate threat. When you have defeated this attack, you will probably have another bad guy saddling up on you so get ready to fight the next guy. When you are fighting multiple bandits, remember that one guy may leave you in order to give the chance to kill you to another guy who is in a better position. If you see one bandit disengaging, keep checking six because you may be about to be engaged by his wingmen. If this does not occur, then keep accelerating and separate from the area.
- A head-on one-versus-many fight has a very simple scenario. If you pass multiple bandits head-on, plug in the afterburner and keep on going. It is very foolhardy to start a one-versus-many fight from a head-on pass. In fact, the only way you should initiate a one-versus-many fight is from an offensive position. In any other scenario, the goal is to get out of the fight as quickly as possible.

Two-versus-many

Two-versus-many fights are conceptually very similar to one-versus-many engagements (which, remember, are an extension of one-versus-one BFM). The difference is that your wingman can even up the odds and give you several additional options that you do not have single-ship. The presence of a wingman, however, does not mean abandoning the principles of one-versus-many air combat. Your wingman could be blown up or engaged by a SAM, and you'd be in a bad position. For this reason, always fight your best one-versus-one BFM and follow the rules for one-versus-many that we discussed. The biggest advantage of having a wingman is that you can stay in a turning fight longer to achieve a kill.

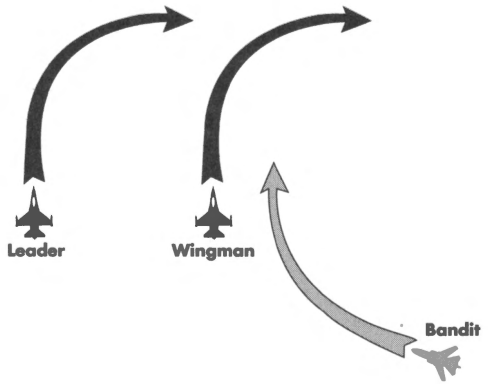
This does not mean that you can disregard your "escape window." The presence of a wingman does mean, however, that you can delay a separation and spend more energy in the form of airspeed and altitude because your wingman can pick off any other bandits that try to enter the fight. Just remember: in two-versus-many fights your wingman will probably become engaged soon after the merge, and you will be thrust suddenly into a one-versus-many fight.

Directive commentary

In *Falcon 3.0,* you can direct your wingman to take one of several actions during the course of the fight. The following list outlines these actions:

- Break left/right
- Break high/low
- Roll out and fly straight and level
- Bypass the current waypoint
- Return to previous waypoint
- Maintain radio silence
- Execute the right/left arm of a bracket
- Engage
- Disengage (knock it off)
- Drag left/right

In *Falcon 3.0,* your wingman is usually a smart fighter pilot who flies in a tactically sound manner. Most of these directive calls to him occur in a two-versus-one situation to optimize a tactical maneuver. In a two-versus-many fight, most of these directives may not be followed because of the dynamic nature of a *Falcon 3.0* multi-bogey engagement. This is, of course, a limitation of the simulation and does not mirror the use of directive commentary in a real multi-bogey fight. In *Falcon 3.0,* you should always try to get your wingman to execute your tactical game plan so use these directive calls regardless of the number of enemy fighters in the air. The following is a brief explanation of the actions that you can direct your wingman to perform.



Break left/right: A break turn is a maximum G turn into a attacking bandit. It is performed to keep an enemy fighter off your back. You would direct your wingman to "break" if you detected a bandit at his 6 o'clock closing into a firing position or if a missile is in the air.

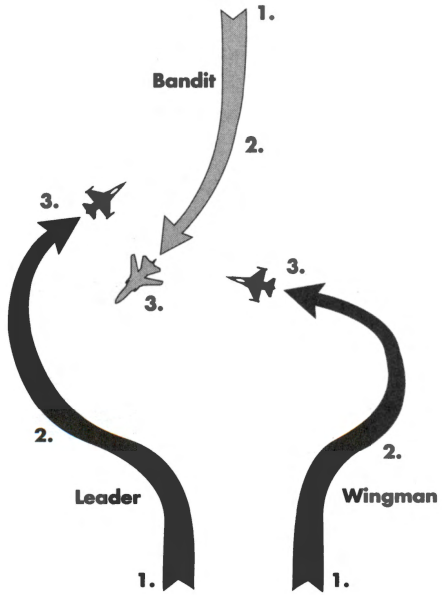
Break high/low: This is the same except it is in the vertical. Use it if a bandit is coming from high (call your wingman to break high) or low (call your wingman to break low).

Roll out and fly straight and level: Use this directive when you notice that your wingman is starting to do something that does not fit into your current scheme of maneuver.

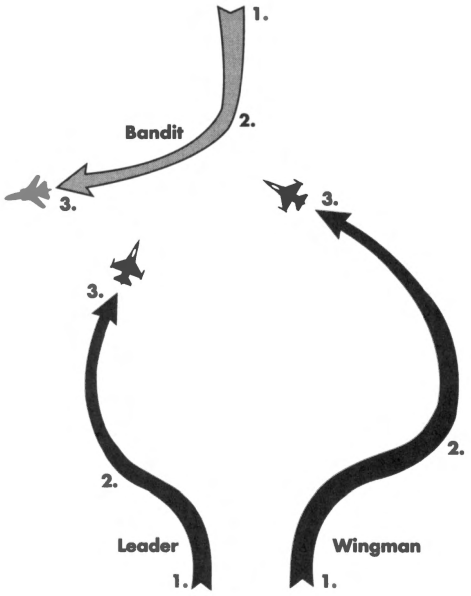
Bypass the current waypoint: This will tell your wingman and the rest of the fighters in your flight to skip the current waypoint and head for the next one.

Return to previous waypoint: This is the opposite of the last command. All the aircraft on your flight will start to head back to the last waypoint you reached.

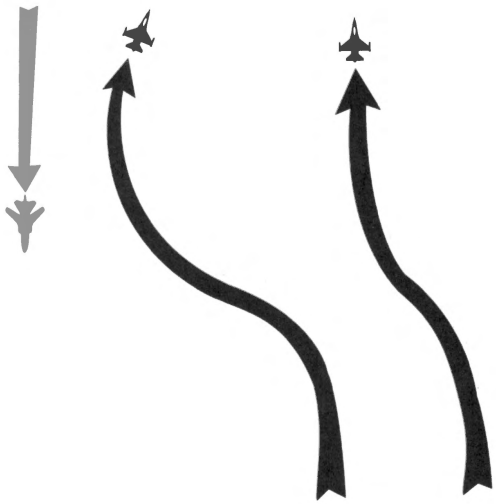
Maintain radio silence: If you want your wingman (and others in your flight) to shut up when you're engaged in a dogfight, you can tell them to keep radio silence. This works two ways, however. You won't be able to hear their cries for help, but by the same token you won't get their warning messages, either.



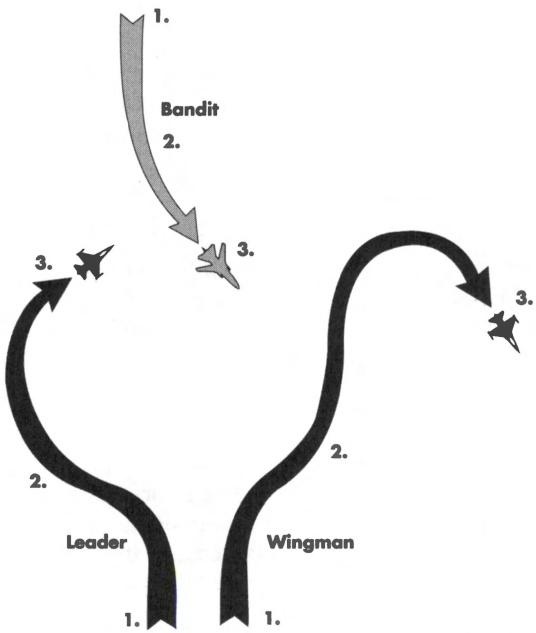
Execute the right/left arm of a bracket: A bracket is a pincer move used by fighters to intercept a bandit formation from two sides and is usually executed outside of 15 miles. The idea of a bracket is to give the bandit two choices — both of which are lethal. Be advised that when you execute a bracket, you will lose a visual on your wingman. Another thing to keep in mind during a bracket is that you should *not* attempt a bracket if the aspect is less than 160° at 20 miles. If you try at a lower target aspect, one arm of your bracket will not get outside the bandit.



Engage: When you direct your wingman to engage, you are asking him to enter a turning fight with the closest bandit.



Disengage: The disengage command is used when you want to "get out of Dodge." If you see your escape window closing down and you want to separate from the fight, you can direct your wingman to separate using the disengage command. The figure above shows a situation where this might occur.



Drag left/right: The drag command (also called a "pump" by fighter pilots) is used to decoy the enemy and have him engage a fighter which is leaving the fight. Normally this is done so that another fighter can get an easy shot at an enemy formation. The above figure shows a drag maneuver. There is one very important thing to remember about a drag: ***It must be initiated before you get within 10 miles of the bandit.*** If you try to drag inside this range, you risk getting speared with an enemy medium range missile.

Radar avoidance

This part of the Advanced Fighter Tactics section will go into detail on the two types of ground radar (continuous wave/doppler and pulse-doppler) you will encounter in *Falcon 3.0.* Each of the two kinds of radar have their flaws in that you can fool them into thinking that you are just another part of the landscape. The ways you can avoid being "painted" (detected) by ground radar will be discussed after the descriptions of the radar types. Finally, there is a brief description of the different aircraft radars and where their radar types can be found.

Radar types

Radar stands for RAdio Detection And Ranging. A radar transmitter puts out either a beam or a series of pulses of radio energy. The transmitter antenna itself or a separate antenna can be used as a receiver to detect the beam or pulse coming back, which it does if it hits a solid object. Since radio waves always travel at the same speed, timing the reception of the return tells the receiver how far away the reflecting object was when the beam hit it. Modern radars are very discriminating, capable of telling both size and basic shape of an object by its radar return. There are two forms of radar in *Falcon 3.0:* continuous wave/doppler radar and pulse-doppler radar.

Continuous wave/doppler

A continuous wave/doppler radar puts out a constant signal. You need a second antenna to act as a receiver, since the transmitter cannot receive while it is transmitting. This form of radar was the first type built and nowadays is mostly used for doppler-effect ranging, using the doppler effect of the beam bouncing off objects moving toward or away from the receiver. If an object does not show movement toward or away from the radar emitter, the radar does not display it.

The probability of being picked up by a doppler radar depends on the plane's angle to the radar and, of course, on the power and range of the doppler radar. If an aircraft turns 90° to the beam of the doppler radar, it makes as little doppler-shift return as possible and the radar does not note any difference. This technique is called "beaming" the radar. The more powerful or close the doppler is, the more likely it is to catch slight variations in the position of the plane and realize it is moving.

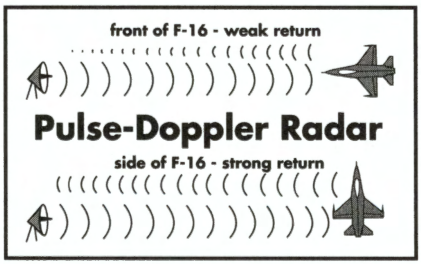
Pulse-doppler radar

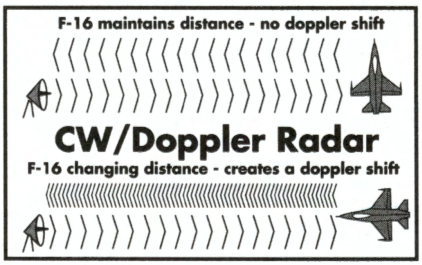
Pulse-doppler radar puts out its radio beam in pulses, rather than a continuous beam, and uses a separate receiver to measure the radio pulse return. Most radars use pulses instead of a continuous beam because it is cheaper and less cumbersome to use the same antenna as transmitter and receiver. A radio pulse is issued, and the same device attempts to pick up any return on the beam caused by it bouncing off a solid object.

As a rule, pulse-doppler radar is shorter ranged and less efficient than doppler radar. It shows everything the radar beam bounces off of, making for a lot of "snow" on the screen. The best way to fool pulse-doppler radar is to "charge" it head-on to make the smallest target for the beam to pick up and blend in to the rest of the static.

Determining types of radar

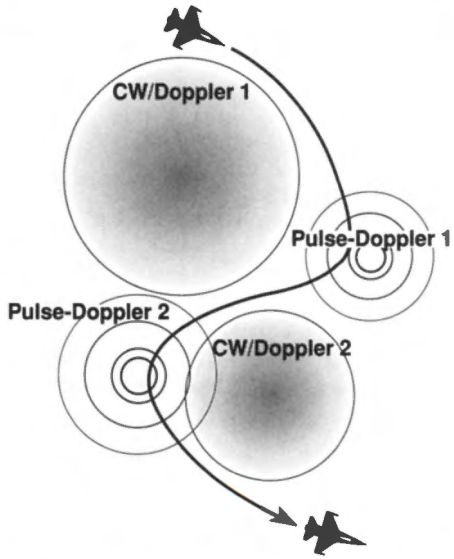
You can tell what kind of radar is in the area by looking on your Threat Indicator. Ground radar signals are displayed here by a large box with a "1" or a "2" inside it. The number "1" indicates continuous wave/doppler radar, while a "2" means pulse-doppler radar. Following is a graphic of the different types of radar.





Multiple radar signals

Common practice among nations who have both forms of radar is to alternate them and overlap their coverage areas, so that a plane coming head-on to a pulse-doppler radar will be detected by a continuous wave radar and vice-versa. However, radars cannot be placed too close to one another because their signals interfere with each other. Also, radar systems are very expensive items — crowding them too close together in one area may mean not enough radar coverage in another. Therefore, it is possible for a clever pilot to weave between radars, alternating a head-on approach and a 90° approach depending on which radar signal is stronger. This is sometimes referred to as "threading the needle."



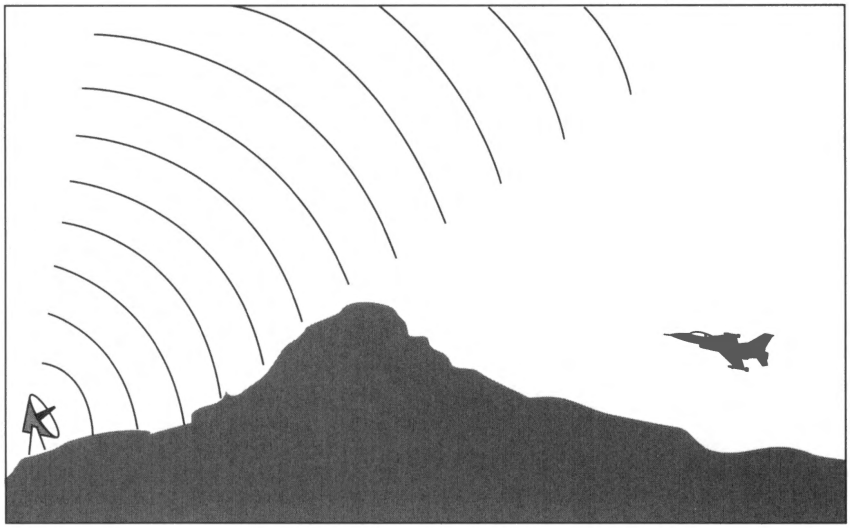
Various devices such as chaff and an ECM pod also can confuse radar, though the radar receiver will know that something is up there or the interference would not exist.

Other methods of avoiding radar

In addition to the basics of beaming and charging radar signals, you can also use two other methods to avoid radar: terrain masking and "nap-of-the-earth" flying.

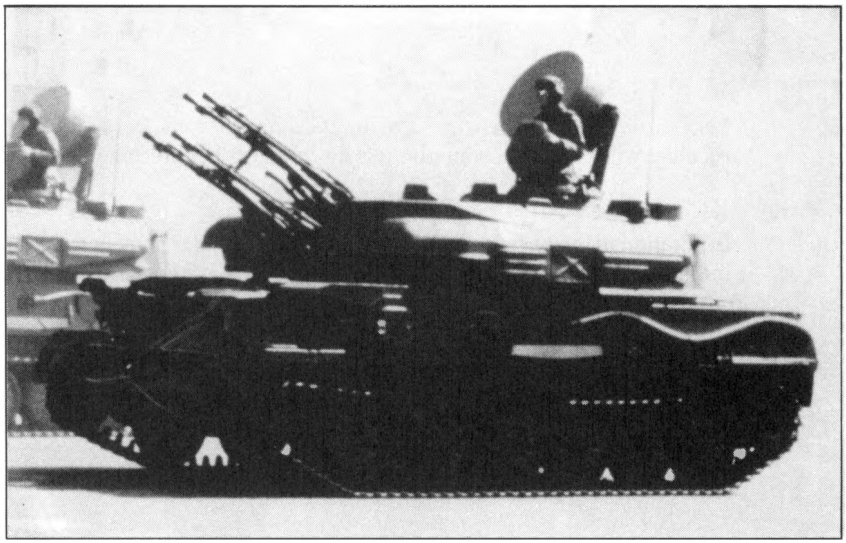
Terrain masking

Since radar waves travel in lines, large ground objects and mountains will generally obscure a radar's signal. Therefore, if you pick up a radar signal behind a hill, you can drop altitude to a point below the peak of the hill, thus masking your radar signature. This is a useful technique to approach a radar installation undetected and for breaking a radar's lock on your aircraft.



"Nap-of-the-earth" (NOE) flying

The other way to hide yourself from a radar broadcast is to fly as low to the ground as possible. This is called "nap-of-the-earth" or NOE flying. When you fly extremely low to the ground, a radar may get confused and think that you are part of the landscape. While NOE flying is quite effective in avoiding radar, its disadvantage is that it makes your plane very vulnerable to AAA and small arms fire from ground troops.



Aircraft radar

Many of the aircraft in *Falcon 3.0* have a radar they use for locating other aircraft. When their radar is on, they will emit a certain signal based on the type of radar their plane is equipped with. As with the ground radar, these types will appear in the Threat Indicator. The different types are listed below:

1. Third generation radar with multiple target tracking. This radar has look down and shoot down capabilities.
2. Second or third generation radar with single target tracking.
3. First or second generation continuous wave radar.
4. Targeting radar.
5. Attack radar.
6. Early warning (EW) radar. This kind of radar is found in AWACS class aircraft.

To see what type of radar a specific aircraft has, see the Technical Specifications part of **Section XV: Reference.**

When an enemy aircraft achieves a lock on you, you can break that lock by either heading directly at that plane or taking a course 90° away from it.

Formations

The final part of this section deals with the different formations you can choose in the Edit Flights screen of the Campaign and the Enemy Aircraft/Allied Aircraft screen in Red Flag. Each of the different formations has a different effect on your radar signature (see the Radar Avoidance section above for more details).

Each of these formations are arranged in an eight-plane formation. Keep in mind that the aircraft in black is Plane #1 (your plane), while the aircraft in gray are the other ones in your flight. To determine a formation with fewer than eight planes, simply picture the formation up to the number you need.

Some of these formations are more useful than others because they may confuse enemy radar into thinking that your formation has fewer planes than you actually have. In addition, other formations may be more useful for air-to-air encounters while others may have more merit in a ground attack situation.

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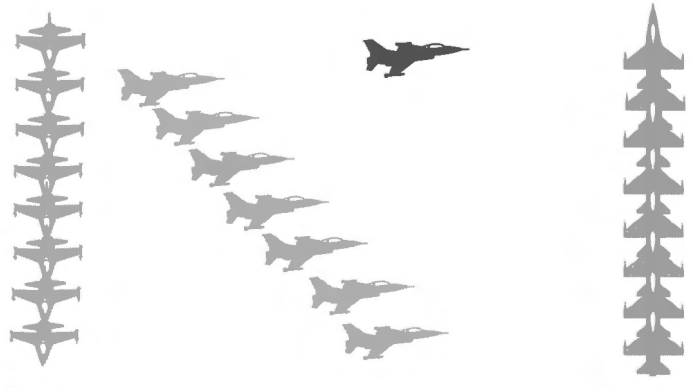

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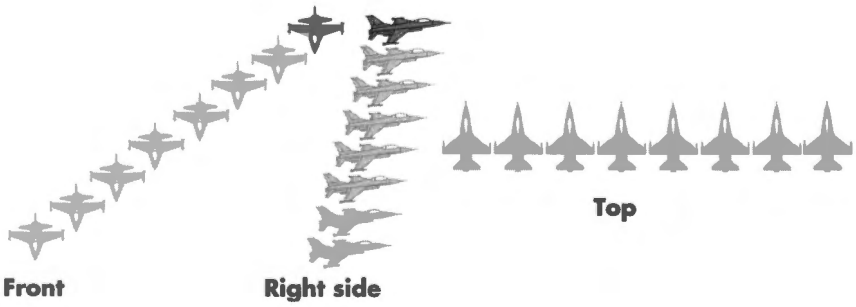

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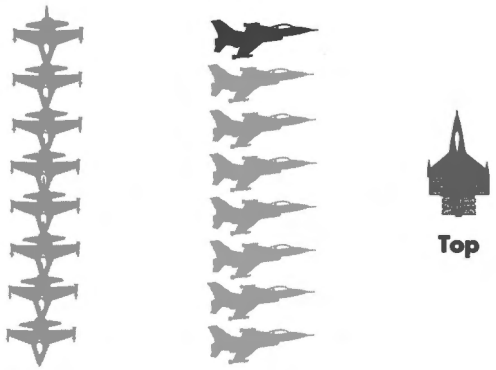

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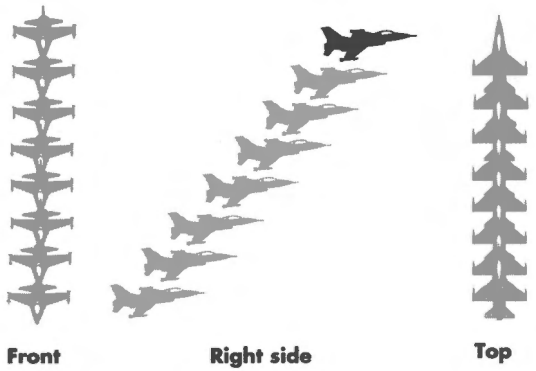
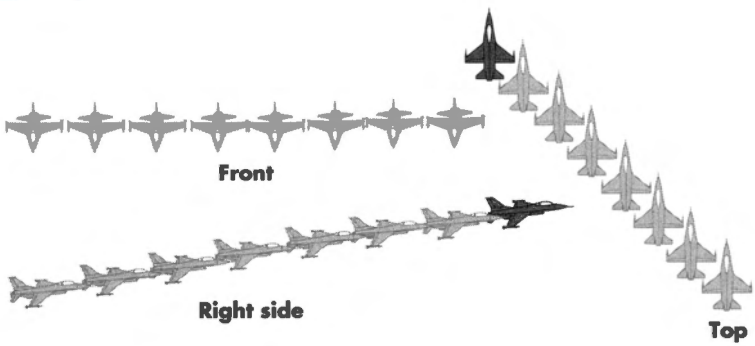
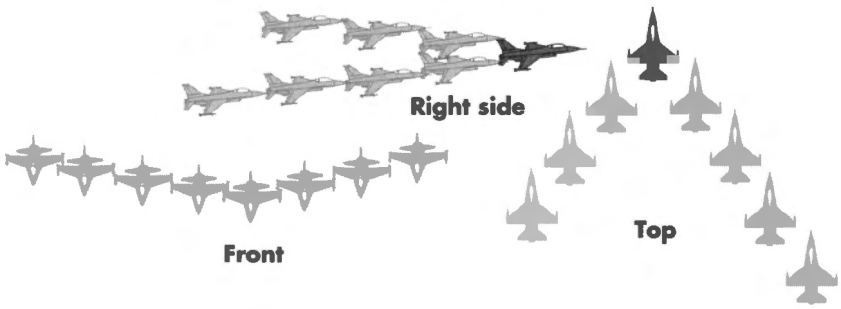


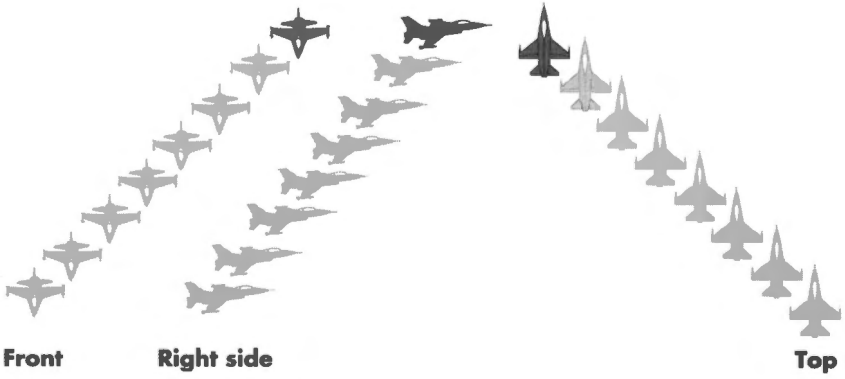
WEDGE



VIC



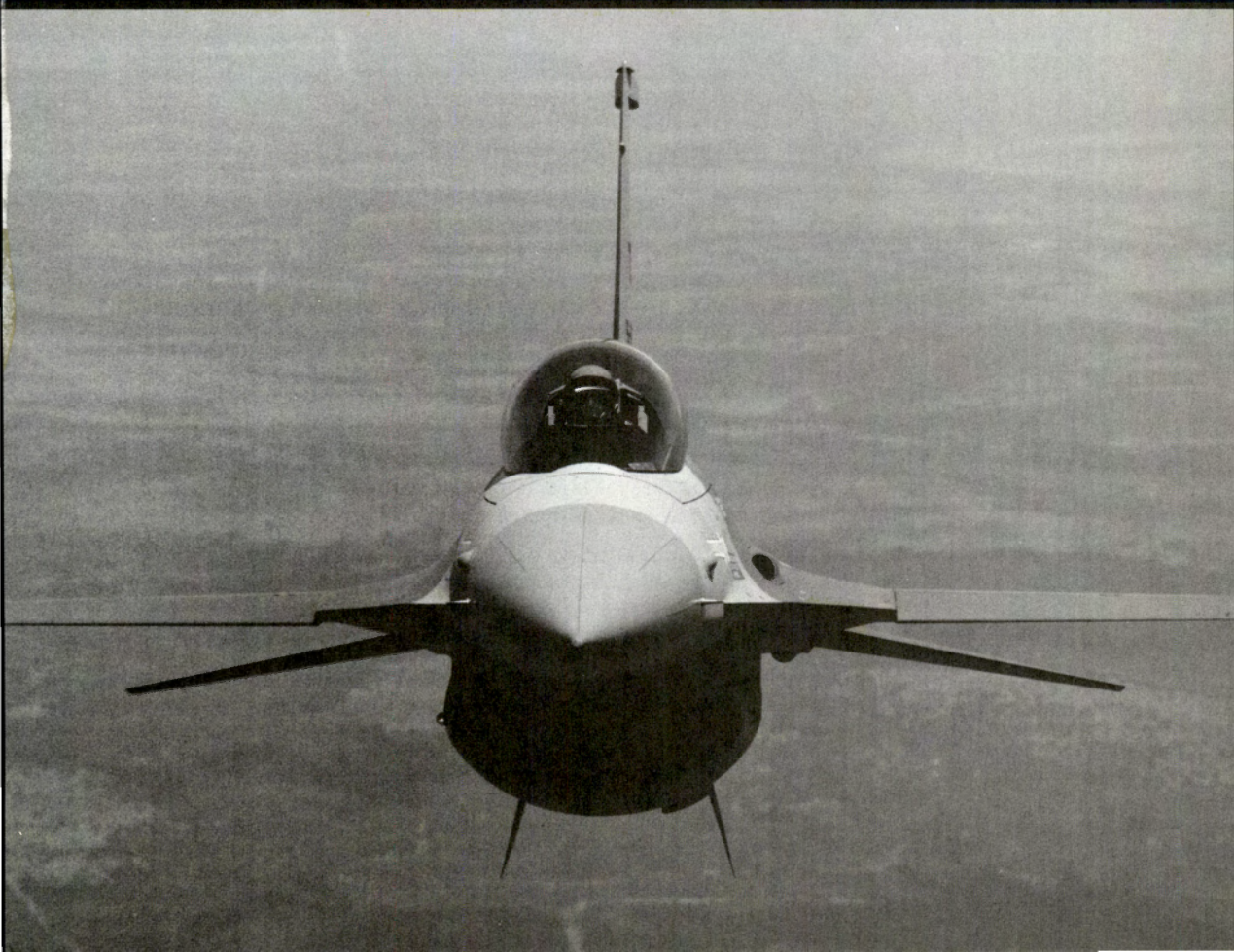
ECHELON



SECTION

XIII

THEATERS OF CONFLICT



Theaters of Conflict

Kuwait

Historical background

Understanding the situation in Kuwait demands an acquaintance with that nation's historical relationship with Iraq. After World War I, Great Britain administered most of the region under a League of Nations mandate. Great Britain gave Iraq its independence in 1932 but maintained one small sheikdom as a protectorate until 1961. This protectorate is now know as Kuwait.

In the late 1940s extensive oil reserves were discovered in Kuwait. Suddenly, the small Arab nation became a serious economic power. Through British-held firms, Kuwait quickly became a major oil producer and, in fact, one of the chief members of OPEC (the Organization of Petroleum Exporting Countries).

The Iraqi areas neighboring Kuwait also held oil, but much less. Iraq and Kuwait competed in the oil market but otherwise interacted only rarely until the Iran-Iraq war, when Kuwait assisted Iraq economically.

After the war, in July 1988, a dispute broke out between Iraq and Kuwait. Iraq maintained that Kuwait pumped far more than its share of oil from the Rumaila Oil Field (which straddles the border) and exceeded its OPEC production quotas. Iraq demanded $14 billion in reparations for lost Iraqi revenue due to quota violations, $2.5 billion for oil stolen from the Rumaila Oil Field, the cancellation of a $12 billion debt to Kuwait from the war against Iran, and the cession of the rest of the Rumaila field to Iraq.

Initially, Kuwait ignored these huge demands. But when tens of thousands of Iraqi troops began massing on the border, the Kuwaitis agreed to talk. Iraq flatly refused to soften its

demands, and Kuwait was not about to hand over $28.5 billion and the lucrative Rumaila fields. Negotiations lasted less than an hour.

On August 2, 1990 Iraq's President Saddam Hussein ordered his army to attack. In less than a day, Kuwait was under Iraqi control and the Emir of Kuwait had fled. Saddam Hussein claimed to annex Kuwait (or the 19th Province, as he called it) in the name of the Arab people.

Hussein, however, underestimated the response from the rest of the world. The United Nations Security Council clapped embargoes on Iraq and authorized an international force to defend nearby Saudi Arabia. Other Arab nations such as Egypt, Morocco and Syria denounced Iraq's actions and sent troops. The United States deployed several divisions and carrier groups to the area, as well as several squadrons of A-10s, F-16s and F-15s. France and Great Britain also sent units.

In November 1990 the United Nations passed a resolution giving Coalition forces (as the United States and its allies were now being called) the right to use any available means to evict Iraqi troops from Kuwait if they did not voluntarily leave by January 15, 1991. One day after the U.N. deadline, Coalition forces began a massive air assault on Iraqi positions in Kuwait and other strategic targets throughout Iraq that continued unabated until the end of the war.

The Coalition quickly gained control of the skies with superior numbers, equipment and pilots; this complete air supremacy allowed the ground forces to circumvent the formidable Iraqi defenses. Without a single plane in the air, Iraq had no reconnaissance capabilities and no real way to respond to Coalition actions even if they could observe them.

Less than 100 hours after the initial move by Coalition ground forces on February 23, 1990, tens of thousands of Iraqi troops had surrendered, over 90% of Iraq's 4,280 tanks in and around Kuwait were destroyed or captured, and Coalition forces were raising the flags of the United States and Kuwait in the heart of Kuwait City. The war was over.

Campaign rationale

Given the ease and speed of victory, few realize the magnitude of the difficulties Coalition commanders faced when planning the attack:

- Iraq had a significant numerical superiority. By January 1990 Iraq fielded an army of 1.85 million, over 540,000 of which were dedicated to the Kuwait theater of operations, with another 250,000 moving south from Baghdad. The U.S. committed 425,000 soldiers to the removal of Iraq from Kuwait. Other Coalition forces totaled about 160,000. Iraq's ground forces outnumbered the Coalition's two to one.
- Iraq's troops occupied heavily fortified defenses built up over the six months of occupation. After occupying Kuwait, Saddam Hussein ordered the construction of a complex barrier system of walls, trenches, minefields, razor wire, pools of oil and killing zones which, he said, "no tank could pass through."
- Iraq fielded more and better artillery than the Coalition. The Coalition's total artillery pieces numbered fewer than 2,000, while Iraq had 3,700 guns and rocket launchers. Iraq employed 300 top-of-the-line G-5 155mm howitzers and special long-range artillery shells, both designed by Dr. Gerald Bull, a Canadian-born world authority on artillery design. The Coalition possessed nothing which had the range or accuracy of the G-5.

Such heavy Iraqi artillery, pre-focused on approach routes, was an integral part of the barrier strategy which had exacted horrific casualties against the Iranians.

- Iraq had an air defense system which the director of U.S. naval intelligence called "square mile for square mile the most sophisticated air defense system in the world." It employed, among other weapons, the U.S.-built Roland and Soviet-built SA-3 and SA-9 surface-to-air missiles and dense anti-aircraft artillery. These AA weapons were coordinated with early-warning and fire-direction radars and area control centers in a network coordinated by France's Thomson-CSF Corporation.
- Iraq possessed many high-tech fighters, including scores of top-of-the-line MiG-29 "Fulcrums." French-built Mirages, MiG-21s, MiG-23s, MiG-25s, Su-24s and Su-25s rounded out Iraq's air power.
- Iraq demonstrated the capability and willingness to use chemical weapons. Numerous chemical and biological weapons plants in the interior of Iraq churned out mustard gas and the nerve toxins Sarin and Tabun. Biological threats suspected to be in Iraq's arsenal included anthrax, botulism, bubonic plague and tularemia. Coalition troops were ill-prepared for this threat; the vast majority employed non-permeable protective suits and gas masks designed for use in cooler climates such as Europe.
- Iraq's army was battle-hardened and experienced from eight years of war with Iran. Coalition forces had only practiced in mock wars. Iraq's people generally perceived the war with Iran as a victory, so morale and battlefield confidence was high among the troops.

The simulation begins on Day 1 of the ground war. In this scenario, Iraq will not surrender the skies so easily and hundreds of high-tech MiGs oppose Coalition control of the skies. With control of the air in dispute, the horrendous pounding Iraq suffered in the 42-day air assault before President Bush's ultimatum will not have occurred, and the secret flanking maneuver which brought victory may not be possible. The Coalition begins its assault against a fully operational Iraqi army.

Campaign objectives

The ultimate goal of the Coalition is to drive the Iraqis out of Kuwait and restore the exiled Kuwaiti government. To do this, the Air Force must accomplish three basic objectives:

- Air superiority must be established. With the skies in dispute, any offensive will suffer heavy casualties. F-14s, F-15s and F-16s will bear the brunt of the air superiority and combat air patrol missions.
- Iraq's command and supply centers must be destroyed or disrupted. F-16s, F-117s and B-52s will carry out most of the strike missions.
- Critical ground threats must be neutralized. Close air support for the ground forces and suppression of opposing air defenses are essential to the success of the ground war. A-10s, AH-64s and F-16s will handle the majority of these duties.

Israel

Historical background

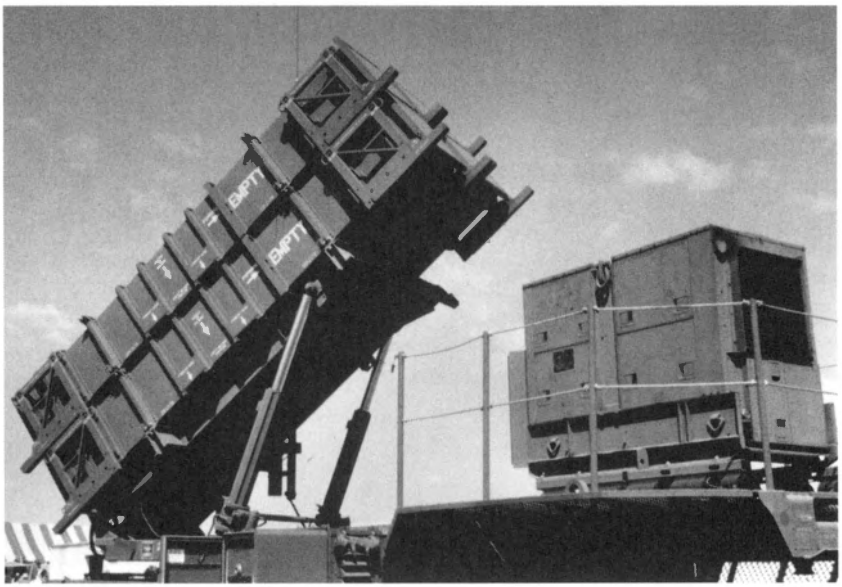
The modern state of Israel has been in a state of war or very close to it since its creation as an independent nation in 1948. Angered at the displacement of the Arab population by Jewish settlers, the nations of Syria, Jordan and Egypt have repeatedly attacked Israel. In every engagement, however, Israel has been the victor and has actually gained territory. Israel has also initiated hostilities, invading the Egyptian Sinai and sending troops into southern Lebanon several times to attack terrorist bases.

Palestinian and Arab frustration at Israel's iron-hand rule over the occupied territories erupted in December 1987, when Palestinian youths began hurling stones at Israeli soldiers. This marked the beginning of a PLO-sponsored general uprising known as the intifada, unrest which refuses to be quelled despite Israel's sometimes harsh military

crackdown. Palestinian deaths in the occupied territories since the beginning of the intifada exceed 600, while Israeli police and soldiers killed number about 40.

In October 1990, almost unnoticed in the rush of news about Iraq and Kuwait, Syrian President Hafez Assad ordered the Syrian army into Lebanon. Syria defeated the Christian forces there and effectively buried the long-running civil war under 42,000 troops. The United States, seeking Syria's help in the war against Iraq, turned a blind eye to the invasion.

Given the removal of Iraq as a major military power in the region, Syria now has great latitude to exercise its vast military power. Furthermore, Israel's treatment of Palestinian Arabs and its occupation of the Golan Heights, the West Bank and the Gaza Strip continue to aggravate neighboring Arab states.



Campaign rationale

Desert Storm is over. The Coalition has dissolved, and U.N. troops have taken over the policing of the Iraq-Kuwait border. U.S. and other foreign troops have gone home, as have most of the naval task forces in the Gulf region. Negotiations between Israel and the neighboring Arab states falter and die as neither side is willing to give an inch.

Syria, having received $2 billion for its participation in the war against Iraq, has negotiated quiet arms deals with the Soviet Union for warplanes and with China for M-9 and M-11 surface-to-surface missiles. Under the pretext of Gulf instability, Syria calls up 200,000 of its reserves. Further arms deals swell Syrian stores of tanks and artillery.

Israel continues its hard-line policies, continuing to settle the Golan Heights and refusing to budge on the Palestinian question. Syria, newly rearmed and safe on its eastern front from war-ravaged Iraq, insists that Israel leave the occupied territories and give the Palestinians autonomy.

Israel, of course, refuses. Syria, expecting such a response, moves in full strength into Lebanon, its 300,000 troops moving directly south towards Israel. Syria has the support of the Lebanese Moslem groups (whom it has aided since the civil war began) and of the various Palestinian factions in Lebanon, who do have one uniting concern: their hatred of Israel. The few remaining Christian forces scatter completely.

The Israelis occupy prepared positions along the Israeli-Lebanese border and in the formidable Golan Heights to form a virtually impenetrable barrier to the advancing Syrian army.

Less defensible, however, is the West Bank bordering Jordan. Although not committing its own troops, Jordan allows free passage to Syrian troops, exposing the entire eastern border of Israel to attack. Israel must defend a front stretching from the Mediterranean to the Golan Heights to the Dead Sea. And it's anyone's guess where along this 120-mile front Assad will decide to strike with the brunt of his military might.

The United States is now in a tricky position. Operation Desert Storm depleted weapon stores and money supplies, and the allies who helped oust Saddam Hussein are not interested in embroiling themselves in an Israeli conflict. In addition, Israel's behavior has placed it in a politically unfavorable position; U.S. and world public opinion simply will not support the kind of massive military move accomplished in Kuwait.

It is decided that the U.S. role must be a purely defensive one. Intervention on Israel's behalf will be limited to protection of its borders and defense of its sovereignty.

American forces are rushed to the area as fast as possible, but with low monetary resources and faltering public support, it will be some time before sufficient strength to repel the Syrians can be amassed. What U.S. forces are available are immediately sent to Israel. Unfortunately, these are quite small compared to the huge Syrian military.

The Israelis and their American allies will have to give ground, buying time until the full American reinforcements can arrive and the Israeli reserves can be called up and readied. Syria must not reach Jerusalem. Israel has the means to deliver thermonuclear weapons — and will do so if pressed hard enough.

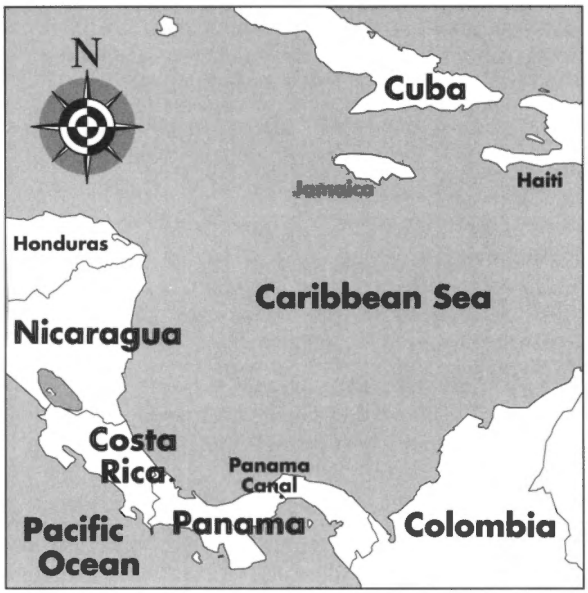
Campaign objectives

The Air Force seeks to achieve the following objectives in this conflict:

- Disrupt the Syrian advance through the destruction of strategic ground targets. The limited access routes into Israel can be closed down very effectively with precise strikes on bridges and railyards. Destruction of command facilities will hamper the coordination of Syrian manuevers.
- Protect civilian areas from enemy bombing. It is likely that the Syrian Air Force will launch strikes on Israeli cities to divert allied air power away from military resources.
- Support Israeli and American ground units defending against the Syrian onslaught. Without effective air support, even the nearly impregnable Golan Heights will be overrun.

All objectives are to be accomplished with an absolute minimum of civilian casualties, especially in Jordan and Lebanon.

Panama



The Panamanian campaign is based upon a hypothetical alliance of Latin American states aimed at ending U.S. military and economic hegemony in Central America.

Historical Background

During the 19th century, power over much of Central America passed from the colonial empire of Spain to the economic empire of the United States. From the Spanish American War in 1898 until World War II, the United States often sent the Marines into Central America to support the interests of U.S. companies operating in the region. United States companies owned vast plantations and mining concerns and frequently controlled the economic and political life of a whole nation (hence the term "banana republic"). Even the existence of Panama as a state is due to the United States' desire to build a canal. Panama, originally a province of Colombia, revolted with U.S. assistance when the Colombian senate refused to ratify a canal treaty.

Since World War II, some United States politicians have claimed that U.S. economic hegemony in the region is threatened by both Communism and the drug trade and have advocated military action to destroy these threats. Since Congress, however, now resists most calls for overt military action, the CIA instead engages in clandestine wars. So far, Cuba and Nicaragua have borne the brunt of U.S. paranoia about Communism. While the CIA botched the Bay of Pigs Invasion in 1961, a United States trade embargo has since crippled the Cuban economy. In Nicaragua the CIA has mined harbors, funded the Contras and advocated political assassination in an effort to depose the Communist Sandinista government. Almost 15 years of civil war, which began with a broad-based revolt against the U.S.-supported dictator Somoza, have left Nicaragua the poorest country in the Western hemisphere. To circumvent Congressional control of the purse strings, the CIA invented

imaginative fund-raising techniques, such as selling arms to Iran and allegedly transporting drugs between its secret airfields in Honduras and Florida.

In 1989 the "War on Drugs" became a real war in Colombia when the United States sent troops, military hardware and $65 million to assist the Colombian government in a crackdown on the drug industry. The drug traffickers responded with bombs and bullets in a wave of violence that left hundreds dead. The war destroyed the Medellin cartel, the largest and most belligerent, but this merely created a gap for other syndicates to fill. While the United States claimed pure motives, allegations from the dark and corrupt underside of Central American politics suggest that the U.S. was merely eliminating its competition.

Former Panamanian strongman Manuel Noriega sits at the middle of such allegations. Even as a schoolboy, Noriega was on the CIA payroll as an informant. Noriega's path to power was brutal — hinging upon at least one political assassination. Until 1988 Noriega continued to work closely with the CIA, helping with the Contra and drug interdiction efforts. The facts of the case are still coming out, but one of three possibilities is likely: (1) Noriega played the CIA and DEA for dupes, using them to reduce the competition as he smuggled his own drugs into the United States; (2) the CIA turned a blind eye to this activity in exchange for Noriega's assistance in other areas; or (3) the CIA and Noriega were partners, manufacturing the "War on Drugs" to reduce competition and raise the profitability of their own safe supply routes to bases in Florida. After 1988, Noriega seemed to become increasingly unstable, defying the United States and threatening to forge ties with the Communist world. The United States mounted a campaign to oust Noriega, who was now both a threat and an embarrassment. This campaign culminated with a full-scale military invasion which captured Noriega and installed U.S.-supported opposition candidate Endara in power.

Campaign rationale

The following events occur immediately before the beginning of the campaign:

A summit meeting between the Central American heads of state is convened to determine if there is a way to establish the peace agreed upon in a 1987 accord. After much debate, a resolution is passed blaming foreign armed forces for much of the recent fighting. Panama, El Salvador and Nicaragua, in particular, have been the sites of bloody wars caused or prolonged by foreign involvement. The Central American states agree to eject all foreign forces and to hereafter resolve internal crises themselves.

A military alliance dedicated to the keeping of peace in the region is formed. Colombia and Cuba join the alliance, even though they were not among the original signers of the Central American peace plan. Costa Rica supports the alliance, though it has no official military. Pressure on Honduras, El Salvador and Panama to ratify the treaty is intense.

Eventually Honduras and El Salvador agree and order all United States troops and advisors removed from their soil. Panama's President Endara refuses, however, since he owes his power to the United States. Anti-U.S. protests sweep Panama. Endara blames the protests and riots on subversive agents and declares martial law. The United States and Panama sign a defense treaty, and CIA and military advisors are pledged to assist the Panamanian police force in keeping order.

The Alliance establishes bases along the border and issue an ultimatum. The United States charges that the alliance is a conspiracy between Communists and drug dealers intent on the democracy in Panama and vows to protect Panama from any aggression.

It is unclear, however, whether the United States will be able to back up its pledge. Its forces are spread thinly worldwide. In addition, support from Congress is uncertain amid repeated Washington scandals involving illegal CIA activities in the region, including allegations of selling drugs and arms to fund anti-Communist groups, training and support of right-wing death squads, support of union busting and intimidation, and political assassinations. To fight the combined forces of the Alliance, which number almost 100,000, the United States has 5,000 Marines backed up by the 8,000 man Panamanian Defense Force, and a few Air Force units. Long range B-52s can also launch strikes from bases in the U.S.

The Air Force units sent to the Canal Zone include several of the versatile F-16s, which will see heavy use in air-to-air, air-to-ground and close-support missions.

Campaign objectives

Several factors are working in favor of the United States forces in Panama. The people of Latin America will not support a war of aggression, nor can their governments afford a protracted conflict. Further, American reinforcements are on the way. Once they arrive, the conflict will close swiftly. Unfortunately, their arrival may be too late. Grossly outpowered in the short term, the American forces must buy time until political, economic and military pressures can come to bear fully on the invaders.

The Air Force has been assigned the following objectives:

- Interdict supply and reinforcement routes. This will entail a variety of strike missions against roads, bridges, railyards and supply depots. Without resupply and reinforcement, the enemy advance will slow to a crawl.
- Achieve air superiority. While they will be outnumbered, the F-16 drivers will have the advantages of superior training and superior equipment. Blinding the enemy's reconnaissance and air strike abilities is of obvious help, but there is a financial side as well: the cash-poor nations of the region can ill afford to lose what few expensive planes they have.
- Destroy enemy command and control centers. An offensive army without leadership is impotent, incapable of effective attack or maneuvering. The F-16's quick response time will be of great use in striking command centers before they can be concealed or moved.

SECTION

XIV

HISTORY

History of the F-16 Fighting Falcon

Until the F-16, the trend in fighter design was that fighters got bigger, heavier and more expensive as time went on. The expensive Vietnam-era F-4 Phantom II was called "the Rhino" by the pilots who flew it, largely because of its size and poor maneuverability. The far cheaper and more agile MiG-17s and MiG-21s shot down two F-4s for every three they lost — a very cost-effective ratio. The next generation of American fighters was the F-14 Tomcat and F-15 Eagle, twin-engined beasts of the sky that weigh in at over 20 tons. The cost for these technological wonders was tremendous at over $20 million each, but they got the job done.

In 1974 it became clear that this theory of fighter design was not going to work. The Soviet Union and Warsaw Pact countries had increased not only the number of aircraft in their inventories, but also their striking power and quality. The cost of the Tomcat and Eagle, coupled with an estimated 56% serviceability (how many operational at any one time), showed that NATO would be painfully short of aircraft in any future hostilities.

The Lightweight Fighter program (LWF), begun in 1972, was originally a research exercise to see what use might be made of a cheap, maneuverable, daylight-only air-to-air fighter. The LWF program started with nine companies submitting competing studies on the low-cost day-fighter concept. Five submitted actual proposals to develop an LWF; two, Northrop and General Dynamics, were awarded contracts to build prototypes. The prototypes of General Dynamics' Model 401, later renamed the YF-16, and Northrop's P-600, later renamed the YF-17, went through a year-long competitive Air Force evaluation in 1974. (The "Y" designation stands for "development," indicating that a combination of existing and experimental technologies are being used.)

Under the pressure of the Eastern bloc air threat, Secretary of Defense James R. Schlesinger upgraded the program significantly in April 1974. It was changed to the Air Combat Fighter (ACF) program, and it was no longer just an academic exercise. Schlesinger wanted a production fighter with multi-mission capabilities and the latest on-board radar and technology. Four NATO nations (Belgium, the Netherlands, Norway and Denmark) also announced their intention to buy a new class of fighter. Under pressure from the Department of Defense and the State Department, the Air Force moved its selection deadline up to January 1975.

Ahead of schedule, the two YF-16 prototypes flew in January, February and May 1974, just 23 months after the prototype contract was awarded. While no weapons were fired, the flights went off without a hitch. Although the YF-16s looked impressive in those flights, Northrop continued testing their YF-17s and eventually had their test flights in June and August.

The prototype planes were pitted in simulated air-to-air combat against a number of planes from two different nations: the F-4 Phantom II, the A-37B Dragonfly, the F-106 Delta Dart and the MiG-21.

Based on the performance and dogfight tests, the Air Force selected the YF-16 as its fighter of choice in January 1975. It showed better performance at supersonic and near-supersonic speeds, demonstrated better acceleration and endurance, climbed faster, and turned tighter than Northrop's entry. The Air Force announced it would order 650 F-16s, at a cost

of under $5 million each. The Navy, however, preferred the Northrop design; after further development it became the F/A-18 Hornet now in use today.

In Europe the competition had narrowed to three: Dassault's Mirage F1, Saab's Eurofighter and whoever the winner of the USAF competition turned out to be. Saab could not offer sufficient shared-production incentives (a large part of major defense contracts), and both American designs were clearly newer in concept and superior in capability. The USAF's selection of the F-16, coupled with its large initial order, tipped the scales in the competition for the European fighter contract towards General Dynamics. Dassault's sales pitch was based on European unity, military independence from the Americans and problems with the older U.S.-built F-104 and F-111. General Dynamics's approach, meanwhile, was simply to demonstrate the abilities of the F-16 and let it speak for itself.

The four-nation Multinational Fighter Program Group (MFPG) attended the Paris air show on June 7, 1975. The YF-16 at the show far outperformed its rivals, performing seemingly impossible maneuvers at times. Marcel Dassault himself told the YF-16 pilot wonderingly, "You have a fine airplane." The MFPG ordered 348 General Dynamics F-16 Fighting Falcons that same day.

Since that time, a number of other countries have chosen the F-16 for their air forces, including South Korea, Thailand, Pakistan, Venezuela, Egypt and Israel.

In June 1981, Israel directed a tactical strike on the Iraqi nuclear plant near Baghdad. Eight F-16s and six F-15s were sent in, with the F-16s assuming the strike role. The reactor was demolished by 12 Mk84 2,000-pound bombs, two carried by each Falcon, with every bomb delivered on target. All planes returned without a scratch. The attack caused an international outcry; the U.S. stopped shipping F-16s to Israel for almost a year. But the effectiveness of the F-16 had been undeniably proven in a long-range, surgically accurate military strike.

The F-16A and B (single-seat and two-seat) evolved into the F-16C and D in 1984. The primary differences between the two versions are the implementation of a head-up display compatible with the LANTIRN navigation system, a better radar and an improved fire-control computer.

The F-16 played a major role in Desert Storm, with its ability to accurately deliver laser-guided and television-guided "smart" weapons on all-weather and long-range missions. By the end of the war, 249 F-16s had flown approximately 13,500 sorties (the most of any aircraft used in the war) while maintaining a 95.2% mission capable rate (how many operational at any one time). The Falcons attacked chemical production facilities, Scud sites, military production and support facilties. With over 1,500 in the U.S. Air Force's arsenal, the F-16 Fighting Falcon is the mainstay of America's air defense.

(For a list of more detailed books on the plane and its history, please see the Bibliography in **Section XV: Reference** *at the end of the manual.)*

How does the F-16 differ from other fighters?

For the first time in any fighter, the stick (control) is located on the right side of the plane rather than between the pilot's legs. The stick itself originally did not move at all; sensors in the stick detected the pilot's movements. Since some pilots had difficulty adjusting to this, the stick was given some minimal movement. Mechanical stops tell the pilot when the stick is at its maximum in a given direction. This electronic stick is far more sensitive than previous fighters' sticks because the control responses are electronically transmitted to the aircraft. This is called "fly-by-wire" and has given the Falcon the nickname "the Electric Jet."

Pilots in fighters prior to the F-16 were only able to withstand 6–7 Gs before tunnel vision or blackout set in. Due to the increase in the seat's angle from 13° in other fighters to 30° in the F-16 and the addition of armrests, the F-16 pilot can withstand up to 9 Gs for a short period of time. This increased G capability and the Falcon's small turn radius give a tactical edge in an engagement.

A one-piece "bubble" canopy allows the pilot 360° vision around the plane. The heavy supporting bow frame is at the rear of the cockpit, where it does not block the pilot's view. Handrails along the side consoles help the pilot swivel. Other fighter cockpits were sunk into the plane, cutting off most of the vision to the rear. The F-16 has the greatest field of view of any fighter yet produced.

The Falcon makes use of a revolutionary aerodynamic technology called relaxed static stability (RSS). This technology allows for a much smaller wing size, thus reducing weight and visual profile. More importantly, RSS technology allows the F-16 to pull an extra 0.2 to 0.6 Gs at 30,000 feet, to turn 0.7° to 1° faster at that height, and to accelerate faster. This extra maneuverability is the key to the F-16's dogfighting ability, and the reduced fuel consumption allows longer range and greater dogfight endurance.

With a small frame and lightweight construction, the F-16 has incredible velocity. An F-16 can climb from takeoff to 40,000 feet in less than a minute, which gives the plane an added advantage in maneuvering and the ability to escape quickly when threatened.

Finally, the relatively low cost of an F-16 allows great numbers to be produced. The Fighting Falcon is a tough air-to-air and air-to-ground opponent, but losses are a fact of warfare. A low replacement cost is of tremendous benefit.

All of these factors make the F-16 a unique plane for its time and ensure its longevity as one of the top fighter planes for years to come.

What is "Red Flag"?

Red Flag is a pilot training program operated out of Nellis Air Force Base in Nevada, near Las Vegas. Simulated combat missions, ten in all, are flown over a two-week period. The purpose is to give new pilots the experience usually gained only in war.

All types of squadrons come to fight over "Redland," a mythical country situated in the Nevada desert. F-15s, F-16s, A-10s, B-52s and even C-130 transport planes go through the Red Flag exercises, as do Navy F-14s and Marine F/A-18s.

Flying against them are the Aggressors. The 64th and 65th Aggressor squadrons are made up of F-5s, older fighters which resemble the MiG-21 in capability and in appearance. The Aggressor pilots are trained to fly like Soviet and Soviet-trained pilots in order to give as realistic a scenario as possible.

For each two-week session, a scenario is written by the Red Flag intelligence people concerning hostilities between "Red," the Aggressors, and "Blue," the trainees. The Blue forces comprise the core unit (the unit which makes up the bulk of the trainees) and detachments from other units. The Red forces consist of the 64th and 65th Aggressor squadrons, detachments from other air units, simulated surface-to-air missile batteries, simulated anti-aircraft artillery and simulated ground forces.

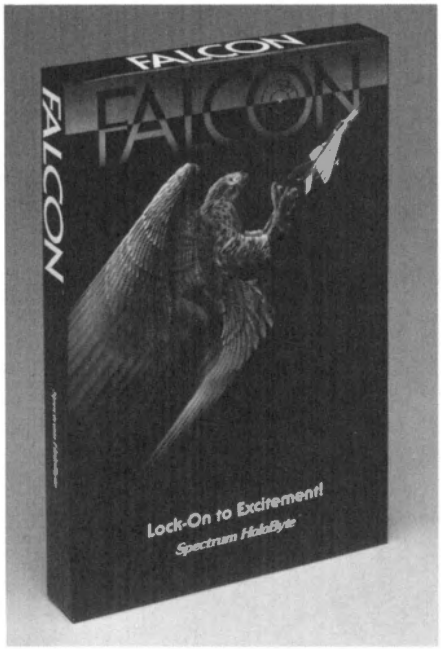
Red Flag was started by the Air Force in 1975 after extensive study and interviews with pilots uncovered a basic flaw in pilot training: it didn't go far enough. The quick, ever-changing types of decisions pilots need to make in combat were never taught in a combat situation. Luckily, the "enemy" was already available and prepared: the 64th Fighter Weapons Squadron (later the 64th Aggressor Squadron) had been formed three years earlier at Nellis specifically to learn and emulate enemy tactics in USAF wargames. The first Red Flag exercise started that November.

Red Flag in *Falcon 3.0*

You can obtain the same sort of non-combat combat training real USAF pilots receive in *Falcon 3.0*'s Red Flag. Red Flag allows you to set up a simulated mission of whatever type you wish, much as intelligence staff members at the real Red Flag do. You select the enemy and friendly forces, their deployment and general strategy. Then climb into your cockpit and welcome to Redland, Nevada.

History of *Falcon*, the computer simulation

On October 14, 1985, the CEO of Nexa Corporation, Gilman Louie, and a handful of programmers began work on a project that would culminate two years later. Their goal was to create a computer program that would both teach the art of aerial combat and be the most realistic flight simulation ever. This program was *Falcon*, the F-16 flight simulator for IBM and Macintosh computers.



It could be said that *Falcon* has its roots in Japan. Louie's first F-16 simulator, called *F-16: The Real Dogfight Simulator*, was created in 1984 for the MSX, a Japanese computer. From the outset, Louie wanted two players to compete against one another in aerial combat. Les Watts, the other programmer on the project, wrote communications code that let players connect two computers for head-to-head play through the joystick ports. Since then every subsequent version of *Falcon* has contained a head-to-head option.

Nexa's next project was *Falcon* for the IBM and Macintosh. The next two years saw other programmers added to the project and a company merger with Colorado-based Spectrum HoloByte. The resulting corporation, Sphere, then moved to Alameda, California and released *Falcon* for both formats in November 1987.

But Louie was not satisfied. Work was begun on *Falcon AT,* a version of *Falcon* to take advantage of the capabilities of the EGA video card. At the same time in England, Rowan Software was developing versions of *Falcon* for the Atari ST and Amiga computers. All three versions of *Falcon* were completed in late 1988. But as with the original *Falcon*, Louie was still not satisfied. He wanted to create the ultimate in flight simulators. Since the release of the original *Falcon*, a number of other companies had released competing products. Louie saw these and knew he could do better.

Before work had begun on *Falcon 3.0,* Sphere worked with a military contractor, Perceptronics, to develop a low-cost military training simulator. Sphere developed the software, while Perceptronics created the hardware and coordinated the project. The result was the ASAT (Advanced Situational Awareness Trainer), completed in November 1989. In working on the ASAT project, the *Falcon* team gained a lot of valuable knowledge, especially concerning situational awareness.

The *Falcon 3.0* project began in earnest in January 1990 with just a few programmers. The team soon expanded as more and more detail was added to the simulation. Enhanced 3-D VGA graphics, a more realistic flight model and a detailed campaign structure are the primary ingredients of this new simulation, and the result is what you hold in your hands: the best flight simulator yet.

Falcon 3.0 and its predecessors

Those of you who have owned or upgraded from either the original *Falcon* or *Falcon AT* will notice a large number of differences between those two programs and *Falcon 3.0.* Below are a few of the major changes implemented in this version of the simulation:

- Squadron vs. single plane — In previous versions of *Falcon,* the player had access to only one plane. *Falcon 3.0* allows the player to control an entire squadron of 18 planes. Each computer pilot has his own strengths and weaknesses and can become fatigued after flying for long periods of time. The player must use these pilots to his advantage by sending pilots on missions which play to the pilot's individual strengths. Since each plane can have a wingman, dual plane tactics become a necessity, and skill and strategy are of the utmost importance.
- Campaign structure vs. individual missions — *Falcon 3.0* utilizes a complex series of interlocking missions completely generated by the computer. The player has a choice of three theaters of war, each with its own strategic points and campaign objectives. Within this theater, enemy forces act and react to what the player does with his fighter squadron. If your squadron destroys a bridge, the enemy will have to re-route its forces to avoid that bridge or send engineers and troops to rebuild it. This artificial intelligence keeps the player guessing and ensures that no two campaigns will ever turn out exactly the same.
- Realistic terrain vs. artificial terrain — This simulation uses realistic 3-D graphics to accurately map the terrain in Latin America, the Middle East and the Persian Gulf region. Actual cities, airbases, factories, jungles and lakes can also be found using your own map of the region or one of the maps provided in the box.
- Varying flight models — There are four different flight models to choose from, ranging from a simplified easy-to-fly version to the declassified one used on the ASAT flight trainer by Perceptronics, a military contractor.

- Variety of targets and enemies — Not only do you have the MiG-21 to contend with, there's also the MiG-23, MiG-25, MiG-27, MiG-29, the Su-27 and a number of others. You also have to worry about anti-aircraft guns, SAM sites, tanks, helicopters and infantry. In addition to the bridges, buildings and airfields, we have added power plants, trains, and radar installations to the list of targets.
- ACMI (Air Combat Maneuvering Instrumentation) — This part of the program allows pilots to review their air engagements from multiple perspectives and camera angles. ACMI gives pilots the opportunity to learn from their mistakes and improve on their combat tactics. Replays can be saved for further review and sharing with friends.

SECTION

XV

REFERENCE

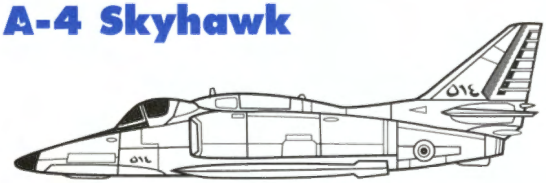
Technical specifications

The first part of this section contains detailed descriptions of the aircraft and weapons for both the allied and enemy forces in *Falcon 3.0*. Wherever information could not be found, the designation "N/A" for "Not Available" will appear next to the item in question. The different types of radar are described in **Section XII: Advanced Fighter Tactics**.

Allied aircraft

Following are the allied aircraft you may encounter in *Falcon 3.0:*

A-4 Skyhawk

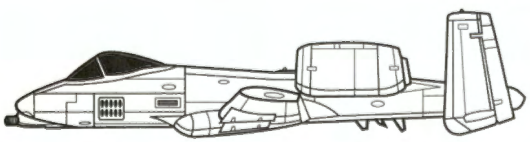


Owner: U.S. and allies
Type: Attack
Crew: 1
Min wt: 10,465 lb
Max wt: 24,500 lb
Length: 40 ft 4 in
Wingspan: 27 ft 6 in
Armament: Two Mk 12 20mm cannon (30mm available) and five hardpoints capable of holding up to 9,200 lbs. of widely variable stores.

Made by: McDonnell Douglas
Engine: 1 Pratt & Whitney J52 turbojet
Top speed: Mach 0.9
Max range: 800 nm
Combat radius: 330 nm
Max ceiling: 42,250 ft
Radar type: None

Although considered obsolete by present superpower standards, the A-4 Skyhawk remains a remarkable attack craft. Its maximum ordnance load almost equals its empty weight, a fantastic load for such a small vehicle. The Skyhawk began its career on aircraft carriers; its naval past serves it well on land, making it capable of short-runway takeoffs and landings. For many nations of the world, the durable, maneuverable "Scooter," as it is affectionately known, is the perfect strike platform. The A-4 serves in the air forces of the United States, Israel and Kuwait, among others.

A-10 Thunderbolt II



Owner: United States
Type: Close air support
Crew: 1
Min wt: 25,000 lb
Max wt: 50,000 lb
Length: 53 ft 4 in
Wingspan: 57 ft 6 in
Armament: General Electric GAU-8/A 30 mm seven-barrel cannon and eleven hardpoints capable of carrying up to 16,000 lbs. of stores.

Made by: Fairchild
Engine: 2 General Electric TF34 turbofans
Top speed: 450 mph
Max range: 2,240 nm
Combat radius: 500 nm
Max ceiling: 45,000 ft
Radar type: None

The A-10, affectionately called the "Warthog" by those close to it, is large, ugly and slow; it will level just about any ground threat in its path. The 30mm depleted-uranium shells from the nose-mounted GAU-8/A crack tanks open like eggs, and the eight tons of ordnance this beast can haul threaten everything else.

In air-to-air combat, however, its great size and low speed make it a relatively easy target — and no heat-seeking missile can miss those enormous TF34 engines. The Warthog's only saving grace in air-to-air combat is its tight turning radius and low flying altitudes. An A-10 can out-turn even an F-16, and even the bravest fighter pilots have no wish to drop to 50 feet for combat. Even its slow speed can help the Warthog: many jets overshoot or stall out at the 200–300 mph the A-10 fights at. Finally, every pilot must respect the power of the Warthog's 30mm cannon. The A-10 pilot's technique of a fast turnabout followed by a burst of GAU-8/A fire is called the "Warthog stomp" for good reason.

A wise interceptor pilot will simply attack from above, where the A-10 cannot defend itself. For this reason, Warthog drivers depend on good air cover to complete their missions. Keep the MiGs away, and the Warthog will do the rest.

The A-10 serves only in the United States Air Force.

AH-64 Apache

Owner: United States
Type: Helicopter
Crew: 2
Min wt: 10,800 lb
Max wt: 21,000 lb
Length: 49 ft 5 in
Rotor diam: 48 ft

Made by: McDonnell Douglas
Engine: 2 GE T700-GE-700 turboshafts
Top speed: 190 mph
Max range: 1,100 nm
Combat radius: 428 nm
Max ceiling: 21,000 ft
Radar type: None

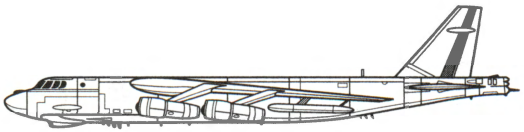
Armament: Hughes M230 30mm chain gun and four hardpoints capable of carrying four Hellfire anti-tank missiles, 19 unguided folding-fin aircraft rockets or one 230-gallon fuel tank each.

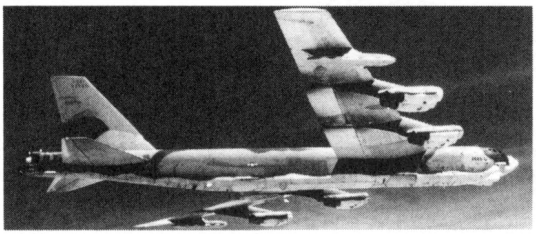
Hughes Aircraft, now a division of McDonnell Douglas, developed and produced the Apache as a durable anti-armor platform. Typical Apache techniques include nap-of-the-earth flying and pop-up attacks on armor with its accurate and deadly Hellfire missiles. Experiments with installing Sidewinder air-to-air missiles have been marginally successful, but no Apaches in service have been so fitted. More likely is an adaptation of the shoulder-fired Stinger missile.

While Apaches effectively have no air-to-air capability, they are vital in their ground support role. AH-64s started the air war in the Gulf War by destroying Iraqi forward early-warning radar sites, clearing an attack lane for the strike aircraft. The effectiveness of the Apache was summarized by a tank commander when he said that he saw no reason to engage tanks himself when the A-10 and AH-64 could do it faster and with fewer casualties.

The Apache is strictly an American military asset.

B-52 Stratofortress



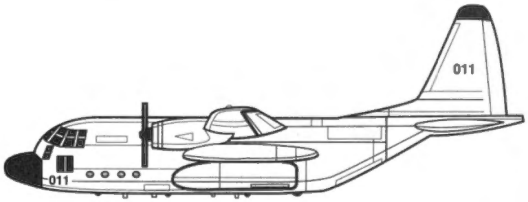


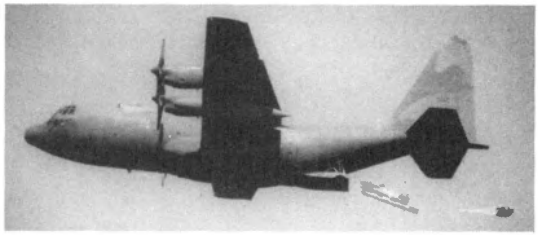
Owner: United States
Type: Bomber
Crew: 6
Min wt: 195,000 lb
Max wt: 488,000 lb
Length: 157 ft 7 in
Wingspan: 185 ft
Made by: Boeing
Engine: 8 Pratt & Whitney TF33 turbofans
Top speed: 595 mph
Max range: 8,800 nm
Combat radius: 3,000 nm
Max ceiling: 55,000 ft
Radar type: 4
Armament: One 20mm M61A1 Vulcan cannon in radar-controlled tail turret. Up to 50,000 lbs. of bombs of all types and short range attack and cruise missiles can be carried.

Carrying 25 tons of ordnance aloft with its 62 yards of wingspan, the monstrous B-52 is the original BUFF (big ugly fat f*cker). It was designed and entered service in the 1950s at the height of the Cold War with the sole purpose of carrying the then enormous nuclear devices into the heart of the Soviet Union. Since its entry into service in late 1957, the Stratofortress has, with minor modifications, proven itself to be far more than merely a strategic threat. The B-52 can fly in low and deliver a staggering payload of "smart" weapons (such as laser-guided bombs) with great accuracy, or it can strike from afar with a full load of 20 cruise missiles. The enormous range required to carry out its original strategic mission has given the Stratofortress such a wide area of effectiveness that the base on Diego Garcia in the Indian Ocean was a viable takeoff point for missions in the Persian Gulf war.

Though aging, the enormous Buff is still a "big stick" to carry against America's foes. Once the skies are cleared, a single wing of these behemoths can destroy scores of hardened ground targets in a matter of minutes.

C-130 Hercules





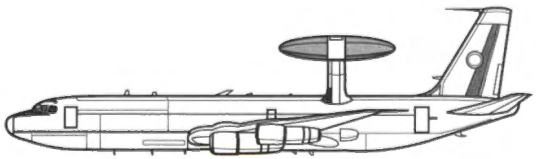
Owner: U.S. and allies
Type: Transport
Crew: 9 to 12
Min wt: 130,000 lb
Max wt: 175,000 lb
Length: 97 ft 9 in
Wingspan: 132 ft 7 in
Armament: None usually, but gunship versions such as the AC-130A Spectre carry a variety of guns including 7.62mm, 20mm, 40mm and 105mm weapons.

Made by: Lockheed
Engine: 4 Allison T56 turboprops
Top speed: 380 mph
Max range: 4,250 nm
Combat radius: 1,000 nm
Max ceiling: 33,000 ft
Radar type: None

The Lockheed C-130 Hercules first entered service in 1956 as a transport. Since then, it has been exported to dozens of countries and still serves as a primary transport aircraft for the United States. The basic design has proven so durable and flexible that over 20 different conversions exist, from the EC-130E airborne command and control center to the AC-130U gunship which packs a 105mm howitzer as part of its armament. Despite the tremendous air-to-ground firepower such conversions can carry, the C-130 is little more than a fat, slow target in air-to-air combat.

The vast majority of C-130s are still used in their original transport role. When so configured, the Hercules can carry up to 42,675 lbs. of cargo. The C-130 serves in the air forces of the United States, Canada, Colombia, Egypt, Israel, Italy, Jordan, Morocco, Pakistan, Saudi Arabia, Syria and many other countries worldwide.

E-3 Sentry



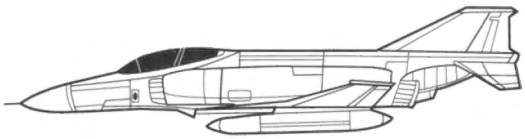
Owner: U.S. and allies
Type: AWACS
Crew: 20
Min wt: 170,277 lb
Max wt: 325,000 lb
Length: 152 ft 11 in
Wingspan: 145 ft 9 in
Armament: Can carry air-to-air missiles on underwing pylons.

Made by: Boeing
Engine: 4 Pratt & Whitney TF33 turbofans
Top speed: 530 mph
Max range: 3,740 nm
Combat radius: 1,000 nm
Max ceiling: 30,000 ft
Radar type: 6

The actual flight crew of an E-3 comprises just four airmen. The other 16 crewmembers are required to operate the sophisticated onboard electronics. This comprehensive suite includes electronic countermeasures (ECM), airborne early warning radar (AEW), electronic intelligence equipment (ELINT), and other communications and jamming facilities. The Sentry can detect, track and identify thousands of missiles or aircraft hundreds of miles away regardless of weather, terrain or altitude. The Sentry is also used to direct friendly aircraft in combat engagements, vectoring fighters and bombers towards or around hostile aircraft and ground forces as appropriate.

The E-3 greatly enhances the combat effectiveness of any force it flies with, but is itself no real combatant. Large and slow, the Sentry relies on its ECM and detection capabilities to evade trouble, using AAMs in only the most desperate self-defense situations. Versions of the E-3 serve with the air forces of the United States, France, England and Saudi Arabia.

F-4 Phantom II



Owner: U.S. and allies
Type: Class B fighter
Crew: 2
Min wt: 29,535 lb
Max wt: 61,795 lb
Length: 63 ft
Wingspan: 38 ft 7½ in
Armament: Some versions carry the M61A1 20mm cannon internally, while others must mount a gun pod on one of the eight external hardpoints. Up to 16,000 lbs. of ordnance and other stores can also be carried.

Made by: McDonnell Douglas
Engine: 2 General Electric J79 turbojets
Top speed: Mach 2.1
Max range: 1,640 nm
Combat radius: 684 nm
Max ceiling: 57,200 ft
Radar type: 2

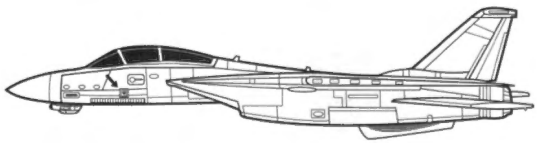
The Phantom has been flying in the air forces of the United States and its allies since 1960. For years, it was the Navy's front-line carrier-borne fighter, but it has now been replaced by the F-14 and F/A-18. The Marines still use it extensively as its range and high payload capacity suit their close air support needs well. With the arrival of the F-16, however, most Air Force Phantoms are being relegated to reserve wings.

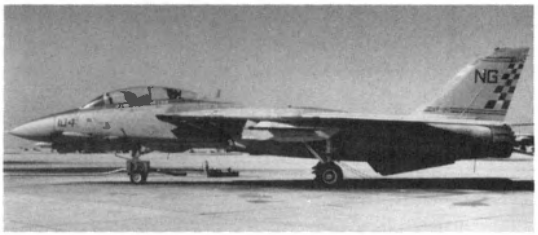
But the RF-4G version, known as the "Wild Weasel," shows no signs of fading away. It makes use of the Phantom's high-load airframe to carry extensive electronics for detection and suppression of enemy radar. The gun is replaced by the AN/APR-38 system, which provides excellent radar homing and warning through its 52 special aerials placed all over the aircraft. Two HARM anti-radar and two Maverick optical-homing missiles per Weasel give the RF-4G the firepower it needs to destroy detected radar sites.

In air-to-air combat, the F-4 relies on its electronics and missiles to get the job done; the Phantom (sometimes called the Rhino by its pilots) seems to have been built with the idea that, given enough power, a brick can fly.

No fewer than fifteen versions of the Phantom II exist, serving in the air forces of the United States, Britain, Egypt, Israel and several other nations around the world.

F-14 Tomcat





Owner: U.S. and allies
Type: Class A fighter
Crew: 2
Min wt: 39,920 lb
Max wt: 74,350 lb
Length: 62 ft 8 in
Wingspan: 38 ft 2½ in (min)
Armament: One 20mm M61A1 cannon and up to eight air-to-air missiles. Six hardpoints can carry up to 14,500 lbs. of other stores instead for air-to-surface missions.

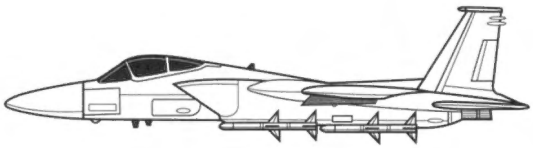
Made by: Grumman
Engine: 2 Pratt & Whitney TF30 turbofans
Top speed: Mach 2.34
Max range: 1,750 nm
Combat radius: 500 nm
Max ceiling: 56,000 ft
Radar type: 1

A dedicated air-to-air fighter, the Tomcat is extremely fast and packs the best air-to-air weaponry and electronics on any carrier deck. The Hughes AWG-9 radar system can track 24 targets and engage 6 simultaneously; the AIM-54 Phoenix radar-guided missile can lock and home from over 75 nautical miles away. Close in, the F-14 is fairly agile, but its true strength lies in the immense range at which it can engage. Its variable-sweep wing allows wide variation in speeds. The flight test officer of the F-14 joint evaluation team in 1982 wrote, "There are aircraft that fly faster or slower, but not both." The unswept wingspan is over 64 ft wide.

Extra power was added by refitting the Tomcat with GE TF110 afterburning turbofans, and the newer production versions all carry this engine. Since 1990 all production versions also carry the new Hughes AN/APG-71 radar package, which includes better ECM and jamming capabilities.

The F-14 was built for air-to-air combat, and it does that very well; most opponents find themselves hunted by missiles long before they enter lock-on range. Only Iran and the United States fly the Tomcat, and all of Iran's are older versions and poorly serviced.

F-15 Eagle



Owner: U.S. and allies
Type: Class A fighter
Crew: 1
Min wt: 28,000 lb
Max wt: 56,000 lb
Length: 63 ft 9 in
Wingspan: 42 ft 9¾ in
Armament: 20mm M61A1 six-barrel gun plus five hardpoints capable of carrying an additional 16,000 lbs. of stores. A variety of advanced air-to-air missiles is standard.

Made by: McDonnell Douglas
Engine: 2 Pratt & Whitney F100 turbofans
Top speed: Mach 2.5
Max range: 2,500 nm
Combat radius: 650 nm
Max ceiling: 60,000 ft
Radar type: 1

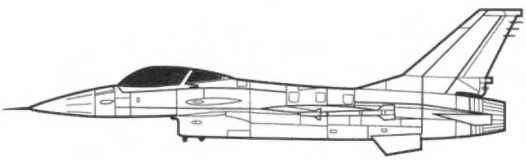
The Eagle is first and foremost an air-superiority fighter. Its combination of high power, high ceiling, high speed and high radar profile confine it to an air-to-air role — which is fine with its pilots. Carrying eight air-to-air missiles and an advanced AN/APG-70 radar package, the F-15 is a formidable stand-off opponent, while its tremendous thrust and good maneuverability make it a dangerous dogfight adversary. Finally, its simple design makes repair and service remarkably easy.

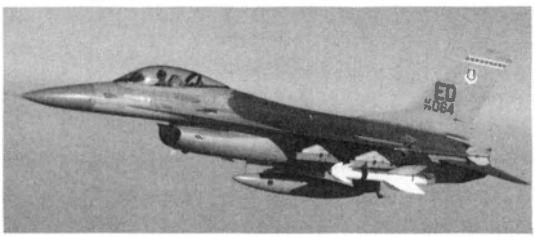
On the modern battlefield, however, the Eagle shares a problem with other fighters of its period (such as the F-14 and F-4): high radar profile. The range and accuracy of recent SAM systems can seriously threaten the F-15 if it is lacking support from "Wild Weasel" radar-suppression craft or heavy jamming. Thus, the Eagle is safest in the air-to-air duels for which it was built.

High payload capacity and advanced electronics, however, make the F-15 a logical choice for a strike platform. The F-15E, known as the "Strike Eagle," is designed with the air-to-ground job firmly in mind and is quite successful at it.

Each plane in the modern battlefield has its job, and the Eagle's is air superiority. A wing of F-15s overhead means peace of mind for allied pilots and headaches for the enemy. The Eagle serves in the air forces of the United States, Israel and Saudi Arabia.

F-16 Fighting Falcon





Owner: U.S. and allies
Type: Class A fighter
Crew: 1
Min wt: 15,600 lb
Max wt: 35,400 lb
Length: 47 ft 7¾ in
Wingspan: 31 ft
Armament: General Electric M61A1 20mm six-barrel cannon and two wingtip Sidewinder or Sparrow air-to-air missiles; nine additional hardpoints capable of carrying up to 15,200 lbs. of other stores.

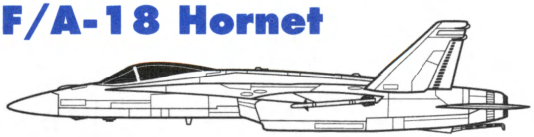
Made by: General Dynamics
Engine: 1 Pratt & Whitney F100 turbofan
Top speed: Mach 2
Max range: 2,415 nm
Combat radius: 500 nm
Max ceiling: 60,000 ft
Radar type: 2

The General Dynamics Fighting Falcon is considered by many to be the most agile modern fighter. Less than half the weight of the F-14, it carries a larger payload; less than one-fourth the cost of the F-15, it has superior maneuverability. In addition, advanced avionics and electronics give it excellent air-to-ground precision. The F-16 can deliver a crippling ground strike and still maintain a credible air threat.

The Falcon's versatility is still being explored. The variety of stores it can carry and the wide range of missions it can undertake with great effectiveness are staggering. The F-16 has proven itself capable of air superiority, "Wild Weasel," strike, and reconnaissance missions without any structural modifications. The simple addition of the proper external pods or ordnance is all that is required. There is even an experimental GPU-5 external gun pod which contains a 30mm cannon firing the same shells as the A-10's famous tank-busting Avenger.

The Fighting Falcon forms the backbone of the USAF with over 1,500 in service. The F-16 also serves in the air forces of Egypt, Israel and Pakistan, as well as in several European air forces.

F/A-18 Hornet



Owner: U.S. and allies
Type: Class A fighter
Crew: 1
Min wt: 21,830 lb
Max wt: 51,900 lb
Length: 56 ft
Wingspan: 37 ft 6 in
Armament: M61A1 20mm Vulcan cannon and nine hardpoints capable of carrying up to 17,000 lbs. of ordnance.

Made by: McDonnell Douglas
Engine: 2 General Electric F404 turbofans
Top speed: Mach 1.8
Max range: 2,000 nm
Combat radius: 550 nm
Max ceiling: 50,000 ft
Radar type: 1

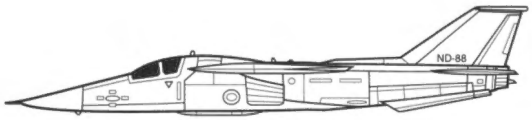
As the modern attack plane on today's carriers, the Hornet fills a vital position in the United States' carrier-borne air strategy. The F-14 was designed solely for air-to-air combat; the F/A-18 was designed for air-to-surface missions as well.

The Hornet was designed around the same time as the F-16 and was in fact developed from the Northrop YF-17, a failed F-16 competitor. As a result, it shares some of the characteristics of the Falcon: it is light, cheap and quite agile. These qualities, coupled with its immense ordnance load, make it the strike fighter of choice for both the Navy and the Marines.

All production Hornets since 1989 have all-weather and night attack capability. Laser designator pods and the Hughes AN/APG-65 radar package give excellent accuracy in the air and on the ground. Its agility and its ability to carry up to six AMRAAM missiles make the F/A-18 a serious air threat; however, as it serves alongside the dedicated air-to-air Tomcat, the Hornet is almost always used in the attack role.

The F/A-18 serves in the air forces of the United States and Canada; Kuwait was scheduled to receive Hornets beginning in 1994 before the Gulf War broke out.

F-111 Aardvark



Owner: United States
Type: Bomber
Crew: 2
Min wt: 47,481 lb
Max wt: 100,000 lb
Length: 73 ft 6 in
Wingspan: 31 ft 11 in
Armament: Weapons bay can hold two nuclear bombs or one M61A1 20mm cannon and one nuclear bomb; four wing pylons can carry up to 31,500 lbs. of ordnance.

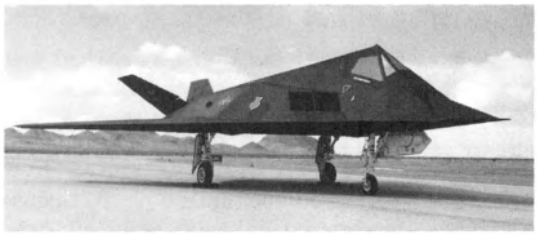
Made by: General Dynamics
Engine: 2 Pratt & Whitney TF30 turbofans
Top speed: Mach 2.5
Max range: 2,934 nm
Combat radius: 440 nm
Max ceiling: 57,100 ft
Radar type: 2

Designed as a supersonic long-range fighter-bomber, the Aardvark performs its duties exceptionally well in both all-weather and nighttime missions. In the Gulf War, the F-111 had the highest effectiveness rating of any aircraft killing over 1,500 tanks and maintaining an 85% mission-capable rate while losing no planes throughout the conflict. The deadly accuracy of the Aardvark's laser-guided and other "smart" weaponry was proven in both the raid on Libya and in the Gulf War.

The F-111's long range was a proven asset when, in the Libyan raid, aircraft flying from British bases were forced to go around French airspace to reach Libya.

The F-111 was the first variable-sweep aircraft when it was introduced in 1968; the maximum unswept wingspan is 63 feet. The F-111 flies in the United States Air Force and in the Royal Australian Air Force.

F-117A Stealth Fighter



Owner: United States
Type: Bomber
Crew: 1
Min wt: N/A
Max wt: 52,500 lb
Length: 65 ft 11 in
Wingspan: 43 ft 7 in

Made by: Lockheed
Engine: 2 GE F404 turbofans
Top speed: Mach 0.8
Max range: N/A
Combat radius: 400 nm
Max ceiling: N/A
Radar type: Stealth

Armament: Two internal stations for 2,000-lb laser-guided bombs or Maverick or HARM missiles.

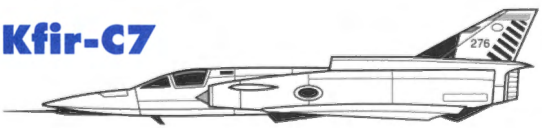
Developed under a veil of secrecy, the F-117A was designed to be as undetectable as possible by radar, infrared, sound and vision. Its composition, shape, engine design and color make it virtually invisible to opposing air defenses on its night strike missions.

The Stealth Fighter was first used in battle in Operation Desert Storm in 1991. None were even damaged by enemy fire, and the Air Force claimed an 80% success rate against all the F-117A's targets.

From the beginning, the Stealth Fighter was meant to take advantage of the latest "smart" weapons, and has the electronics to do so. The IR navigation system and swiveling laser designator allow near-perfect delivery of ordnance under widely varying conditions.

In air-to-air combat, the F-117A has a simple but effective strategy: disappear. If by chance an opposing pilot did happen upon a Stealth Fighter, it is possible that the foe's missiles would have difficulty locking on the elusive plane. However, the F-117A's low speed and lack of air-to-air weaponry make it a $50 million clay pigeon for any true fighter craft.

Kfir-C7



Owner: Israel
Type: Class B fighter
Crew: 1
Min wt: 16,060 lb
Max wt: 36,375 lb
Length: 53 ft 7¾ in
Wingspan: 26 ft 11½ in

Made by: Israel Aircraft Industries (IAI)
Engine: 1 General Electric J79 turbojet
Top speed: Mach 2.3
Max range: 1,600 nm
Combat radius: 700 nm
Max ceiling: 58,000 ft
Radar type: 4

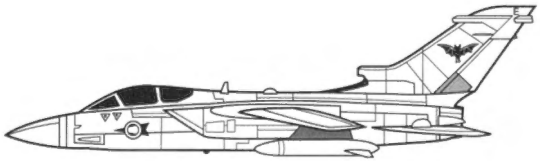
Armament: Two DEFA 552 30mm cannon; either two infrared homing missiles or a mix of bombs and other ground ordnance up to 13,400 lbs. can be carried under the wings and fuselage on nine weapons pylons.

The Kfir was developed from the Nesher, which was in turn developed from Dassault's Mirage III and 5, as an emergency measure when France placed an embargo on Mirage deliveries to Israel. The Kfir carries improved Israeli avionics, has more weapons stations, carries a larger payload, has a longer range and uses a more powerful General Electric engine, but is otherwise similar to the Mirage.

In keeping with Israeli doctrine, no piece of equipment has just one job, and the Kfir has seen action as interceptor, bomber and strike fighter. It performs all jobs quite well, but is an older design and is out of its league when competing with modern specialized aircraft

The Kfir-C7 serves in the air forces of Israel and Colombia.

Tornado



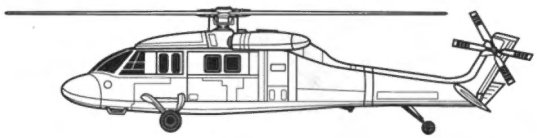
Owner: U.K., Germany, Italy
Type: Strike
Crew: 2
Min wt: 31,065 lb
Max wt: 58,400 lb
Length: 54 ft 9½ in
Wingspan: 28 ft 2½ in (min)
Made by: Panavia
Engine: 2 Turbo-Union RB199 turbofans
Top speed: Mach 2.2
Max range: 2,050 nm
Combat radius: 750 nm
Max ceiling: 70,000 ft
Radar type: 1
Armament: Two 27mm IWKA-Mauser cannon and seven hardpoints (including four swiveling wing pylons) which can carry up to 19,800 lbs. of other stores, including air-to-air and air-to-surface missiles.

At sea level, there is no faster strike aircraft than the Panavia Tornado. Hugging the earth with terrain-following and ground-mapping radar at supersonic speeds, the Tornado is an extremely difficult target. Meanwhile, it can deliver nearly 10 tons of the latest "smart" and submunition weaponry with pinpoint accuracy in any weather, day or night.

The Tornado can hold its own in the air as well. Its maneuverability is good, though not as good as some dedicated air-to-air fighters, and it can carry the all-aspect Sidewinder AAM. The variable-sweep wing gives good performance at all airspeeds (unswept wingspan is 45 ft 7¼ in). Some Italian Tornados are even used specifically for air superiority missions. But the Tornado's true mission, and the one it excels at, is A-G attack.

The all-weather, all-mission Tornado has earned a reputation for delivering when no other plane can. The Tornado serves in the air forces of Britain, Italy and Germany.

UH-60 Black Hawk



Owner: U.S. and allies
Type: Helicopter
Crew: 3 plus 14 passengers
Min wt: N/A
Max wt: 16,500 lb
Length: 50 ft ¾ in
Rotor diam: 53 ft 8 in
Made by: Sikorsky
Engine: 2 General Electric T700 turboshafts
Top speed: 184 mph
Max range: 325 nm
Combat radius: 120 nm
Max ceiling: 19,000 ft
Radar type: None
Armament: Can carry two side-firing M60 machine guns; optional external stores support system (ESSS) stub wings have two pylons each for rocket pods, Hellfire missiles, etc.

The Black Hawk has been the United States Army's standard transport helicopter since it entered service in 1979. Able to fit into the cargo hold of a Lockheed C-5 Galaxy transport plane, the UH-60 is an integral part of the United States' rapid deployment forces (RDF). Assault versions employing the ESSS are used in combat roles by Israel and the U.S.; the Israeli version is called the Desert Hawk. Westland produces a version for the United Kingdom under the designation WS70.

Avionics includes Doppler radar, IR countermeasures and a radar warning receiver; armed versions can carry as many as 32 Hellfire anti-tank missiles, 16 ready to fire. Armed versions are easily identified by the stub wings on which the weapons are mounted.

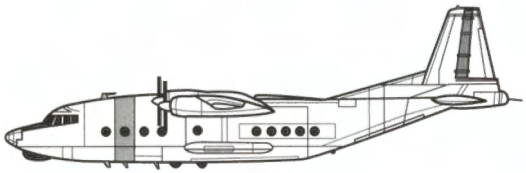
Transport Black Hawks are used extensively by crack units such as the 101st Air Assault Division for air mobility and evacuation of casualties and wounded.

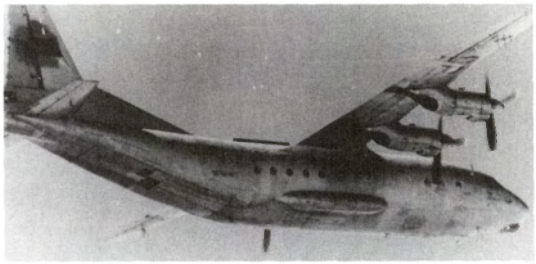
As with most helicopters, the Black Hawk has little to no air-to-air combat ability; some versions with Stinger missiles are planned but are not in operation. Hawk drivers count on allied fighters for air defense; without such aid, they must fly low to evade enemy aircraft and thus risk ground fire.

Enemy aircraft

Following are the enemy aircraft you may encounter in *Falcon 3.0:*

An-12 "Cub"





Owner: Soviet Union and allies
Type: Transport
Crew: 10 to 15
Min wt: 90,000 lb
Max wt: 134,480 lb
Length: 108 ft 7¼ in
Wingspan: 124 ft 8 in
Armament: Two NR-23 23mm guns in tail turret.

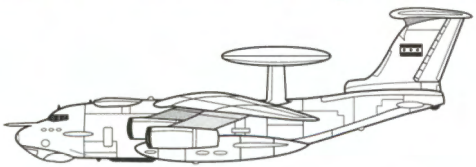
Made by: Antonov
Engine: 4 Ivchenko AI-20K turboprops
Top speed: 480 mph
Max range: 3,080 nm
Combat radius: 1,200 nm
Max ceiling: 33,500 ft
Radar type: None

This venerable aircraft has long been the transport workhorse for nations around the world. Entering Soviet service in 1959, the An-12 (NATO designation "Cub") is the counterpart to Lockheed's C-130 Hercules.

More recently, the Cub found new life in the air over the modern battlefield as a dependable, durable electronic intelligence (ELINT) platform. Filled with the latest Soviet technology, the ELINT version seems restricted to Soviet use.

When configured for transport, the Cub can carry up to 22 tons. The An-12 serves in the air forces of the Soviet Union, Iraq, Jordan and Syria, as well as in the air forces of many Soviet allies and former allies.

IL-76 "Mainstay" and Adnan-1



Owner: Soviet Union and Iraq
Type: AWACS
Crew: 15 to 20
Min wt: N/A
Max wt: 374,800 lb
Length: 152 ft 10 ½ in
Wingspan: 165 ft 8 in
Armament: None.

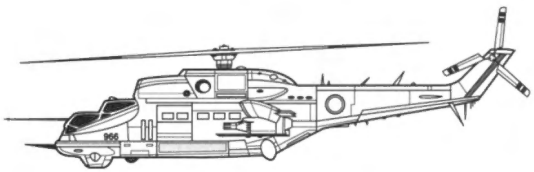
Made by: Ilyushin
Engine: 4 Soloviev D-30KP turbofans
Top speed: 530 mph
Max range: 3,620 nm
Combat radius: N/A
Max ceiling: 50,000 ft
Radar type: 6

The IL-76 transport was the platform chosen for the next generation of Soviet airborne warning and control systems (AWACS) craft. The modified plane received the NATO designation "Mainstay." Capable of detecting and tracking hostile aircraft at all altitudes and over any terrain with the latest Soviet radar technology, the Mainstay handily supersedes its predecessor, the Tu-126 "Moss."

Like its American counterpart, the E-3 Sentry, the IL-76 AWACS greatly enhances the effectiveness of airborne operations, but is itself no combatant. It is large and clumsy, depending on its ECM and jamming gear for last-ditch self-defense. As it controls all nearby aircraft however, the Mainstay is far more likely to vector MiGs or Su-27s to intercept before an attacker could be dangerous.

A similar aircraft was developed in Iraq, also in the AWACS/ELINT role and also using the IL-76 transport design. Called the Adnan-1, its electronics are believed inferior to the Mainstay, though similar in design. The Adnan-1 flies only for Iraq, and the Mainstay is strictly a Soviet aircraft.

Mi-24 "Hind"



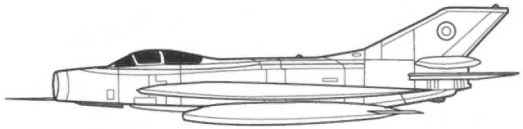
Owner: Soviet Union and allies
Type: Helicopter
Crew: 2 plus 8 passengers
Min wt: 18,250 lb
Max wt: 24,250 lb
Length: 60 ft 8½ in
Rotor diam: 55 ft 9 in
Made by: Mil
Engine: 2 Isotov TV2-117A turboshafts
Top speed: 210 mph
Max range: 600 nm
Combat radius: 246 nm
Max ceiling: 14,750 ft
Radar type: None
Armament: Four-barreled 12.7mm machine gun or 23mm cannon in nose, Swatter anti-tank missiles under wingtips, four underwing hardpoints for rocket pods, bombs or other stores.

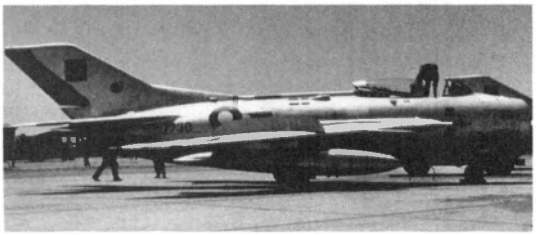
The Soviet Union's heavy assault helicopter is the Mi-24 (NATO designation "Hind"). It bears four "Swatter" anti-tank missiles plus four underwing pylons loaded with rocket launchers or other deadly stores and is still able to ferry up to eight combat troops into battle. A four-barrel 12.7mm gun in a swivel turret slaved to the gunner's targeting system provides instant firepower when necessary.

While it packs a great deal of ordnance, the Mi-24 is an easy mark for surface-to-air missiles. The Hind was the terror of the Afghan rebels until the arrival of the Blowpipe and Stinger man-portable SAMs. As with other helicopters, it is little more than a target in the eyes of a modern fighter pilot. The Hind's only real defense is the low altitude at which it operates; missiles may lose their lock in the ground clutter and prudent fighter pilots rarely risk flying below 100 feet.

The Mi-24 serves in the air forces of the Soviet Union, Cuba, Iraq, Nicaragua and Syria, among others.

MiG-19 "Farmer"





Owner: Soviet Union and allies
Type: Class B fighter
Crew: 1
Min wt: N/A
Max wt: 19,180 lb
Length: 41 ft 1¾ in
Wingspan: 29 ft 6¼ in
Armament: Three 30mm cannon and two underwing hardpoints for air-to-air missiles, bombs or other stores.

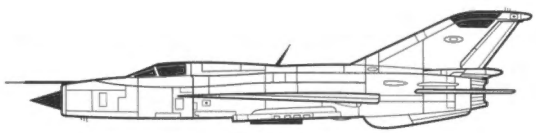
Made by: Mikoyan
Engine: 2 Klimov RD-9B turbojets
Top speed: Mach 1.45
Max range: N/A
Combat radius: 370 nm
Max ceiling: 58,730 ft
Radar type: None

A 1950s-vintage aircraft, the MiG-19 (NATO designation "Farmer") is a dependable aircraft with a tough structure and heavy guns. Unfortunately, the likelihood of its getting into sufficient range to use those guns is subject to question in a modern air battle. While the Farmer is fairly maneuverable at low airspeeds, it is comparatively slow and its avionics are aging or nonexistent. Its successes against the F-4 over Vietnam were largely due to the rules of engagement preventing the Phantoms from using their longer-ranged missiles until visual contact had been made.

Though the MiG-19 is aging, its weaponry is not. "Alkali" radar-homing AAMS and "Atoll" heat-seeking AAMs are very credible air dangers. Worse, if it can get in close enough, the Farmer's three 30mm cannon can tear lighter, more modern aircraft to shreds.

The MiG-19, along with the Shenyang F-6 and J-6 (its Chinese copies), serves in the air forces of the Soviet Union, Cuba, Egypt, Iraq, Jordan and Pakistan. Thanks to China, dozens of other nations also fly this same design.

MiG-21 "Fishbed"



Owner: Soviet Union and allies
Type: Class B fighter
Crew: 1
Min wt: 13,500 lb
Max wt: 22,000 lb
Length: 51 ft 4 in
Wingspan: 23 ft 6 in
Armament: One internal twin-barrel 23mm GSh-23 gun; four underwing hardpoints for up to 3,300 lbs. of widely varying stores.

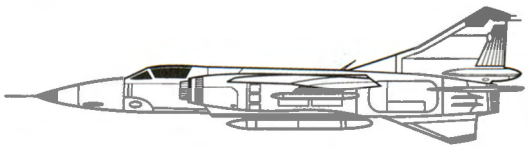
Made by: Mikoyan
Engine: 1 Tumansky R-11 turbojet
Top speed: Mach 2.1
Max range: 1,500 nm
Combat radius: 600 nm
Max ceiling: 59,000 ft
Radar type: 3

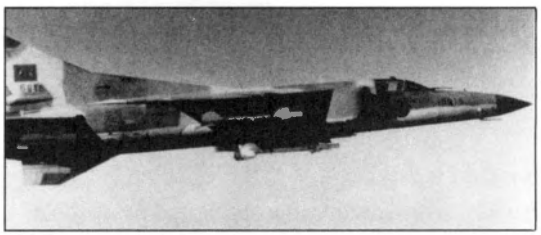
Soviet aircraft design philosophy calls for aircraft that can, with few modifications, make immediate use of new breakthroughs in weapons and electronics. The MiG-21 exemplifies this philosophy. Entering service in 1957, it has been continually upgraded and was still considered a threat in the 1970s with a new radar and engine.

Still quite fast and maneuverable, and refitted with the latest armament, the Fishbed remains a respectable air threat. It should be noted, however, that its maneuverability is in a completely different class than modern designs such as the F-14, F-15, F-16, F/A-18, MiG-29 and Su-27. At low speeds, the Fishbed can almost hold its own; above Mach 0.9 it is badly outclassed.

Thanks to its continued effectiveness and long service career, the MiG-21 has been built in greater numbers than any other fighter. Versions of the MiG-21 serve in the air forces of the Soviet Union, Bangladesh, Cuba, Egypt, Iraq and Syria, as well as numerous former and present Soviet allies.

MiG-23 "Flogger-B"





Owner: Soviet Union and allies
Type: Class B fighter
Crew: 1
Min wt: 25,000 lb
Max wt: 42,500 lb
Length: 55 ft 6 in
Wingspan: 27 ft 2 in (minimum)
Armament: One 23mm GSh-23 twin-barrel gun in belly pack. Also has five hardpoints for carrying up to 8,800 lbs. of external stores.

Made by: Mikoyan
Engine: 1 Tumansky R-29 turbofan
Top speed: Mach 2.35
Max range: 1,400 nm
Combat radius: 520 nm
Max ceiling: 60,000 ft
Radar type: 2

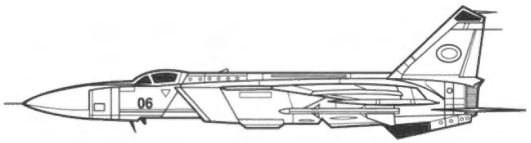
"Flogger" is the NATO designation given to both the MiG-23 and its strike-dedicated cousin, the MiG-27. Both planes are built around the same basic swing-wing design. The MiG-23 entered service in the early 1970s in astonishing numbers due to its ease of production and low cost.

Unfortunately for NATO, this low cost did not mean low performance. The MiG-23 can carry six to eight AAMs to an eleven-mile service ceiling at speeds over Mach 2; the radar and missile system has a greater detection and engagement range than the F-16 (except when using the F-16's AMRAAM).

Its maneuverability is on a par with the F-4 and other planes of its time, but against modern fighter craft the Flogger's best tactic is to keep a distance and use its missiles. The variable-sweep wing design, however, does allow the Flogger to maximize its limited performance at all speeds. Maximum unswept wingspan is 46 ft 9 in.

Versions of the MiG-23, including the MiG-23BN fighter-bomber conversion, serve in the air forces of the Soviet Union, Cuba, Iraq, Syria, and past and present Soviet allies.

MiG-25 "Foxbat"



Owner: Soviet Union and allies
Type: Class B fighter
Crew: 1
Min wt: 44,000 lb
Max wt: 82,500 lb
Length: 73 ft 2 in
Wingspan: 46 ft
Armament: Four air-to-air missiles.

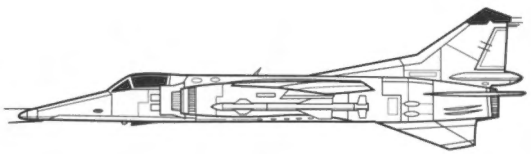
Made by: Mikoyan
Engine: 2 Tumansky R-31 turbojets
Top speed: Mach 2.82
Max range: 1,036 nm
Combat radius: 800 nm
Max ceiling: 78,000 ft
Radar type: 2

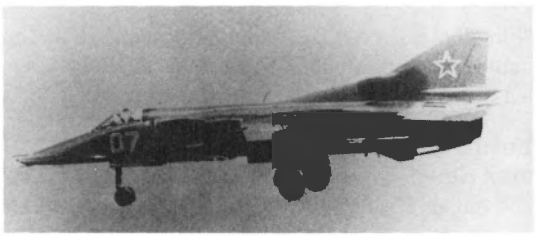
The Foxbat is a pure interceptor. Designed solely for speed and climb, it has impressive top speed, acceleration, rate-of-climb and maximum ceiling statistics. But the MiG-25's maneuverability is less than impressive.

Most of the damage done by the Foxbat was before the first production model was ever flown. Western intelligence sources vastly overrated the MiG-25's capabilities during its development, and as a result spent enormous amounts of money developing the F-15 to counter a mythical Soviet superplane.

After the myth was dispelled by a defecting Foxbat pilot and his plane in 1976, the Soviet Union began exporting the MiG-25 as an interceptor and high-speed, high-altitude reconnaissance platform. The Foxbat performs both roles well. Nations employing the Foxbat are likely to make use of these capabilities, so the MiG-25 will rarely see air-to-air combat except as an interceptor. The MiG-25 serves in the air forces of the Soviet Union, Iraq, Syria and close Soviet allies.

MiG-27 "Flogger-D" and "Flogger-J"





Owner: Soviet Union and allies
Type: Class A fighter
Crew: 1
Min wt: 25,000 lb
Max wt: 44,500 lb
Length: 58 ft 1 in
Wingspan: 27 ft 2 in (minimum)
Armament: One six-barrel 23mm gun in belly pack. Also has five hardpoints for carrying external stores weighing up to 10,000 lbs.

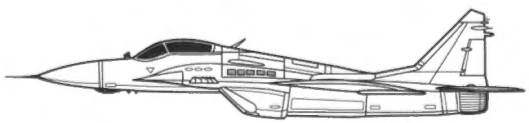
Made by: Mikoyan
Engine: 1 Tumansky R-29 turbofan
Top speed: Mach 1.75
Max range: 1,350 nm
Combat radius: 210 nm
Max ceiling: 55,000 ft
Radar type: 2

The MiG-23 was an effective, easy-to-build design, so when the Soviet Union began looking for a strike fighter in the 1970s, it seemed logical to simply modify the already-successful Flogger. The two aircraft are essentially the same; NATO saw so few differences that the designation "Flogger" was applied to both.

The MiG-27 is slightly longer, with different electronics specialized for the ground-attack role and a higher external stores load, but it lacks the nose radar of the MiG-23. The unswept wingspan is the same as the MiG-23 (46 ft 9 in). It is slower than the MiG-23, and shares the same poor turn rate. It also enjoys the same long range as the MiG-23, which is a definite asset in a strike fighter. Finally, the ease of production of the Floggers means more of them in the sky; purchasers of these craft can easily build up large air forces. The MiG-27 serves in the air forces of the Soviet Union, Iraq and most Eastern Bloc nations.

The MiG-27 can carry and use the latest generation of Soviet-built guided bombs, missiles and other "smart" weapons. It also normally carries two Atoll heat-seeking AAMs for self-defense. Normally encountered only on low-level attack missions, the MiG-27 is nearly as dangerous an air-to-air fighter as the MiG-23 and should be treated with respect.

MiG-29 "Fulcrum"



Owner: Soviet Union and allies
Type: Class A fighter
Crew: 1
Min wt: 18,000 lb
Max wt: 36,000 lb
Length: 50 ft 10¼ in
Wingspan: 39 ft 6 in
Armament: One 30mm cannon plus six to eight air-to-air missiles or extra fuel tanks on six hardpoints.

Made by: Mikoyan
Engine: 2 Tumansky R-33D turbofans
Top speed: Mach 2.3
Max range: 1,400 nm
Combat radius: 620 nm
Max ceiling: 60,000 ft
Radar type: 1

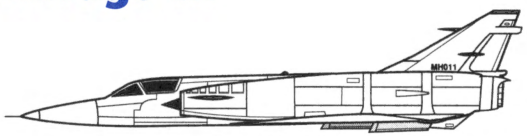
The lessons learned in the Bekaa Valley engagement between Israel and Syria were not lost on the Soviet Union. The earlier philosophy of sacrificing quality for quantity was largely abandoned when it was shown that the expensive, high-performance F-15s could wipe out scores of cheaper MiGs with minimal losses.

The Fulcrum is one of the latest generation of Soviet-built fighters, and takes advantage of some of the same advances in avionics and aerodynamic design found in the F-16 and F/A-18. Departing somewhat from the standard Soviet doctrine of simplicity in design and operation, the MiG-29 uses avionics only slightly less complex than its modern Western opponents and uses some non-standard materials in its construction.

Sporting leading edge root extensions (LERX) such as those seen on the F-16, the Fulcrum is very maneuverable, matching or outperforming the best of its opponents in most situations. Its look-down, shoot-down radar can detect and lock on targets beyond visual range and guide the latest air-to-air missiles onto the targets. A truly multi-role fighter, the MiG-29 can also carry a healthy ordnance load for ground attack.

Wherever encountered, the Fulcrum should be treated as a primary air threat. The MiG-29 serves in the air forces of the Soviet Union, Iraq, Cuba, Syria and close Soviet allies.

Mirage III



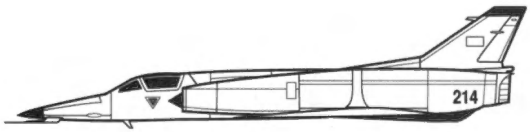
Owner: France and many others
Type: Class B fighter
Crew: 1
Min wt: 22,050 lb
Max wt: 32,400 lb
Length: 49 ft 3½ in
Wingspan: 26 ft 11½ in
Made by: Dassault-Breguet
Engine: 1 SNECMA Atar 9C turbojet
Top speed: Mach 2.2
Max range: 1,300 nm
Combat radius: 650 nm
Max ceiling: 59,000 ft
Radar type: 4
Armament: Two 30mm DEFA cannon and three air-to-air missiles. The missiles are replaced with up to 8,800 lbs. of bombs and other stores for attack missions.

France's Dassault-Breguet has a reputation for building dependable, multi-role fighter aircraft. The Mirage III established this reputation early on, and for nations with a limited budget, the Mirage III is still an attractive option. All Mirages can land from an interceptor mission and take off on a strike mission within hours. Upgrade packages from Dassault-Breguet keep even the 1960s-era Mirage III in front-line service.

While the Mirage III can perform both air-to-air and air-to-ground duties equally well, it cannot compete against more modern aircraft in either role individually. The F-16 handily outflies it, and the MiG-27 delivers more ordnance with greater accuracy.

The Mirage III serves in the air forces of France, Lebanon and Pakistan, as well as many others thanks to Dassault's aggressive worldwide marketing and the plane's remarkable affordability.

Mirage 5



Owner: France and many others
Type: Class B fighter
Crew: 1
Min wt: 21,385 lb
Max wt: 30,203 lb
Length: 51 ft ½ in
Wingspan: 26 ft 11½ in
Armament: Two 30mm DEFA cannon, plus five hardpoints for carrying up to 8,800 lbs. of a wide variety of external stores, including bombs, rocket pods and air-to-air missiles.

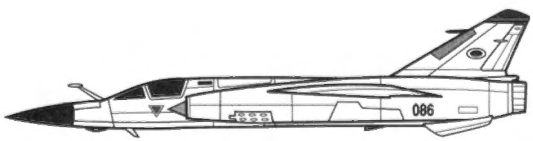
Made by: Dassault-Breguet
Engine: 1 SNECMA Atar 9C turbojet
Top speed: Mach 2.2
Max range: 1,400 nm
Combat radius: 675 nm
Max ceiling: 55,800 ft
Radar type: 4

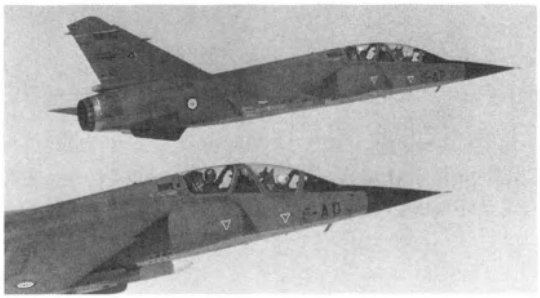
The Mirage III was a true multi-role fighter, but there was a need to improve the range and ground-attack abilities of the type. Dassault-Breguet came up with the Mirage 5 to handle those deficiencies; improved electronics and larger fuel capacity were incorporated into the new design.

Originally designed for daylight operations, the Mirage 5 can be given an all-weather/night flying upgrade at the expense of some fuel capacity or weapons payload. The air-to-air capabilities of the Mirage III were slightly improved in the Mirage 5, but it still cannot stand up to modern aircraft such as the Su-27 or F-16.

The Mirage 5 serves in the air forces of France, Colombia, Egypt and Pakistan. Like other Mirage designs, this plane has been widely sold to many nations.

Mirage F1





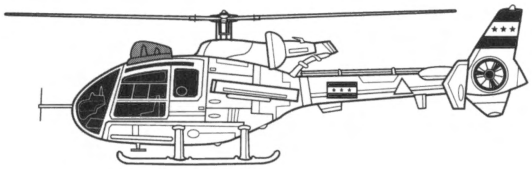
Owner: France and many others
Type: Class A fighter
Crew: 1
Min wt: 24,030 lb
Max wt: 35,715 lb
Length: 49 ft 2½ in
Wingspan: 27 ft 6¾ in
Made by: Dassault-Breguet
Engine: 1 SNECMA Atar 9K-50 turbojet
Top speed: Mach 2.2
Max range: 1,000 nm
Combat radius: 750 nm
Max ceiling: 65,600 ft
Radar type: 4
Armament: Two 30mm DEFA 553 cannon and five hardpoints for weapons stores up to 13,900 lbs.

The Mirage III/5 series could perform just about any mission effectively except one: interception. The Mirage F1, with its faster climb rate, greater acceleration and higher ceiling, fills that role well. In addition it retains the classic Mirage ability to fight air-to-air and air-to-ground. No fewer than eight versions exist; some are lower-cost versions for export to poorer nations, while others are specialized interceptors, attack planes or reconnaissance craft. The most sophisticated export version, the F1-E, has excellent avionics and exceeds the Mirage III/5 series in attack and air superiority capabilities. The Mirage F1 also carries out reconnaissance missions exceptionally well.

While it exceeds its 1970s-era contemporaries in several respects, the Mirage F1 is nevertheless at a disadvantage against a modern fighter, though much less so than its cousins in the Mirage series.

Due to the wide range of options offered by Dassault-Breguet, versions of the Mirage F1 serve with the air forces of many nations, including Kuwait, Iraq, Jordan and Morocco.

SA 342 Gazelle



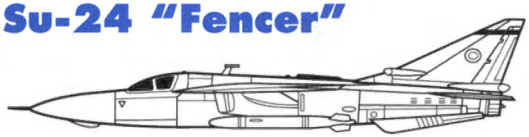
Owner: France and many others
Type: Helicopter
Crew: 2 plus 3 passengers
Min wt: 2,198 lb
Max wt: 4,410 lb
Length: 39 ft 5½ in
Rotor diam: 34 ft 5½ in
Made by: Aérospatiale/Westland
Engine: 1 Turboméca Astazou XIVM turboshaft
Top speed: 174 mph
Max range: 360 nm
Combat radius: 120 nm
Max ceiling: 13,450 ft
Radar type: None
Armament: Either two rocket pods, four or six HOT anti-tank missiles, two or four AS.11 or AS.12 missiles or two forward-firing 7.62mm machine guns.

The Gazelle is a light military attack helicopter. With no internal gun and little armor, it relies on its maneuverability for defense. The advanced anti-tank missiles carried by several versions (including the British and Iraqi aircraft) have proven highly effective against armor, and the optional gun pods provide good supporting fire against infantry. The enclosed stabilizing rotor is resistant to damage from small-arms fire, increasing survivability. Mobility is crucial on the modern battlefield, and the Gazelle's ability to carry three infantrymen with their equipment is a further benefit to units which employ it.

Lacking any real sort of air-to-air combat ability, the Gazelle depends on good air cover to operate safely. Without such protection, the SA 342 must continually fly at dangerously low altitudes to take fullest advantage of ground cover and avoid air combat.

The SA 342 serves in the air forces of France, Egypt, Iraq, Jordan, Kuwait, Lebanon, Morocco and Syria, among others. The older SA 341 version, with a less powerful Astazou III engine, serves with France and Britain.

Su-24 "Fencer"



Owner: Soviet Union and allies
Type: Bomber
Crew: 2
Min wt: 41,890 lb
Max wt: 68,000 lb
Length: 69 ft 10 in
Wingspan: 33 ft 5½ in (min)
Made by: Sukhoi
Engine: 2 Tumansky R-29B turbofans
Top speed: Mach 2.4
Max range: 1,950 nm
Combat radius: 700 nm
Max ceiling: 57,400 ft
Radar type: 5
Armament: One 30mm six-barrel cannon plus up to 24,250 lbs. of stores carried on eight hardpoints.

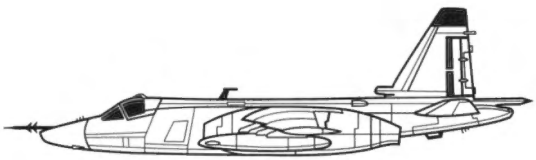
First appearing in service in 1974, the Sukhoi Su-24 (NATO designation "Fencer") is the premier Soviet-built fighter-bomber. Built along the same design lines as the F-111, its variable-sweep wings maximize performance at all speeds. The Fencer is a large target; the unswept wingspan is 57 ft 5 in.

Terrain-following and attack radars, a long-range all-weather navigation suite, and electro-optical weapon delivery systems allow deep penetration and highly accurate strikes by day or night. The tremendous weapon load makes the Su-24 a heavy hitter, and in-flight refueling gives it virtually unlimited range.

In air-to-air combat, the Fencer is much better off than a pure bomber or close support aircraft but is no match for a dedicated interceptor like the F-15 and has its hands full with even an F-4. The Su-24's radar is not designed for dogfighting; if its AAMs don't do the job, the Fencer is better off using its high speed, ECM and ground-hugging abilities to escape.

The Su-24 is flown by the Soviet Union, Syria and a small number of other Soviet customers.

Su-25 "Frogfoot"



Owner: Soviet Union and allies
Type: Close air support
Crew: 1
Min wt: 19,200 lb
Max wt: 42,000 lb
Length: 50 ft 6¾ in
Wingspan: 46 ft 11 in
Armament: Twin-barrel 30mm gun and up to 9,900 lbs. of ground-attack ordnance on ten underwing pylons. Air-to-air missiles are not uncommon, usually Atoll or Aphid heat-seeking AAMs.

Made by: Sukhoi
Engine: 2 Tumansky R-13 turbojets
Top speed: Mach 0.8
Max range: 700 nm
Combat radius: 300 nm
Max ceiling: 23,000 ft
Radar type: None

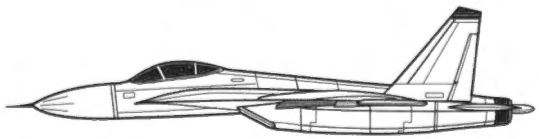
The Su-25 Grach (NATO designation "Frogfoot") is the Soviet bloc's heavy hitter against ground targets. First seen in action over Afghanistan in 1982, it became fully operational by 1984. The Su-25 employs the same low-flying tactics as the A-10, its U.S. counterpart, in order to lose itself in ground clutter and evade hostile aircraft The Frogfoot is usually seen in coordinated operations with the Mi-24 "Hind" assault helicopter.

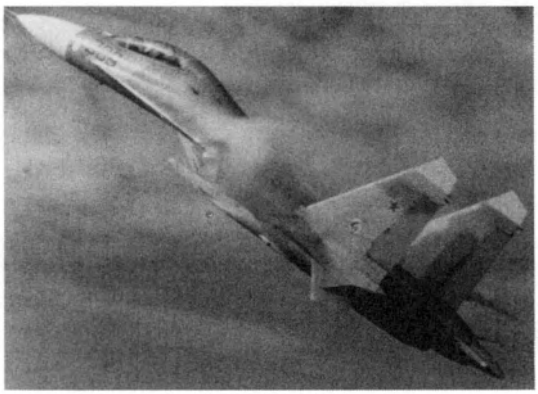
A variety of heavy attack ordnance can be fitted on eight of the underwing pylons; the other two are dedicated AAM racks. The 30mm cannon is no tank killer like the A-10's, but is highly effective against soft targets.

In air-to-air situations the Frogfoot is in trouble unless its opponent is another close-support craft. Its AAMs give it an edge against attack helicopters and other low-and-slow aircraft, but a careful fighter pilot in any kind of dogfighting machine would make short work of an Su-25.

The Frogfoot flies with the air forces of the Soviet Union and Iraq; it is also in the inventories of several other former and present Soviet allies.

Su-27 "Flanker"





Owner: Soviet Union
Type: Class A fighter
Crew: 1
Min wt: 33,070 lb
Max wt: 60,000 lb
Length: 67 ft 3½ in
Wingspan: 47 ft 6 in
Armament: One 30mm cannon; eight hardpoints and two wingtip racks for air-to-air missiles.

Made by: Sukhoi
Engine: 2 Tumansky R-32 turbofans
Top speed: Mach 2.3
Max range: 2,000 nm
Combat radius: 810 nm
Max ceiling: 60,000 ft
Radar type: 1

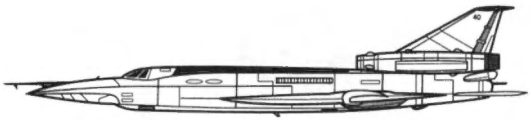
As Soviet fighter design has strayed away from simplicity, it has begun to embrace specialization. The Su-27 is a dedicated interceptor and air-to-air fighter. Using fly-by-wire (FBW) controls and with leading edge root extensions (LERX), the Su-27 is easily the most maneuverable Soviet fighter. Upgrade plans include replacement of conventional components with lighter, composite-construction ones.

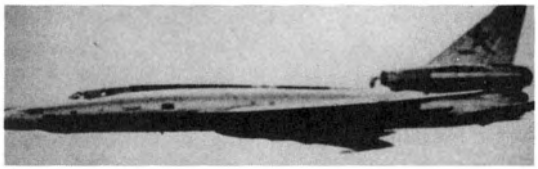
Sensory equipment includes state-of-the-art look-down/shoot-down radar with a 150-mile range, infrared search and track systems (which are undetectable by the target), laser rangefinder and radar warning receivers. Su-27 pilots can make good use of the helmet-mounted aiming system and head-up display (HUD). Standard weapon load includes no fewer than 10 AAMs of latest design, some with beyond visual range (BVR) locking and tracking.

This aircraft is extremely deadly in the hands of a skilled pilot. Its speed, radar and weapons range allow it both "first look" and "first fire" over almost every other aircraft in the sky. Frequently, the BVR missiles are the first — and last — thing an opposing pilot sees of the Flanker.

The Su-27 belongs only to the Soviet military.

Tu-22 "Blinder"



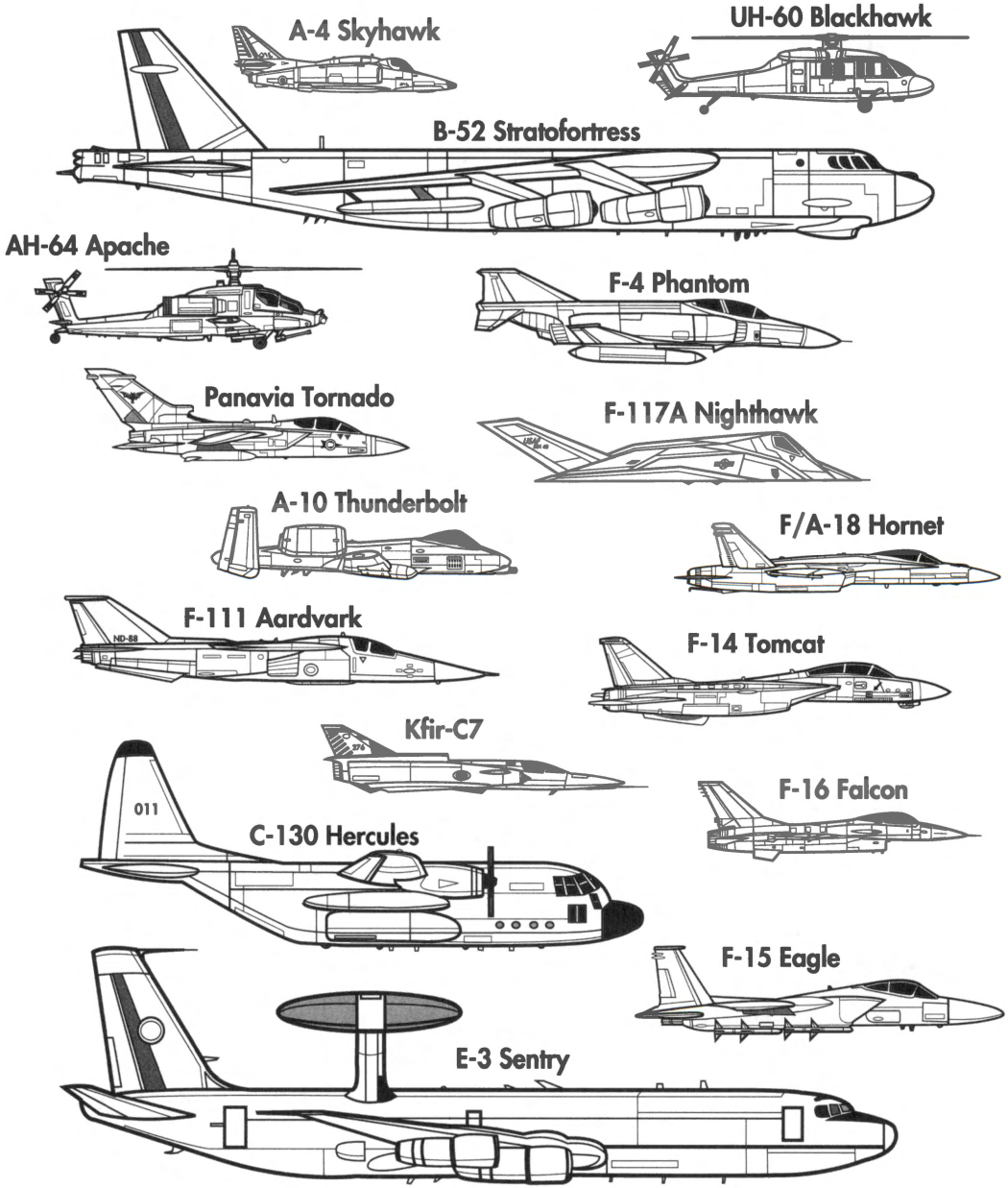


Owner: Soviet Union and allies
Type: Bomber
Crew: 3
Min wt: N/A
Max wt: 185,000 lb
Length: 132 ft 11½ in
Wingspan: 90 ft 10½ in
Made by: Tupolev
Engine: 2 Koliesov VD-7 turbojets
Top speed: Mach 1.4
Max range: N/A
Combat radius: 1,670 nm
Max ceiling: 60,000 ft
Radar type: N/A
Armament: Weapons bay in fuselage and radar-directed 23mm MS-23 gun in tail turret.

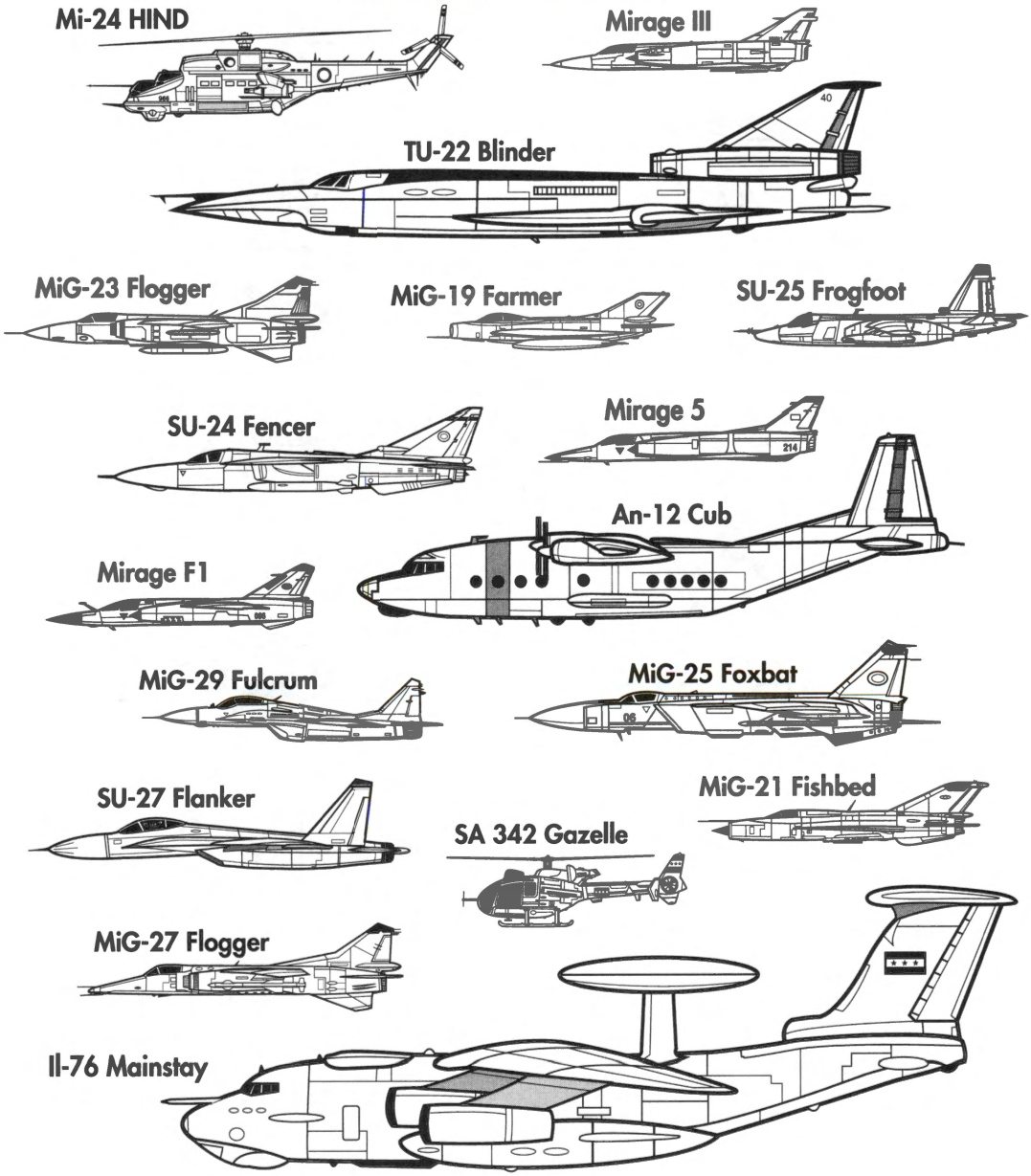
An aging design, the Tu-22 is the Soviet Union's first supersonic heavy bomber, entering service in the early 1960s. With outdated electronics and no air-to-air weaponry other than its tail gun, the Blinder is a threat only to nations with little or no air defense and against targets which do not require pinpoint accuracy.

The Tu-22's main advantages lie in its high speed and high operational ceiling. Beyond the reach of many older interceptors and moving fast enough to leave little time for reaction, the Blinder has been quite effective in the hands of Iraqi and Libyan pilots against their neighbors. The Soviet Union, however, now uses the aircraft mainly for reconnaissance, assigning the bombing duties to the newer Mach 2, swing-wing Tu-26 "Backfire" bomber.

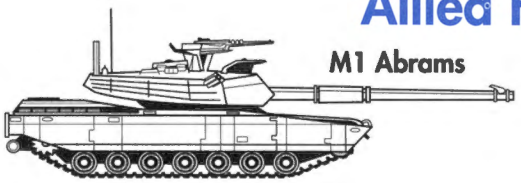
Allied Aircraft

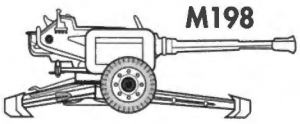


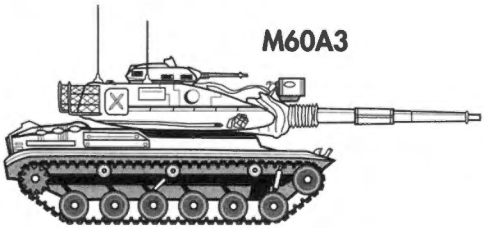
Enemy Aircraft

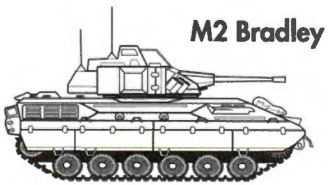


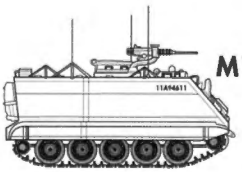
Allied Forces

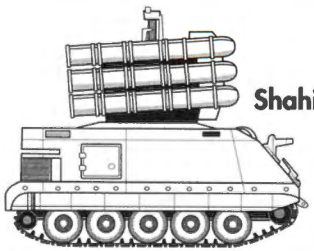


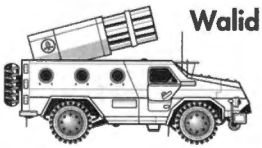


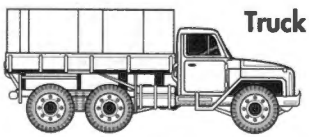


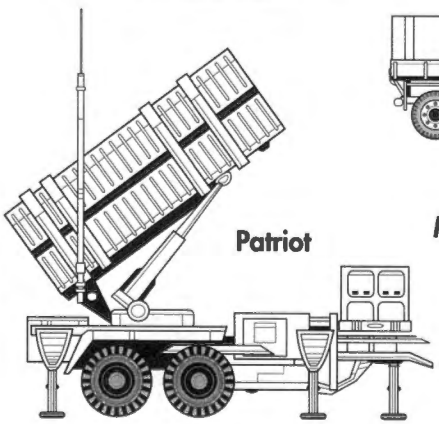




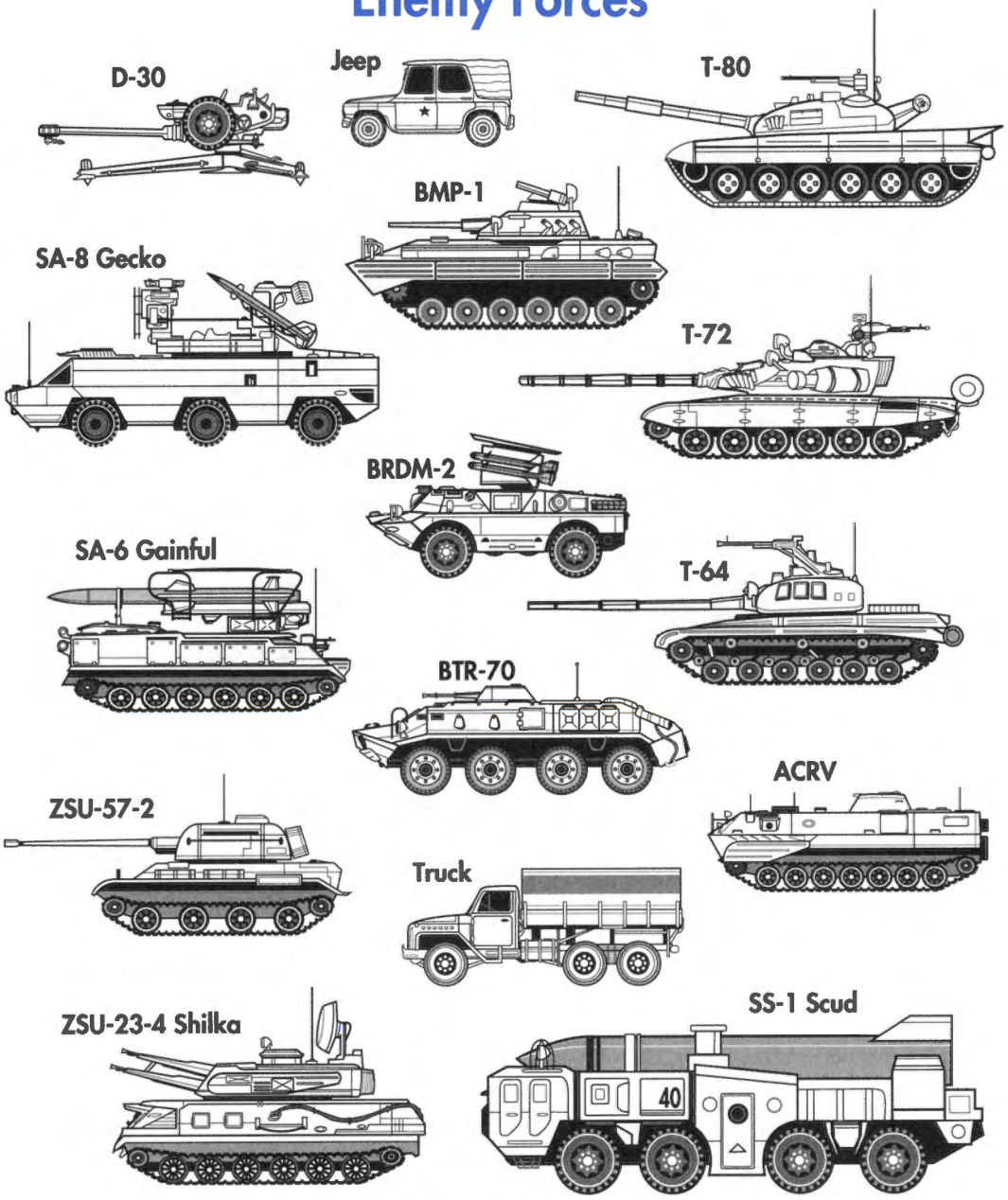




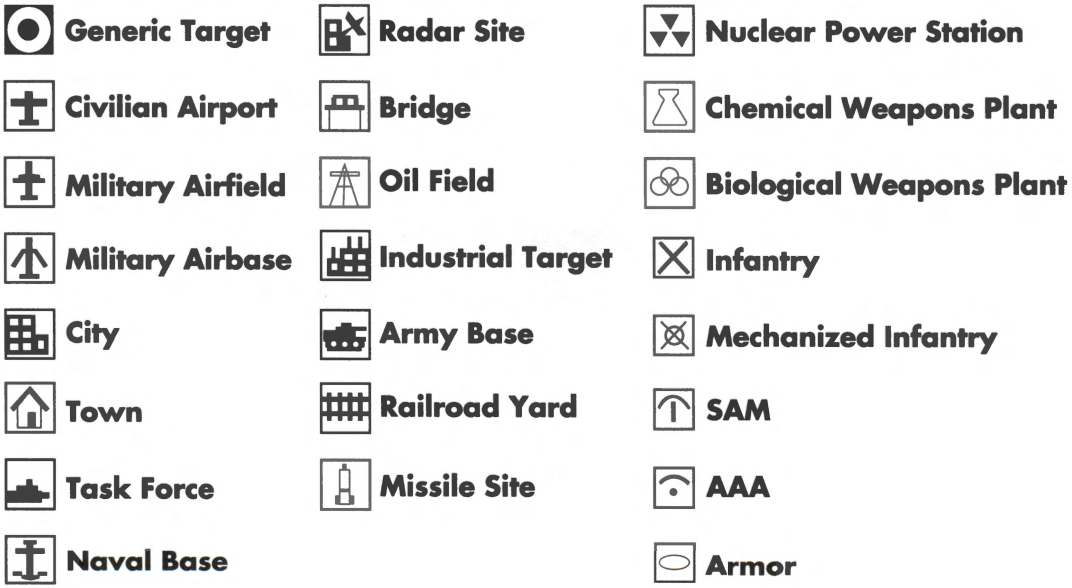




Enemy Forces

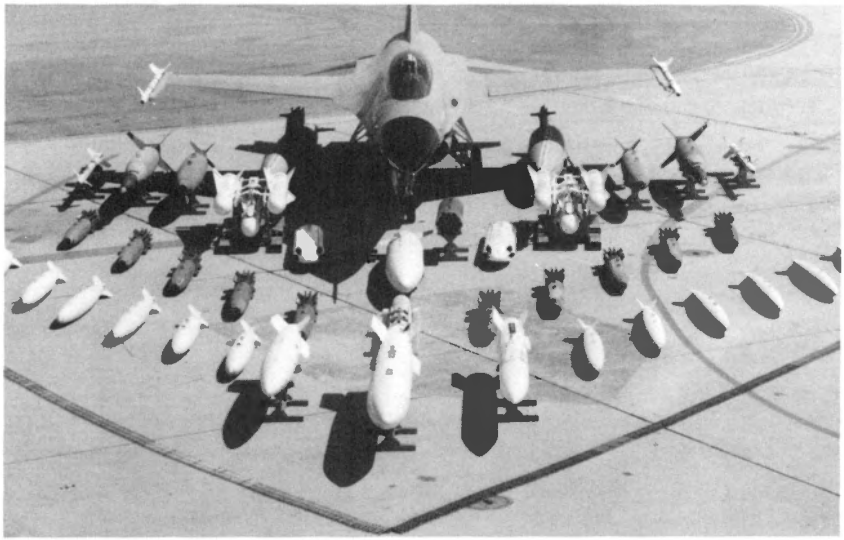


Map Icons


Generic Target
Radar Site
Nuclear Power Station
Civilian Airport
Bridge
Chemical Weapons Plant
Military Airfield
Oil Field
Biological Weapons Plant
Military Airbase
Industrial Target
Infantry
City
Army Base
Mechanized Infantry
Town
Railroad Yard
SAM
Task Force
Missile Site
AAA
Naval Base
Armor

F-16 armament and stores

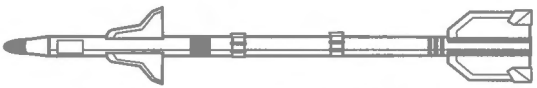
Following are the different weapons and other stores (fuel tanks and ECM pods) that you can load on your F-16.



Air-to-air missiles

The next couple of pages show the various air-to-air missiles your F-16 can carry.

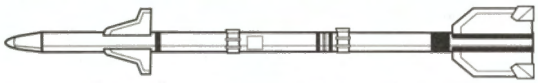
AIM-9M Sidewinder



Seeker: All-aspect infrared
Speed: Mach 2+
Length: 9 ft 7 in
Weight: 198 lb
Warhead: 22 lb blast fragmentation
Range: 10 miles
Diameter: 5 in
Drag factor: 30

The AIM-9M is a third-generation model of the Sidewinder. The all-aspect capability allows the seeker to acquire targets from any angle, although it still works better from the rear hemisphere. It outperforms the -9P in all areas, including maneuverability, seeker sensitivity, target tracking, lethality and susceptibility to countermeasures. It also has a low-smoke motor which reduces launch and ingress detection. Of the 1,000 Sidewinders fired in combat since the missile's introduction, 308 destroyed their targets.

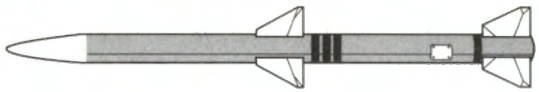
AIM-9P Sidewinder



Seeker: Rear-aspect infrared
Speed: Mach 2+
Length: 9 ft 11 in
Weight: 178 lb
Warhead: 22 lb blast fragmentation
Range: 10 miles
Diameter: 5 in
Drag factor: 30

The Sidewinder is a battle-proven, close-range missile that has been in the Air Force arsenal for 30 years. The AIM-9P is the best of the second-generation Sidewinders, but is outdated compared with the -9M and the -9R (due in service by 1994). The AIM-9P can only acquire its target from the rear hemisphere, where it has an unobstructed view of the target's engines. Still, under good launch conditions, the -9P is a capable weapon.

AIM-120 AMRAAM



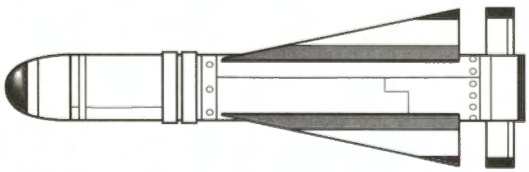
Seeker: Active radar
Speed: Mach 4+
Length: 11 ft 9 in
Weight: 335 lb
Warhead: 40 lb high explosive
Range: 25 miles
Diameter: 7 in
Drag factor: 36

The AMRAAM (Advanced Medium-Range Air-to-Air Missile) was designed to replace the disappointing AIM-7 Sparrow. It is guided by an active pulse-doppler radar and propelled by a high-speed, reduced smoke rocket. The AMRAAM can acquire its targets beyond visual range (BVR) and be launched at any aspect angle and speed. The AIM-120 is untested in actual combat.

Air-to-ground missiles

Following are the different air-to-ground missiles for your F-16.

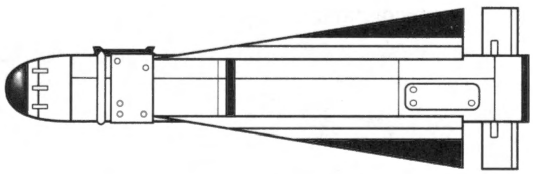
AGM-65B Maverick



Seeker: TV with magnification
Length: 8 ft 2 in
Weight: 464 lb
Warhead: 125 lb shaped charge
Range: 0.6 to 14 miles
Drag factor: 46

The Maverick is a "fire and forget" air-to-ground missile, enabling the pilot to seek other targets or leave the area once the missile is launched. The AGM-65B model uses a TV-imaging seeker with scene magnification to allow the pilot to acquire targets from a greater distance. The Maverick employs a high-explosive shaped-charge warhead effective against tanks, trains and other vehicles.

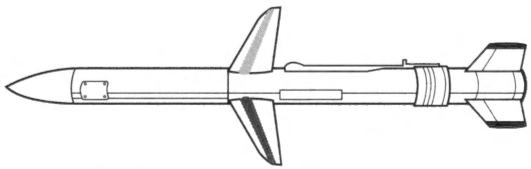
AGM-65D Maverick



Seeker: Imaging infrared
Length: 8 ft 2 in
Weight: 500 lb
Warhead: 125 lb shaped charge
Range: 0.6 to 14 miles
Drag factor: 46

The AGM-65D model seeker has an imaging infrared seeker which allows target acquisition at night and also helps cut through smoke and dust in the daytime. In addition, the -65D employs a new lower-smoke motor.

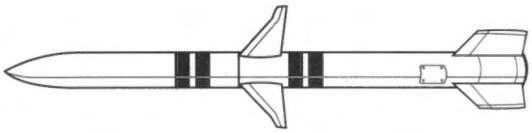
AGM-45A Shrike

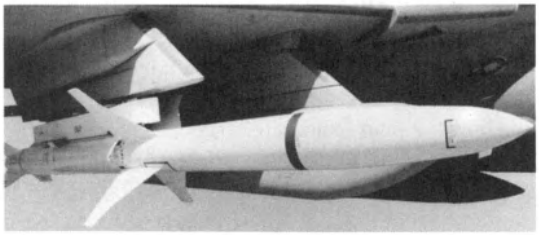


Seeker: Passive radar
Length: 10 ft
Weight: 395 lb
Warhead: 145 lb fragmentation
Range: 12 miles
Drag factor: 40

The AGM-45A Shrike is an anti-radiation missile effective against continuous wave (CW) radar emitters. These include all enemy air defense radar systems except the SA-8 Gecko. While the F-16 lacks the avionic systems to be a true Wild Weasel platform, you may be asked to perform this mission anyway.

AGM-88A HARM

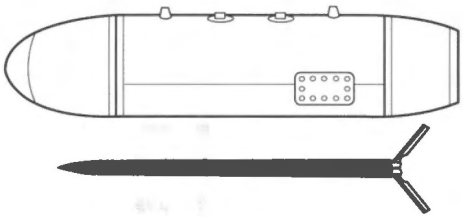




Seeker: Passive radar
Length: 13 ft 9 in
Weight: 807 lb
Warhead: 145 lb fragmentation
Range: 30 miles
Drag factor: 46

The AGM-88A HARM (High Speed Anti-Radiation Missile) is an upgrade of the Shrike. Towards the end of the Vietnam War, enemy radar operators learned to turn off the radar when they detected a Shrike missile launch. The HARM was developed with a much higher speed and range so it could hit a radar source without warning. It also has a better target acquisition system that is effective against both CW and pulse-doppler radar. Both the enemy SA-8 Gecko and the allied Roland SAM systems use pulse-doppler radar.

LAU 5003A Rocket Launcher



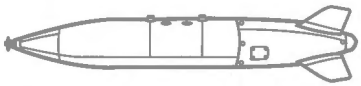
Seeker: Unguided
Length: 6 ft 5 in
Weight: 540 lb
Warhead: 19 CRV7 rockets
Range: 4 miles
Drag factor: 58

The LAU 5003A rocket launcher fires up to 19 air-to-ground missiles effective against light armor, vehicles and other soft targets.

Free-fall munitions

Below are descriptions of the iron bombs your Falcon can carry.

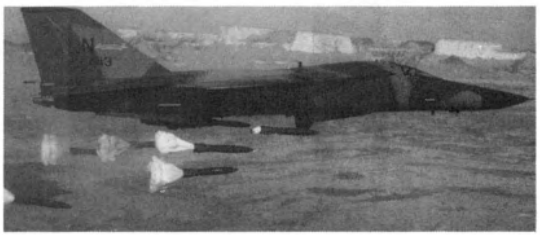
Mk82



Type: 500 lb class general-purpose iron bomb
Length: 7 ft 2 in
Weight: 531 lb
Warhead: 275 lb H-6 high-explosive
Drag factor: 40

Simple, cheap and effective, the Mk series of general-purpose bombs usually makes up the bulk tonnage of munitions dropped in any engagement. The Mk82 is effective against tanks and other ground force targets as well as small buildings.

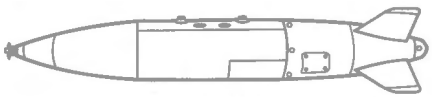
Mk82HD Snakeye



Type: 500 lb class high-drag iron bomb
Length: 7 ft 6 in
Weight: 570 lb
Warhead: 275 lb H-6 high-explosive
Drag factor: 40

The Snakeye version of the Mk82 has drag fins which open upon release to rapidly decelerate the bomb. This causes the bombs to hit well behind the plane, allowing a safe egress from a low level drop. This bomb is otherwise the same as the Mk82.

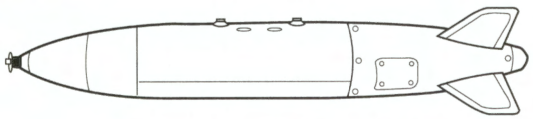
Mk83



Type: 1,000 lb class general-purpose iron bomb
Length: 9 ft 11 in
Weight: 985 lb
Warhead: 416 lb H-6 high-explosive
Drag factor: 50

The Mk83 bomb is effective against medium to small buildings, storage tanks and warehouses.

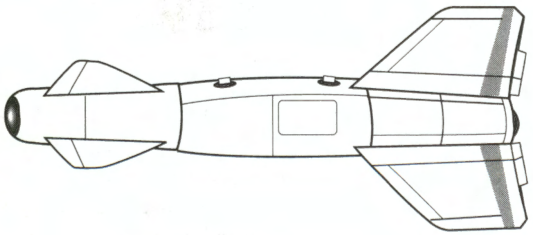
Mk84



Type: 2,000 lb class general-purpose iron bomb
Length: 12 ft 9 in
Weight: 1,972 lb
Warhead: 945 lb H-6 high-explosive
Drag factor: 60

The Mk84 is the largest bomb in the Falcon arsenal. It is effective against large buildings, factories, power plants, bridges, hardened aircraft shelters and bunkers.

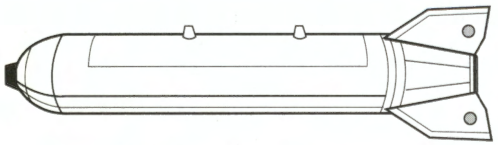
GBU-15 Guided Bomb Unit



Type: TV guided bomb
Length: 12 ft 10 in
Weight: 2,510 lb
Warhead: 945 lb H-6 high-explosive
Range: 5 miles
Drag factor: 46

The GBU-15 uses a TV or imaging infrared seeker to lock onto its target, then glides to the point of impact using control fins. The GBU should be used for important and hard to destroy targets like command bunkers, hardened aircraft shelters and nuclear weapons plants. In addition, it can be used against targets in civilian areas. The warhead of the GBU-15 is the same as the Mk84.

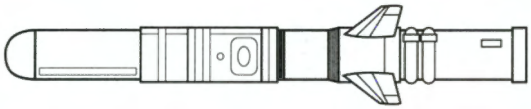
CBU-84 Cluster Bomb Unit

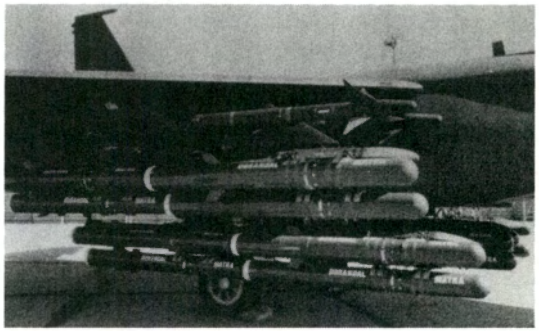


Type: Sub-munitions dispenser
Length: 7 ft 8 in
Weight: 960 lb
Warhead: 202 combined-effect bomblets
Drag factor: 50

The CBU-84 has fins to spin the unit at high velocity and disperse the released bomblets over a wide area. Each bomblet contains a half-pound forward-firing, shaped charge and a zirconium incendiary ring. This munition is effective against light armor, infantry and other soft targets.

BLU-107/B Durandal





Type: Anti-runway cratering bomb
Length: 8 ft 2 in
Weight: 450 lb
Warhead: 330 lb high-explosive
Drag factor: 40

The Durandal was designed solely for the purpose of destroying runways. The bomb first penetrates the runway surface and then a delayed explosion buckles a large portion of the runway — damage much more difficult to repair than the crater of a general-purpose bomb. Note that a bomb hit toward the end of a runway might not destroy enough pavement to put the runway completely out of action.

Other weapons and stores

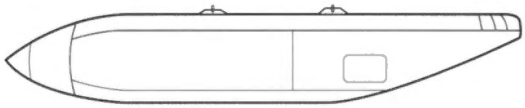
In addition to the missiles and bombs, your aircraft is equipped with an internal gun and can load additional fuel tanks and an electronic countermeasure (ECM) device.

M61A1 Vulcan

Type: Gatling cannon
Range: 1 mile
Ordnance: 20mm shell
Weight: 255 lb
Mount: Internal
Muzzle Velocity: 3,400 feet/second
Fire Rate: 6,000 rounds/second
Max. Rounds: 515

The M61 Gatling Cannon has been the standard internal aircraft gun of the United States Air Force for 30 years. It is capable in both dogfighting and strafing roles. While current Air Force doctrine stresses the development and use of BVR missiles such as the AMRAAM, the gun is the only weapon effective at very close ranges. In fact, during the Vietnam War, guns accounted for one-third of the air combat kills, despite being installed on only a small percentage of the American fighter contingent.

Fuel Tank



Type: 300 gal external
Weight: 1,900 lb

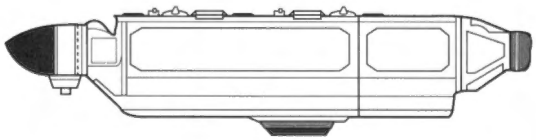
Mount: Centerline
Drag Factor: 30

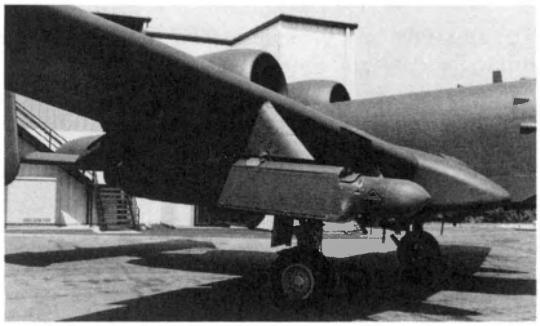
Fuel Tank

Type: 370 gal external
Weight: 2,400 lb each

Mount: Inner wing pylon
Drag Factor: 76

ALQ-131





Type: ECM pod
Weight: 535 lb

Mount: Centerline
Drag Factor: 18

The ECM (Electronic Countermeasure) pod produces a noise signal with deception modulation to jam SAM guidance systems and prevent lock-on. It can also confuse the missile radar of enemy planes — but not reliably.

Enemy air-to-air missiles

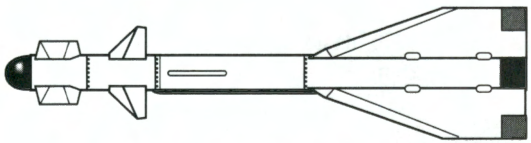
These are the air-to-air missiles you most likely to encounter in *Falcon 3.0.*

AA-2 Atoll

Seeker: Rear-aspect infrared
Speed: Mach 2+
Warhead: 13 lb blast fragmentation
Range: 5 miles

The Atoll is a copy of the Sidewinder and is roughly equivalent in capability to the AIM-9P. It is carried by most Soviet-built aircraft, as well as the early Mirage models.

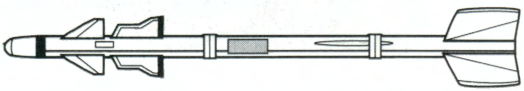
AA-8 Aphid



Seeker: All-aspect infrared
Speed: Mach 2+
Warhead: 18 lb blast fragmentation
Range: 5 miles

The Aphid has about the same capabilities as the AIM-9M and is carried by Soviet-built aircraft.

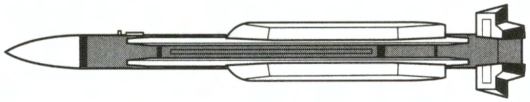
Matra R.550 Magic



Seeker: All-aspect infrared
Speed: Mach 3
Warhead: 27 lb blast fragmentation
Range: 6 miles

The Magic is a French-built missile carried primarily by the Mirage series of fighters.

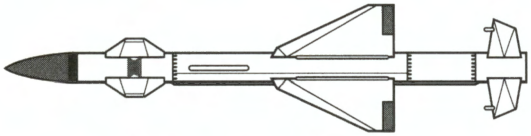
Matra Super 530



Seeker: Active radar
Speed: Mach 4+
Warhead: 30 lb blast fragmentation
Range: 22 miles

The Super 530 is a French-built missile carried primarily by the Mirage series of fighters.

AA-7 Apex



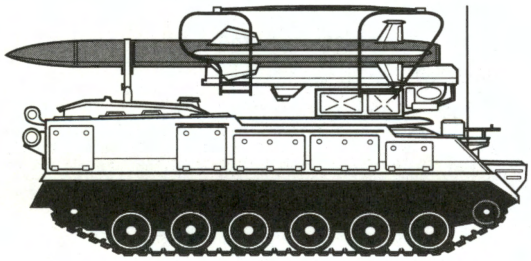
Seeker: Active radar
Speed: Mach 3.5
Warhead: 88 lb blast fragmentation
Range: 25 miles

The Apex is roughly equivalent to the AMRAAM. It is usually carried by the more capable Soviet-built aircraft, such as the MiG-29 and Su-27.

Enemy anti-aircraft weapons

Finally, these are the enemy's air defenses you will have to contend with in combat.

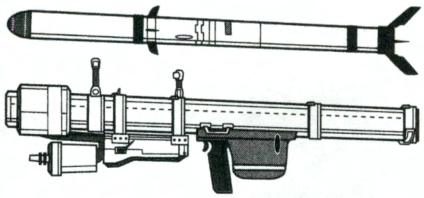
SA-6 Gainful



Guidance: CW Radar
Altitude: 300 to 47,000 ft
Warhead: 176 lb blast fragmentation
Range: 2 to 30 miles

The SA-6 Gainful is a medium-range, medium-altitude mobile SAM. It is employed in the air defenses of many countries.

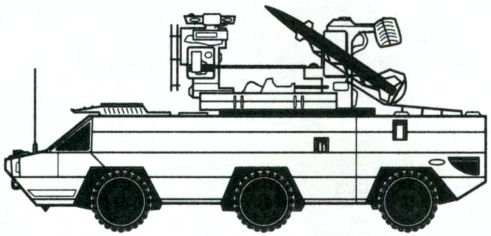
SA-7 Grail



Guidance: Infrared homing
Altitude: 100 to 12,000 ft
Warhead: 5 lb blast fragmentation
Range: 1 mile

The SA-7 Grail is a short-range, shoulder-launched SAM used to provide anti-aircraft protection to mobile ground units.

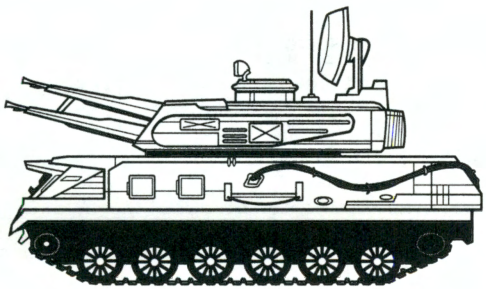
SA-8 Gecko



Guidance: Pulse-doppler radar
Altitude: 32 to 20,000 ft
Warhead: 88 lb blast fragmentation
Range: 1 to 10 miles

The SA-8 Gecko is a short-range, low-altitude mobile SAM.

ZSU-23-4 Shilka



Fire-Control: CW Radar
Altitude: 2,000 ft
Armament: Four 23mm cannons
Range: 1 mile

The Shilka rounds out the air defenses of most Soviet client states. While it has a restricted range, aircraft flying at low altitudes to avoid the large SAMs become targets for the Shilka as well as for shoulder-launched Grails.

Glossary/Abbreviations

A-A – Air-to-Air

AAA – Anti-Aircraft Artillery.

Aardvark – F-111.

AB – Afterburner.

ACM – Air Combat Maneuvers. Flight tactics used to destroy the enemy.

ACMI – Air Combat Maneuvering Instrumentation.

ACT – Air Combat Tactics.

Action – The point of the initial position-to-target run where the pre-briefed maneuver is begun. Also, the Officer's Club on Friday.

Adnan-1 – Iraqi AWACS aircraft.

AEW – Airborne Early Warning.

Afterburner – Acceleration over and above normal military power, achieved by spraying fuel out the back of the engine.

A-G – Air-to-Ground

AGL – Altitude above ground level.

AGM – American designation for Air-to-Ground Missiles.

AGM-65 – An optically-guided A-G missile.

Aileron – A trailing-edge wing control surface used to roll aircraft.

AIM – Air Intercept Missile.

Aiming Funnel – An element of the HUD display in DGFT mode.

Aiming Reticle – A visual aid to help improve your probability of hitting a target. If a target is inside the reticle, you have a good chance of hitting it.

Airfoil – A wing.

Airspeed – The velocity of the aircraft in relation to the surrounding air.

All-aspect – Weapons which are effective at any angle to the target.

ALO – Air Liaison Officer.

ALQ-131 – A jamming pod mounted on the underside of the F-16 designed to counter enemy radar. See *ECM*.

ALT – Altitude above sea level.

AMRAAM – Advanced Medium Range Air-to-Air Missile.

Angels – Altitude of friendly aircraft in thousands of feet. "Viper is at angels 23" means that the pilot is at 23,000 feet. It is also the name of the U.S. Navy demo team.

Angle of attack – The angle formed by an aircraft's direction of flight and its longitudinal axis.

Angle of climb – The angle of the aircraft nose above the horizon.

Angle of dive – The angle of the aircraft nose below the horizon.

Angle-off – The distance, measured in degrees, between your heading and the bandit's heading. This angle tells you relative fuselage alignment.

Anti-radiation missile – A missile which homes on radio frequency radiation.

AOA – Angle of Attack.

Apache – AH-64 attack helicopter.

Apex – Soviet-built, radar-guided missile.

APG-66 – Designator for the radar installed in the F-16.

Aphid – Soviet-built, all-aspect heat-seeking missile.

AR/NWM – Air Refuel/Nose Wheel steering system.

ASAT – Advanced Situational Awareness Trainer.

Aspect angle – This is the angle formed by the intersection of two lines (the line from you to the target and the line through the target's longitudinal axis). On the HUD, the aspect angle is represented by a caret on the aiming reticle. If the MiG is coming at you head on, the aspect angle is 180° and the indicator will be at the top of the Aiming Reticle.

ATO – Air Tasking Order.

Atoll – Soviet-built, rear-aspect heat-seeking missile.

Attack geometry – The spatial relationship between an attacking pilot and his quarry.

Autopilot – A feature of the flight control computer allowing it to fly the plane.

Avionics – An aircraft's electronic systems.

AVTR – Airborne Video Tape Recorder.

AWACS – Airborne Warning And Control System.

Ballistic – Something with the aerodynamic qualities of a rock, i.e. out of control. Never used to describe F-16 BFM.

Bandit – A plane identified as an enemy aircraft.

Bank – To roll left or right in the air so that your lift vector is no longer vertical.

BFM – Basic Fighter Maneuvers. What you do to kill the other guy once you are in a fight. BFM implies a single plane rather than a formation.

Bingo – Fuel level is such that immediate RTB is required.

Bitchin' Betty – An electronic female voice utilized in the F-16 to warn the pilot of potentially dangerous situations.

Black Hawk – UH-60 transport helicopter.

Blackout – A loss of vision (or consciousness) due to pulling too many positive Gs.

Blast fragmentation warhead – A warhead designed to explode with a large amount of shrapnel.

Blinder – TU-22 Soviet heavy bomber.

Blip – The image of a radar return appearing on the REO.

Bogey – An unidentified aircraft.

Bracket – A maneuver in which a pilot and his wingman separate to both sides of an oncoming bandit. This forces the bandit to commit to one plane, leaving him vulnerable to attack from the other. A bracket is followed by a drag maneuver.

Break – A defensive combat maneuver used when a plane is attacked from the rear. It is performed by turning sharply into a pursuer's line of attack in an attempt to make him overshoot.

BUFF – Big Ugly Fat F*cker; the nickname for the B-52.

Buy the farm – Go to the big F-16 pasture in the sky.

BVR – Beyond Visual Range.

C^3 – Command, Control and Coordination.

Callsign – A codename for a particular fighter pilot.

CAP – Combat Air Patrol.

CAS – Close Air Support.

Cat 1, 2, 3 – Load Category, where Cat 1 is the lightest.

CCIP – Continuously Computed Impact Point. The HUD designation for air-to-ground bombing mode using Mk84 bombs.

Center Point – The exact center of the HUD.

Central Command – Main command center in any theater.

Chaff – Packages of tiny foil strips dropped from the F-16 that confuse radar-guided missiles.

Charlie – Cool pilot talk for "Yes" as in "That's a charlie."

Click – One unit, as in "2 clicks west."

Closure rate – The rate at which a targeted MiG is closing on your F-16 (positive number) or pulling away (negative number).

Coalition – The combined forces arrayed against Iraq in Operation Desert Storm.

COMMS – Communications.

Continuous wave radar – A radar which emits a continuous beam of energy. Also known as doppler radar.

Contrails – Trails of vapor in an aircraft's wake. They are generated by high G turns.

Control zone – The area behind the bandit where the attacking pilot can establish a stable position from which to employ his weapons and counter any defensive move.

Corner velocity (corner speed) – The minimum speed at which an aircraft can pull its maximum rated Gs.

Court-martial – A trial before a board of field grade officers for a serious breach of the UCMJ.

Cub – AN-12, Soviet transport plane.

Dead-reckoning – Navigating without instruments.

Death Dot – CCIP HUD mode indicator showing where the bombs will hit.

Delta Sierra – Dog Sh*t, meaning "bad." "The weather is Delta Sierra."

DGFT – The HUD designation for air-to-air gun mode.

Diamond X – A missile-mode HUD indicator.

DISC – Disconnect.

Dogfight – A maneuvering air-to-air engagement with an enemy aircraft.

Drag factor – An index for the increase in drag caused by loading an external store.

Drag – Air resistance.

Drag – An ACT maneuver in which one plane decoys the enemy into a chase while the other sneaks behind for the kill.

Driver – A pilot flying (rather than navigating) the plane in a two-seater; also used as a term for pilot in a one-seater like the F-16.

DUR – The HUD designation for air-to-ground bombing mode using Durandal bombs.

Durandal – A bomb that drives into an airstrip before exploding, making repairs much more difficult.

Duty Roster – The crew chief's list of available pilots.

Eagle – F-15.

EBS – Electronic Battlefield Series.

ECM – Electronic Countermeasures. In *Falcon 3.0,* this takes the form of an ALQ-131 pod which is designed to foil ground-based SAM sites and confuse the radar of enemy planes that have locked their missiles on you.

Egress – Flying out of the target area.

Elbow – Also known as "control zone." The area behind the bandit where the attacking pilot can establish a stable position from which to employ his weapons and counter any defensive move.

ELINT – Electronic Intelligence Equipment.

EMS – Expanded Memory System.

Engage – Commence BFM.

Envelope – The safe or effective ranges of operation for aircraft or missile systems.

Escape window – A pilot's opportunity to successfully disengage from a dogfight.

EW radar – Early Warning radar.

E-O – Electro-Optical.

FAC – Forward Air Controller.

Falcon – F-16.

Farmer – MiG-19.

Fencer – Su-24.

Fighter jock – A slang term for a fighter pilot.

Fire and Forget – Designates a self-guided weapon.

Fishbed – MiG-21.

Flak – Shrapnel from an AAA battery.

Flanker – Su-27.

Flaps – A wing control surface designed to increase lift.

Flares – Magnesium-based packages designed to fool heat-seeking missiles when released from your F-16.

Flogger-B – MiG-23.

Flogger-D, -J – MiG-27.

Fly the needles – Follow the ILS flight path indicators.

Fly-by-wire – A design whereby all the controls of the plane are controlled directly by the flight computer based on input from a control stick.

Fokker – German WWI fighter plane.

Fox 1 – A radio call from a friendly aircraft announcing that he is firing a radar-guided missile.

Fox 2 Mike – A radio call from a friendly aircraft announcing that he is firing an AIM-9M Sidewinder.

Fox 2 – A radio call from a friendly aircraft announcing that he is firing an AIM-9P Sidewinder.

Foxbat – MIG-25.

Foxtrot Uniform – F*cked Up. "My radar is Foxtrot Uniform."

Frag list – A list of military targets ordered by priority.

Frogfoot – Su-25.

Fulcrum – MiG-29.

Funnel – See Aiming Funnel.

Fur ball – A frantic dogfight.

G suit – A suit worn by pilots to counter the physiological effects of high G forces.

G – Gravitational force. The force that is being applied to the plane and its pilot.

Gainful – SA-6 SAM.

Gazelle – SA-342, French light attack helicopter.

GBU – Guided Bomb Unit.

Gecko – SA-8 SAM.

Glarescreen – Another term for the HUD.

Glareshield – Another term for the HUD.

Glide Slope Deviation (GSD) – Vertical deviation from the ILS beam.

GLOC – Gravity Induced Loss of Consciousness

Good landing – One you walk away from.

Grail – SA-7 shoulder-launched SAM.

HARM – High Speed Anti-Radiation Missile. Designates the AGM-88A.

HCA – Heading Crossing Angle.

Heat signature – An infrared "portrait" of an aircraft or other object which determines its vulnerability to heat-seeking missiles.

Hercules – C-130.

HFR – High Fidelity Radar.

High yo-yos – An out-of-plane fighter maneuver.

Hind – Mi-24 attack helicopter.

Home plate – Home airfield.

Horizontal axis – The line running from wingtip to wingtip of an aircraft.

Hornet – F/A-18.

HOTAS – Hands On Throttle And Stick.

HUD – Head-Up Display.

I'm a dot – I'm outta here, I'm gone. If my wingman says "I'm a dot," he's left the fight and I'm on my own. If I look for him, I'll just see a dot on the horizon. Among the fighter pilot community, it has come to mean "I'm leaving" (for the O' Club, dinner, etc.).

ILS beam – A composite radio beacon broadcasting the optimal landing approach to a runway.

ILS – Instrument Landing System.

Ingress – Approach to a target area.

Intel – Military Intelligence.

In-plane maneuver – A maneuver performed without leaving the horizontal plane.

I-R – Infrared.

Jamming – The act of confusing enemy radar systems with radio frequency noise. See *ECM*.

JFS – Jet Fuel Starter. A cockpit light that turns on to indicate that the engine has started.

Joker – Fuel level is such that plans for egress and RTB should begin.

Kill circle – The Aiming Reticle for an A-A missile.

Killing zone – A pre-arranged fire zone into which enemy forces are channeled by mine fields and other defenses.

Knife fight – A hot and heavy fight with an enemy plane at close quarters.

Knot – Short for nautical mile. A nautical mile is approximately 6,076 ft.

Kts – Knots.

Lag pursuit – A combat maneuver where a pursuing pilot aims the nose of his aircraft just outside his opponent's turn circle.

LANTIRN – Low-Altitude Navigation Targeting Infrared Night.

LCK – Lock.

Lead pursuit – A combat maneuver where the pursuing pilot aims the nose of his aircraft inside his opponent's turn circle.

Lift – The force that counters the weight of the aircraft and enables it to fly. It is produced by the wings (and the fuselage in the F-16) and is directed forward from the top of the plane, perpendicular to your flight path.

LNH – Launch.

Load factor – The highest amount of Gs that should be pulled if a given weapons system or device is installed at a particular station.

Localizer Deviation (LD) – Horizontal deviation from the ILS beam.

Lock on – To acquire a target with radar for the purpose of firing a weapon.

Locked – A call indicating a radar lock-on or Maverick lock-on.

Longitudinal axis – The line running from the tail to the nose of an aircraft.

LOS (Line of Sight) rate – The rate at which a target is crossing your line of sight.

Mach – Unit of speed measurement equal to the speed of sound at sea level (about 760 ft/sec).

Magic – French-built, all-aspect heat-seeking missile.

Mainstay – IL-76, Soviet AWACS aircraft.

Math co-processor – An integrated circuit dedicated to floating-point mathematical calculations.

Maverick – The nickname for the AGM-65.

Merge – The point at which opposing aircraft begin BFM.

MIA – Missing In Action.

MiG – Mikoyan/Gurevich, common designator for Soviet-built fighters.

MIL – Standard power and acceleration measure.

Military Power – 100% RPM (thrust).

Mirage – French-built fighter aircraft.

Missile growl – An audible cue produced by the Sidewinder seeker head.

Mover – A moving target on the ground.

MRM – Medium Range Missile.

MSLS – The HUD designation for air-to-air missile mode.

NAM – Normal Air Mode.

NATO – North Atlantic Treaty Organization.

Negative Gs – The force you would experience if you were swung in a circle by your ankles.

No joy – I don't see it (wingman, lead target, etc.). The opposite of "No joy" is *tally* or *tally ho.*

NOE (Nap-of-the-Earth) flying – Flying as low to the ground as possible to avoid enemy radar.

NWS – Nose Wheel Steering.

NWSS/LGSI – Nose Wheel Steering System/Landing Gear Status Indicator.

On the beam – Aligned to the ILS landing beacon.

OPEC – Organization of Petroleum Exporting Countries.

Out-of-plane maneuver – A maneuver which entails leaving the horizontal plane.

Overshoot – To fly past a pursued enemy aircraft.

Padlocked – To look away would be to lose visual sighting. "I can't look away or I will lose tally."

Painted – To be illuminated by a search radar.

Parasitic drag – Skin friction drag.

PDF – Panamanian Defense Forces.

Phantom – F-4.

Pickling – Setting a weapon to fire at one specific location, similar to a lock-on.

Pigeons – Friendly aircraft.

Pincer – Attack bandit from opposite sides.

Pitch – The movement of a plane in the vertical and longitudinal plane.

POL – Petroleum, Oil, Lubricants.

Pop-up – To leave the NOE in order to acquire a target.

Positive Gs – The force you would experience if swung in a circle by your wrists.

POW – Prisoner Of War.

Pre-strike sweep – A sweep flown in advance of an attack force to clear the area of enemy fighters.

Puke – An insult to another pilot. An F-16 driver could call an Eagle driver a "twin-engine puke."

Pulling lead – Purposely aiming in front of an enemy plane while figuring in the distance to target and the target's speed to insure the weapon scores a hit.

Pulse-doppler radar – A type of radar which emits a pulsed rather than continuous signal.

Punch out – Eject.

Pure pursuit – An offensive maneuver where a pursuing pilot matches his opponent's turn circle. See *lag pursuit* and *lead pursuit* also.

Radar – Radio Detection And Ranging.

RDY – Ready.

Realism Value – An approximate measure of realism for the simulation.

Recon – Reconnaissance.

Red Flag – Air Force fighter training program at Nellis AFB, Nevada.

Redout – A loss of vision (or consciousness) due to pulling too many negative Gs.

Release cue – Cross hairs used to determine the time to release your bombs if the bombsight is not displayed in the HUD.

REO display – Radar/Electro-Optical display.

Rhino – Unflattering nickname for the F-4 Phantom II.

Riding the beam – Same as "flying the needles."

Roll – Rotate the aircraft around the longitudinal axis.

Rookie – Pilot without flight experience.

RPM – Revolutions Per Minute. The percentage of power being produced by your engine. See *thrust*.

RTB – Return To Base.

Rudder – A vertical aircraft control surface used to turn the plane without bank.

S and D – Search and Destroy.

SA – Situational Awareness.

SAC – Strategic Air Command.

SAD – Situation Awareness Display.

SAM – Situation Awareness Mode.

SAM – Surface-to-Air Missile.

SA-6 Gainful missile – A SAM designed in 1967, and launched from SAM sites against aircraft flying at medium heights. It is more effective than the SA-2, but can be fooled occasionally by ECM and chaff.

SA-7 Grail missile – A shoulder-launched SAM designed to be used against low-flying targets.

SA-8 Gecko missile – A truck-mounted, short-range, low-altitude SAM.

Scooter – A-4.

SCP – Stores Control Panel.

Screen – A type of defensive patrol. Differs from CAP in that a screen is flown between the defended area and a threat, while a CAP is flown directly above the defended area.

Sentry – E-3 AWACS aircraft.

Shaped charge – An explosive device designed to penetrate armor, concrete or other defensive shields.

Shilka – ZSU-23-4 mobile AAA battery.

Shrike – AGM-45A anti-radiation missile.

Sidewinder – The nickname for the AIM-9 air-to-air missiles.

Sierra Creek – As in "up Sierra Creek without a paddle."

Sierra Hotel – Sh*t Hot, meaning "good." "The weather is Sierra Hotel."

Situational Awareness – A pilot's ability to keep track of his surroundings and foresee possible actions in air combat.

Six o'clock – Rear.

Skin friction – Aircraft wind resistance.

SLUFF – Slow Ugly Fat Fellow, or the A-10.

Smart weapon – An A-G weapon which can lock onto a target and guide itself to the point of impact.

Snakeye – A high-drag version of the Mk82.

Soft target – A target without armor or other defensive reinforcement, such as infantry, trucks and normal buildings.

Sonic boom – The shock wave created by breaking the sound barrier.

Sortie – A mission.

Sound barrier – The large increase in air resistance encountered by aircraft approaching the speed of sound.

Spad – A WWI fighter.

Speed brakes – Aircraft control surface used to make a quick reduction in speed while flying or to help stop the plane after it has landed on the runway.

Speed of heat – Somewhere between the speed of sound and the speed of light. Often used when egressing the target area; the folks back there are no doubt angry and you'd like to put as much distance between them and your jet as quickly as possible. Also used to beat the crowd to Happy Hour at the O' Club.

Splash one MiG – Statement commonly spoken after successfully downing an enemy.

Spoof – Slang term for "fooling" an enemy missile with flares or chaff.

SRM – Short Range Missile.

Stall speed – The minimum speed at which an aircraft will stall.

Stall – A loss of control of the plane due to low airspeed or radical maneuvering in high altitudes.

Stick – A pilot's directional controller.

Stores – Anything which can be loaded onto an aircraft.

Stratofortress – B-52.

STRF – Strafe.

STT – Single Target Tracking.

Sweep – An aggressive patrol into enemy territory.

Tally (ho) – I see it (wingie, lead target, etc.). Sometimes it refers to a bandit only. See *visual* and *no joy.*

Target bearing – The angle of the target from the front of your F-16. If a target has a bearing of 340°, it is 20° to the left of the F-16's nose. If the target's bearing is 15°, it is 15° to the right of your F-16.

TAS – True Airspeed.

Taxiing – Steering your aircraft around while it is on the runway.

TD box – The Target Designator box on the HUD.

Terrain masking – Flying behind terrain features to prevent radar detection.

Threading the needle – Flying through the gaps in air defense radar systems.

Threat – Anything with both the desire and the ability to kill you.

Thrust – RPM. The amount of power being produced by your F-16's engine. The terms "thrust" and "RPM" can be used interchangeably.

Tomcat – F-14.

Tone – An audio cue emitted by missile control systems to indicate that the target has been acquired and is being tracked; an indication that it is time to launch a missile.

Tumbleweed – A pilot out of airspeed, altitude and ideas. No tally, no visual, no clue!

Turn circle – The geometric path of a turning aircraft.

Turn radius – The radius of the turn circle.

Turn rate – How fast your plane is moving around its turn circle.

TWI – Threat Warning Indicator.

TWS – Threat Warning System.

UCMJ – Uniform Code of Military Justice. The legal system governing the conduct of all members of the U.S. Armed Forces.

Unload – Push forward on the stick to reduce drag in order to accelerate.

Vertical axis – The line perpendicular to both the longitudinal and horizontal axes.

Visual – I see whatever it is you are describing. Sometimes used to mean "I see my wingie" (or lead) as opposed to *tally,* which then means "I see the bandit." See *tally.*

VMS – Voice Message System.

Warsaw Pact – The Soviet answer to NATO.

Warthog – A-10.

Waterline – An artificial horizon line.

Wave drag – The drag caused by the shock waves created by supersonic flight speeds.

Waypoint – Locations of targets as computed by the F-16's navigational computer. The waypoint numbers will appear in the lower right corner of the HUD.

Weapons envelope – The area surrounding the enemy plane where you are within the correct range, aspect angle and angle-off parameters to shoot a missile or the gun.

Whiteout – The inability to distinguish colors during the initial stages of a blackout.

Wild Weasel – A method of hunting SAMs by using your own aircraft as bait; also the aircraft used for this mission.

Winchester – Out of ordnance (weapons).

Wingman (Wingie) – Flying partner. Combat aircraft generally fly in pairs.

WVR – Within Visual Range.

Yaw – Movement around the vertical axis of the aircraft.

Yo-yo – An offensive maneuver that uses vertical maneuvering to stay inside the enemy's turn radius.

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Designer's Notes

Introduction

Flight simulators have been among the most successful entertainment software on personal computers for years. I can remember buying my first flight simulator in 1980 for my Apple II computer. That program gave me hundreds of hours of enjoyment as I learned about flying, practiced takeoffs and landings, and flew WWI missions in "Spad mode." Flying, especially flying sophisticated military jets like the F-16, is beyond the reach of most of us. But now anyone can experience flying without ever leaving his or her seat. Without any flying experience, a player can learn the fundamentals of flying on a personal computer. Over the years, flight simulators have become more realistic and more sophisticated, taking advantage of the power of each new generation of computers.

Today there are dozens of flight simulators on the market, and it is clear that there are many ways to write a good flight simulator. Some companies emphasize fast 3-D graphics, while others prefer to use 2-D bitmap pictures to give a cinematic quality. Another approach is to concentrate on accurately reproducing the flight characteristics and instrumentation found in the actual aircraft being simulated. There are also several good simulators which do not attempt to simulate the complexities of flight but instead concentrate on arcade-style action. A few companies try to recreate the strategy and tactics of battle. All of these approaches are valid. As powerful as today's computers are, they are still not to the point where a computer simulation can give everything to the player. Tradeoffs must still be made.

Even in multimillion-dollar military flight simulators, tradeoffs have to be made, resulting in what the military simulation business calls "limited fidelity." As one Air Force Colonel pointed out: if you want to build a simulator without any limitations or compromises, you'll end up building the airplane itself. The rule in building a flight simulator is never ask the pilot what he wants because he too will end up building an airplane. Instead, ask him what he needs to learn.

When the design team set out to develop *Falcon 3.0,* we wanted to incorporate everything we had learned from previous *Falcon* versions as well as draw on the knowledge and expertise we gained working on our military versions. We wanted to make the game as realistic as possible not only in the modeling of the aircraft, but also in the tactical and strategic use of air power. We did not want to make a product that either glorified or trivialized war. In short, we set out to develop the most realistic combat simulator on the market and still make the product playable to the widest range of consumers. The team at Spectrum HoloByte feels very strongly that flight simulators should be more than just pretty graphics and a fast frame rate.

The *Falcon 3.0* team realized that there are all sorts of flight simulator enthusiasts. Some just like to find out what it's like to fly an F-16; others want to gain a deeper insight into the art of aerial combat. Still others want a better strategic and tactical understanding of air power. *Falcon 3.0* allows the user to configure the game to his or her preferences. The player can choose to play a short game in Instant Action or can become engrossed in an all-out war which can take weeks to finish. All the major elements can be tailored by the user, from flight model and enemy logic to radar modes and quality of intelligence.

In addition, *Falcon 3.0* has different options for different computers. We recommend that you use the options suggested by the program for your machine. While you may not get all

of the bells and whistles, depending on your computer system, the integral features that make *Falcon 3.0* a cutting-edge product (such as the Campaign, smart computer-generated enemies, accuracy and realism) will all still be in the simulation.

Situational awareness

The hardest part of designing a flight simulator is understanding what the program needs to teach and what is important to a pilot. Many of us who worked on *Falcon 3.0* also worked on the ASAT (Avionic Situational Awareness Trainer) for Perceptronics. The ASAT is designed to teach F-16 pilots about SA, or situational awareness. SA is the correlation of information being generated by the Radar, Head-Up Display, Threat Warning Indicator and the pilot's visual observation to formulate a tactical solution in a combat environment. Pilots can easily become overloaded in a high-threat situation. The ASAT teaches a pilot how to deal with information overload while searching for, tracking and engaging the enemy. After working on the ASAT, we began to realize the importance of SA. Situational awareness quickly became the foundation on which *Falcon 3.0* was built.

In order to teach a player about SA, it was necessary to design a flight simulator that was accurate and realistic. Too often in computer games, the programmers design magic weapons and radar systems. Weapons that hit all the time and radar that gives you 100% perfect information give the user a sense of being Superman in the sky. The reality of combat is that 80% of the pilots who are shot down never saw the missile or plane that brought them down. *Falcon 3.0* gives a much more realistic view of what a pilot's job is. All of the basic functions as well as the limitations of the actual weapons and radar systems have been programmed into *Falcon 3.0*. We modeled not only the aircraft flight model but also the flight models of the weapons. Because of this, the player will gain a better appreciation of what real pilots have to do in combat.

The design and programming team devoted a great deal of time to creating a highly realistic and accurate threat environment. We have been disappointed with how little attention other products have paid to this area where the computer-generated threats simply flew in horizontal circles. Air combat is a three-dimensional fight. Managing altitude, speed, Gs and tactics is essential in dogfighting. At the highest levels of play, we wanted to create high-quality threats — capable of all of the actions that you are. Many man-months were spent on this aspect of the game. We interviewed pilots, reviewed standard Soviet and U.S. doctrine, and read every book we could get our hands on. A great book that every would-be fighter pilot should have is Robert L. Shaw's *Fighter Combat: Tactics and Maneuvering*. Much of our basic fighter logic is based on Shaw's book.

Lessons from Air Combat USA

But no matter how much someone reads and studies about air combat, there is no substitute for going up and fighting in real aircraft. This is a point that every fighter pilot I worked with insisted on. Even though I had several hundred hours in F-16 combat trainers, pilots insisted that unless I went up in a real aircraft, I could never really understand fighter combat.

I was invited down to Miramar, California, home of the Navy's Fighter Weapons School, better known to most as Top Gun. The civilian air combat school, Air Combat USA out of Fullerton, California, was giving a series of demonstration rides to the Navy and press. Air Combat USA flies the SIAI-Marchetti SF.260W Warrior. The SF.260W is a NATO light attack, tactical support, Forward Air Controller, armed reconnaissance and training two-

seater. Air Combat USA invited me to fly with Navy and Marine pilots over the Top Gun range. In my flight was an F-14 squadron commander, the Top Gun base commander and another civilian.

I fought in four one-versus-one engagements and participated in a four-fight. While the tactics and SA I had learned in simulators were extremely useful, a number of things were unexpected. First, the other aircraft seemed a lot smaller and harder to spot. Second, once the fight began, my eyes were glued to the top of the canopy tracking the target that I was fighting. There was no time to look into the cockpit or at instrumentation. The only time that I looked out the front or through the sights was right before I squeezed the trigger. I had a new appreciation for the old fighter adage "lose sight, lose the fight."

We took this knowledge gained from flying ACM at Air Combat USA and applied it to a *Falcon 3.0* innovation. The padlock view simulates what a real pilot looks at during a dogfight. Once the target is in visual range, a pilot never takes his eyes off it. Players who get used to this view (it takes a few hours of flying around using padlock view to get used to the orientation) never use any other mode once they get into the fight. The two upper mini-windows are used to orient you relative to the ground, while the main screen tracks the target. The program will identify the aircraft as long as it is within the normal range at which a real pilot could make out the target.

Tactically, it became clear that fighting only in the horizontal, as most computer would-be fighter jocks do, is a quick way to lose a fight. Speed is life, and the only way to manage your speed is to fight using the vertical, trading altitude for speed. You never want to be out of altitude and out of speed. Target fixation (paying attention to only one target) is death in a multi-target engagement, just as in the movie "Top Gun," when Maverick's fixation on destroying Jester allowed another plane to sneak up on his tail and gun him down.

Of course, pulling Gs and approaching grey-out is an experience that you'll never appreciate unless you have flown. The trick to air combat maneuvering (ACM) is to fly the aircraft and your body to the edge of the envelope. Usually, with two pilots of equal ability flying similar aircraft, the one who can keep himself and his aircraft on the edge will win the fight.

The flight characteristics of the actual plane are much more fluid than in computer simulations. Another aspect I found interesting is that the controls are much more sensitive in the real aircraft, especially the stick. One of our programmers who flew at Air Combat USA grabbed the stick and slammed it to the side to bank hard left as if he were flying a computer simulation. The plane immediately went into a series of over-controlled rolls. Needless to say, the instructor grabbed the stick back from the programmer.

Besides having a great time, the flight experience at Miramar gave me new insight into what is and isn't important. Real planes are a lot easier to fly than simulators because you get immediate and physical feedback. In addition, the field of vision on a computer screen is much too small to get a real feel of motion or peripheral vision.

In spite of these limitations, however, flight simulators do work. I felt comfortable at the controls of the aircraft and confident in my BFM abilities. Every programmer and project designer who worked on *Falcon 3.0* (with the exception of Ian Falicov, who is deaf) has now been to Air Combat USA.

Flight models

The game includes four different flight models. The first two are simplified flight models, for those who are used to flying other combat simulators. The Complex flight model duplicates the basic flight characteristics of a jet fighter, including energy bleeding, cornering velocity, thrust to weight, drag model and basic performance. The fourth flight model requires a math co-processor and is based on a modified flight model that was used in the ASAT simulator. The High Fidelity model is the most accurate flight model available on a personal computer. Airflow, lift, drag, thrust and a dozen other variables are used to generate a fluid and dynamic sense of flight.

This is not to say that the Complex or simplified models are not fun to use. In fact, the Complex model is very realistic, much better than many of the models used by other computer games. Using the Complex model, the plane is restrained to the same limits as the actual F-16. You won't be able to pull a -9G turn nor turn on a dime at Mach 2 like you can in some games. The principal difference between the Complex and the High Fidelity models is the feel of the aircraft. With the High Fidelity model, you can feel the momentum of the plane in a roll. The motion is fluid and smooth. Once you've flown it, you'll never go back to the other models.

In the real F-16, the stick is hooked up to a strain gauge. The gauge reads the pressure the pilot is exerting on the stick and translates it into the proper motion. The actual stick in the F-16 moves less than a quarter of an inch in any direction. The joystick in the game reflects the sensitivity of the real stick. You must remember that the maximum roll rate of the F-16 exceeds 230° per second. Try to roll a plane on another flight simulator, and you'll probably find that takes several seconds. If the real plane took this long, you'd be a sitting duck. The stick will take a while for you to get comfortable with it; you'll have a tendency to over-control at first. But as you get used to it, you'll find that fast roll rate a great advantage when getting out of trouble.

Radar

Through the work on the ASAT project, the programmers gained a much better understanding of the avionics in the F-16A block 15 series. The F-16's Westinghouse APG-66 radar is good, compact and simple by today's standards to operate. Its range is limited, but it is effective since it provides good look-down, shoot-down operations. The radar display symbology is simple and easy to read. For the sophisticated user, we have included these basic radar modes: NAM, SAM, STT, ACM and GM. A big part of dogfighting is the initial move that takes place beyond visual range with 80% of the victories determined during the intercept phase in real battle. The trick of beyond visual range (BVR) interception is getting on your enemy's six before he realizes you are there.

Radar is not a perfect system. It can be fooled. You must also know where and when to look. If you want to search a large volume of air space, the radar information will only provide you with basic positional information once every four seconds. If you want more information on a target, then you must lock your radar only on that target. If you attempt to search for a target, the target will pick you up on his threat indicator at twice the range of your radar. Accurate simulation of a full-function radar allows a player to experience BVR intercepts.

Terrain

The design team wanted to incorporate real terrain data so that you can fly over real countries. Most of today's flight simulators fight either over an imaginary world or over a flat terrain model. Terrain changes the tactics of a fight. Ingress and egress tactics vary with the terrain and can change the nature of a fight. Because of this, *Falcon 3.0* incorporates the capability to fly over contour models of different countries. Each map is a 90,000-square-mile representation of altitudes and terrain down to three-tenths of a mile resolution. The contour maps allow terrain masking and dead-reckoning navigation. A fast 80386 (20MHz to 40MHz) with a 16-bit VGA board is recommended for using the terrain. The "flat world" mode is designed for slower machines or for people who prefer faster frame rates. This mode compares favorably to existing flight simulators. We felt it was necessary to offer both in order to satisfy the action-oriented user as well as the hard-core simulation fan.

Your wingmen

Today most computer air combat simulators have one player flying against the entire world. In the real world, this is never done. A lone fighter is easy pickings. Sneak up behind one, and before he knows it, he's blasted out of the sky. In Vietnam, enemy MiG pilots would look for "strays" as easy targets. Multiple plane tactics have been the foundation of ACM ever since WWI. Whether flying in a loose deuce formation with your wingman or flying as part of a squadron, mutual support is required. Just as they said in "Top Gun," "You never, ever leave your wingman." *Falcon 3.0* incorporates squadron-level and multiple-ship logic. A computer-generated wingman flies with the player so that multiple-plane tactics can be used. Having a wingman act merely as a shadow wasn't good enough. Sophisticated wingman logic was required. We wanted the player to have the ability to issue commands to his squadron so that tactics such as "bag 'n' drag" and "pincers" could be performed. Multi-ship tactics will give you an advantage, especially in the intercept phase. Successfully executed, such tactics will almost always put you on your opponent's six long before entering visual range. Just remember that at the highest enemy logic levels, the computer will do the same to you.

ACMI

We also wanted to expand on the black box feature developed for the original *Falcon* program. The system should not only serve as a video recorder, but should also help the user gain a better understanding of tactical events. So for *Falcon 3.0,* the team decided to base the recording system on ACMI, the system used by the Air Force. In order to properly implement ACMI, large amounts of data have to be recorded. Aircraft data, troop movements, missile fly-out information and a host of other data are compressed and then stored in expanded memory. Because of the compression techniques used, a full rewind capability could not be supported. Instead, headers are recorded after a fixed number of frames have been played. A player can step back to any marker to start the playback. Use the ACMI system, especially if you are a beginner. It will give you a better understanding of air combat maneuvering and multi-ship tactics.

Sound and music

Digitized sound and high-quality music were important design points. We consider music and sound to be very important in setting the mood of the game. The game is intentionally "chatty" with lots of radio calls. Use of the radio to coordinate multi-ship tactics is important in real combat. We decided to use lots of radio chatter, perhaps more than would be used in real life, to help fill in the limitations of the limited view angle of the personal computer screen. Radio messages will help cue you about activities happening around you that you might see in the real aircraft but cannot see with the computer.

Red Flag

The Red Flag option allows you to practice against a variety of targets. Red Flag was inspired by the work done on the ASAT. In Red Flag, players can develop intercept and attack tactics. Especially valuable is practicing BVR intercepts against dumb targets. One of the most complex problems a pilot has to face is intercepting a target who is flying in a straight line or is running away from you. The goal is to intercept a target that is heading straight towards you and end up on his 6 o'clock before getting into visual range without ever breaking radar lock. During the Gulf War, U.S. pilots had to fly these intercepts as Iraqi pilots were trying to run to Iran. If a pilot misjudged the intercept, then he would not have enough time or speed for a second try. With the mission designer, you can create a similar mission.

Campaign

The Campaign feature is perhaps the single most important innovation introduced in *Falcon 3.0*. The idea for the campaign structure of was inspired by the work done on *TANK* and the Mission Disks created for the Amiga and Atari ST versions of *Falcon*. The Mission Disks incorporated the concept that the difficulty of each subsequent mission should be determined by the success of the previous ones. For example, if you failed in your first mission to bomb the bridge, then the tanks that were on the other side of the bridge will cross it and attempt to cut off your supply line. If on the next mission you fail to destroy the tanks, then the tanks will destroy your supply trucks. The problem with the Mission Disks was that each of the missions were pre-scripted. The tanks would always do the same things under the same circumstances.

TANK was one of the first real-time combined arms games. *TANK* was developed with the understanding that battles are fought with coordinated units. Aircraft, helicopters, artillery and tanks all work together. For *Falcon 3.0*, we wanted to continue along that line by making the battlefield rich with dissimilar vehicles. Bombers, AWACS, fighters, helicopters, tanks, infantry, artillery, radar and SAM units all work together in a coordinated battle.

The *Falcon 3.0* team designed a separate series of program modules that simulated both the strategic war and tactical battles. These independent modules act like separate games being played simultaneously while you fly air combat and attack missions. The strategic war module is very similar to logic modules found in computerized versions of military board games. By using computer-generated missions rather than pre-scripted missions, the game becomes much more dynamic as you and the computer counter each other in a series of offensive and defensive missions.

Logistics and large-scale movements are planned and executed at the strategic level. The strategic module is executed at the end of each mission. It examines your success as well as the success of independent units and redeploys your forces and the computer's forces accordingly. The module will also weight your success in determining the success of friendly automated units. The basic system is that when things go well for you, then they tend to go well for your side. On the other hand when things go bad, they go really bad. If you do poorly, then it is likely that your other units will also do poorly. The strategic model will also determine your next mission objectives.

The tactical module determines individual troop movement during the course of a mission. It communicates with the strategic module at the beginning of the mission and places units according to strength and position. It moves the tanks and trucks, and controls the infantry, artillery, SAMs and AAA batteries during the simulation (when you're buzzing around). The success of each battle is recorded and passed back to the strategic module at the end of the mission.

The defense department research and development agency, DARPA, developed a virtual battlefield called SIMNET. SIMNET is a network of over a hundred M-1 tanks, Bradley IFVs, helicopters, A-10s and numerous other support vehicles simulators. Tank and air crews are networked together so that combined arms battles can be practiced. SIMNET even allows long-distance networking so that a tank platoon at Ft. Knox can practice with a helicopter crew at Ft. Rucker. The military has found that training is enhanced when real crews fight with and against other real crews. The simulation becomes much more believable if you know that a real person instead of a computer program is flying that other airplane.

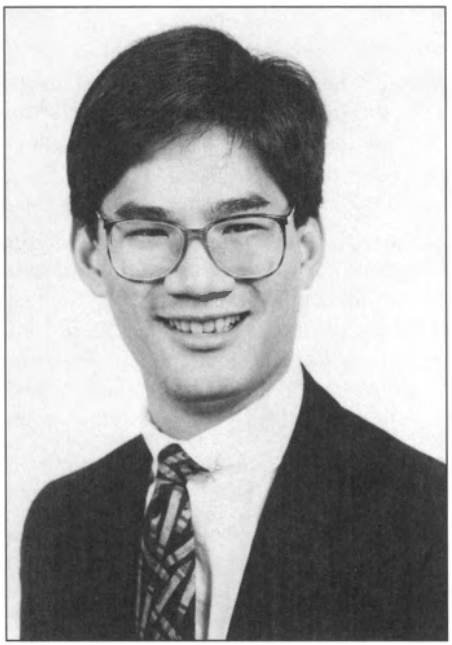
EBS

The Electronic Battlefield Series (EBS) was inspired by SIMNET. *Falcon 3.0* incorporates the ability for two players to play on the same virtual battlefield, either through modems or a direct connection. *Falcon 3.0* incorporates an advanced networking design which eliminates the need for frame lock transmission, which requires that each computer transmit a packet of data each and every frame. In addition, *Falcon 3.0* uses adaptive packets, which means that the program transmits more and larger packets between computers the closer the players' planes get.

Future products, such as scenario disks and simulators for other vehicles (A-10s, helicopters and tanks), will be added to the EBS series. Each of the products can be networked with any other so that you can be flying an F-16 and offer fighter support to another player flying an A-10 on a tank-hunting mission.

Thanks

We at Spectrum HoloByte take great pride in this product. We hope it gives you months of satisfaction. Your input is greatly appreciated; *Falcon 3.0* is the result of having thousands of players who bought previous versions of *Falcon* giving us their suggestions on how to improve air combat simulations. If you have comments or recommendations, please write us or send us an E-mail message on GEnie or CompuServe. We'll continue to improve *Falcon* and the EBS series.



Gilman G. Louie
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SECTION

XVI

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The Falcon 3.0 Team

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