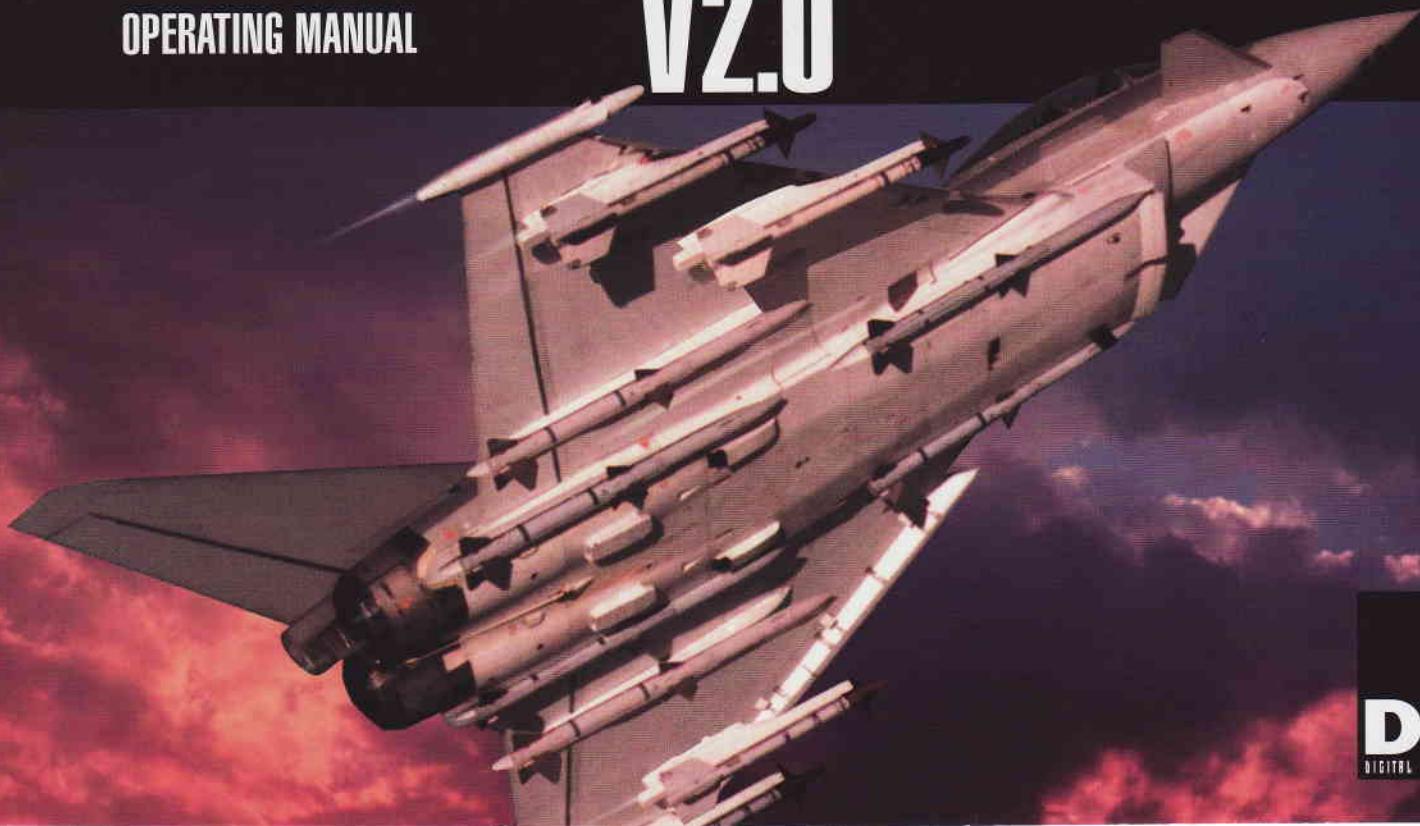




OPERATING MANUAL

V2.0



DID
DIGITAL IMAGE DESIGN

CONTENTS

PLEASE READ FIRST	5	WEAPONS ARMING	56	IRST	118
WELCOME	6	QUICK COMBAT	57	DASS	121
NEW FEATURES	7	SIMULATOR	58	TIALD	128
FEATURES	11	CUSTOM AIR-TO-AIR COMBAT	59	MAVERICK AIMING SYSTEM	133
DEVELOPMENT	18	CAMPAINN	61	MOVING MAP DISPLAY	138
CUT-AWAY	24	THE TACTICAL MISSION PLANNER	65	FLIGHT ASSISTANCE SYSTEMS	142
		MULTIPLAYER	75	INFORMATION AND STATUS DISPLAYS	148
INSTALLATION DOS	26			AIRCRAFT WARNING SYSTEMS	154
INSTALLATION WIN 95	28	EF2000 COMMUNICATIONS (DOS)	76	THE HUD AND HMD	160
GRAPHICS +	30	EF2000 COMMUNICATIONS (WIN 95)	83	AIR-TO-AIR HUD AND HMD MODES	165
CONTROLLERS	32	TOTAL ENTERTAINMENT		AIR-TO-GROUND HUD & HMD MODES	168
QUICK START	37	NETWORK (TEN)	84	LANDING & REFUELING HUD MODES	171
EASY VIEW GUIDE	40	MULTI PLAYER QUICK COMBAT	85	DIGITAL TERRAIN SYSTEM	173
KEY SUMMARY	41	IN FLIGHT CONFIGURATION MENU	86		
KEYBOARD LAYOUTS	47	VIEWS	87	FEATURES AND TIPS	174
				INTRODUCTION TO AIR-TO-AIR	
GETTING STARTED		AVIONICS		WEAPONS	184
INTRODUCTION	53	INTRODUCTION	100	AIR-TO-AIR WEAPONS	188
THE DID DESKTOP	54	ECR-90 RADAR	102	INTRODUCTION TO AIR-TO-GROUND	
MAIN MENU	55	JTIDS	113	WEAPONS	199

CONTENTS

AIR-TO-GROUND WEAPONS	203	SMARTPILOTS SYSTEM	313
RUSSIAN WEAPONS	219	FLIGHT MODEL	315
FLIGHT TRAINING	221	GLOSSARY	320
AIR-TO-AIR COMBAT	228	INDEX	326
AIR-TO-AIR MANEUVERS	232	BIBLIOGRAPHY	329
GROUND ATTACK WEAPONS	242	CREDITS	331
USING GROUND ATTACK WEAPONS	247	DIGITAL IMAGE DESIGN LTD.	333
STRIKE PATTERNS	253		
AIRCRAFT COMMUNICATION	256		
NATO AIRCRAFT	262		
RUSSIAN AIRCRAFT	280		
SHIPS	293		
HELICOPTERS	296		
ARMORED FIGHTING VEHICLES	297		
CAMPAIN	300		
MILITARY AIRFIELDS (NORWAY)	303		
WARGEN SYSTEM	309		

EF2000 V2.0

PLEASE READ FIRST!

COPYRIGHT NOTICE

The computer program and its associated documentation and materials are protected by National and International Copyright Laws. Storage of the computer program and its associated documentation and materials in a retrieval system, reproduction, translation, copying, hiring, lending, broadcasting and public performance are prohibited without the express written permission of Infogrames Entertainment, Inc., and Digital Image Design Ltd. All rights of the author and owner are reserved world-wide.

Publisher: Infogrames Entertainment, Inc.,
333 W. Santa Clara St. Suite 820,
San Jose, Ca 95113.

Developer: Digital Image Design Ltd.,
Tannery Court, Tanners Lane,
Warrington, Cheshire, WA2 7NR.

DATA VALIDITY

All data for EF2000 have been secured from public sources. DID stress that all simulated elements are our interpretation of the facts, and are intended for entertainment purposes

only. Because the real EF2000 is still in development, some of the systems represented in the game may not be associated with the real plane. Any trade names or trademarks are the exclusive property of the respective manufacturers.

CAUTION!

The CD-ROM that holds EF2000 can be damaged by mishandling.

EPILEPSY WARNING! READ THIS BEFORE PLAYING EF2000

A very small percentage of individuals may experience epileptic seizures when exposed to certain light patterns or flashing lights. Exposure to certain light patterns of backgrounds on a television screen or while playing computer games may induce an epileptic seizure in these individuals. Certain conditions may induce undetected epileptic symptoms in persons who have no history of prior seizures of epilepsy. If you, or anyone in your family, has an epileptic condition, consult your doctor prior to playing. If you experience any of the following symptoms while playing the game: dizziness, altered vision, eye or muscle twitches, loss of awareness,

disorientation, any involuntary movement, or convulsions, IMMEDIATELY discontinue use and consult your doctor before resuming play.

PACK CONTENTS

Accompanying the manual inside this box you will find; one CD-ROM, installation/keycard, a map and a guarantee card. Please remember to return your guarantee card, and fill in the questions. This gives us clues for developing the products you want in the future.

QUERIES

If you should find either the program or the documentation unsatisfactory in any way, don't hesitate to drop us a line detailing in full the reasons for your dissatisfaction. This will help us to avoid repeating any similar problems in the future. Opinions and complaints should be sent to:

**The Project Manager, EF2000,
Digital Image Design Ltd., Tannery Court,
Tanners Lane, Warrington, Cheshire, England
WA2 7NR.**

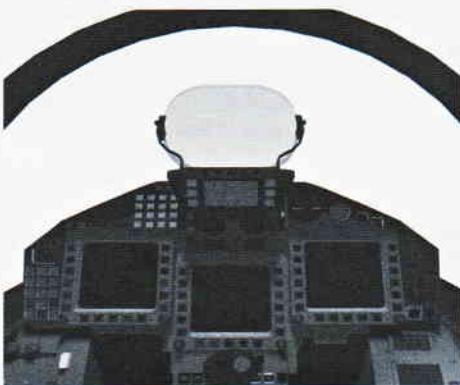
EF2000 WELCOME

VIRTUAL AIR COMBAT IN THE NEXT MILLENIUM

When the original EF2000 was released in November 1995, it represented a major step forward in combat flight simulation for the PC, with full texture mapping of four million square kilometers, sophisticated flight modeling and a host of other features which set it apart from the crowd. The response from dedicated flight-simulation enthusiasts and newcomers alike has been overwhelming. With the release of Windows '95, we were keen to ensure that users of the new operating system could enjoy the fun and graphical sophistication of EF2000. Installation and set-up is straightforward under Windows '95 management and, naturally, EF2000 has all the improvements we made to the original DOS game and more besides. See the section entitled 'New features for Windows '95' to see the changes we have made since the original release.

EF2000 would have been impossible to create without the help and advice of key institutions and their publicity departments, organizations and individuals. Among them is The British Aerospace Publicity Department, GEC-Marconi, The Royal Aeronautical Society, the Royal Air Force, World Air Power Journal and the publishers Key Press, who so kindly helped with

information and aircraft illustrations by people like the renowned Mike Badrocke. Nor will we forget the support and encouragement of our publishers Ocean, who share our enthusiasm for flight simulation (especially when they are produced on time).
For a full list of credits, see 'Who's Who'.



NEW FEATURES FOR EF2000 V2.0

ENHANCEMENTS TO THE ORIGINAL EF2000

The following descriptions outline the changes that we made to the original game.

GRAPHICS +

If you have a 3DFx or Rendition based video card you can take advantage of 3D accelerated graphics. Graphics + offers a high frame rate at high resolution in high-color. It also includes a range of visual effects, such as fogging and pixel smoothing, which create the illusion of simulators costing millions of dollars.

WINDOWS 95 SUPPORT

EF2000 V2.0 offers a Windows 95 installable version. This has all the benefits of using the Windows environment to control audio, video, joystick, mouse and communications devices, eliminating complex configuration.

SIMTECH CS COMMANDER

If you use Thrustmaster joystick then there is a useful utility included on the EF2000 V2.0 CD. SimTech have produced a special version of their CS commander joystick programming

interface. The Windows 95 program provides an intuitive programming system for the joysticks with all the EF2000 functions built in. It can be found in the JOYSTICK/SIMTECH directory.

MODEM AND SERIAL PLAY

EF2000 V2.0 offers new connection options for Multiplay. Modem and serial link ups are available for King of the Skies and Simulator sections of the game.

TEN

EF2000 V2.0 brings you on-line gaming in association with the Total Entertainment Network. Simply start up EF2000 V2.0 and select the TEN option. This will take you to the TEN arena. Once you register with TEN you will be able to mix it up with other pilots from anywhere in the country.

CUSTOM AIR-TO-AIR MISSION CREATION

A new part of the simulator section is the Custom Air-to-Air editor. It is a simple point and click selection process and will get you dogfighting against any plane in seconds. The

editor allows multiple engagements between up to Eight EF2000s and 24 other aircraft. The less scrupulous amongst you will engage unarmed aircraft but just try one EF2000 against 24 SU-35s.

CAMPAIN MISSION EDITOR

The campaign can now be fought from strategic point of view. You may create your own strike missions within the campaign. Along with the EF2000 strike force you can also utilize other aircraft for SEAD and Escort missions and send in a second strike wave for the final blow. All missions are fully interactive with the current campaign so selecting easy targets will bear little fruit. The real goal is threading the needle of SAM and RADAR coverage to strike those well-defended Russian airfields.

NEW FEATURES FOR EF2000 V2.0

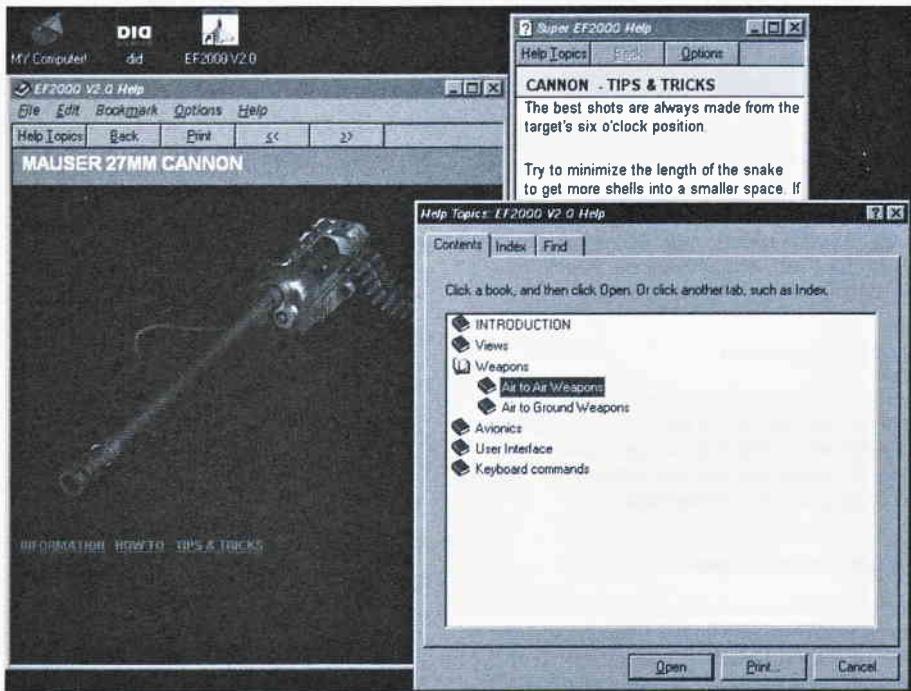
ENHANCEMENTS TO THE ORIGINAL EF2000

On-line help

EF2000 V2.0 Windows 95 version now has an on-line help system installed. In order to access the context-sensitive help file, simply press Alt-F1 in any part of the game. This will display the relevant part of the file. The file may also be accessed by clicking on the help button located at the top of the Graphical User Interface (GUI) screens. These buttons also display context-sensitive information about the GUI. The whole help file can be accessed via the start menu on the Windows 95 taskbar.

The help file contains sections covering the majority of in-game queries. It also gives tips on how to survive in combat and how to use weapons effectively. The help file is split into subject books which are then split into pages. As with all Windows 95 help files, the information may be annotated, copied or printed in the usual way.

For trouble-shooting or solving technical problems with EF2000 V2.0 please refer to the 'Readme' file located in the EF2000 V2.0 program folder or on the CD.



NEW FEATURES FOR EF2000 V2.0

ENHANCEMENTS TO THE ORIGINAL EF2000

Other new features include:

AI CONTROLLED AIRCRAFT

Improved pilot AI - other planes, including enemies and wingmen, are less likely to crash into the ground during dogfights. However, just as in real life, it may happen from time to time.

Improved Air Safety at Trondheim, Orland and other bases - planes using ILS no longer collide with the ground.

SAM killers - computer controlled aircraft will now carry out their mission tasks correctly when assigned to a Wild Weasel mission. SAM sites will be attacked in response to detected radar emissions.

Anti-ship missions - during conflicts, you will see aircraft attack ships using rockets.

Flying level - the wingmen will fly at the same level as the leader.

Low-level wingmen - wingmen now have a much lower altitude limit than the leader, which means the player's wingmen will follow him down to

150 ft over sea.

WEAPONS AND COMBAT ENHANCEMENTS

Deadlier Flak - systems damage on the player's plane is now more apparent - flak will not only jolt the aircraft, but will eventually damage some areas of the aircraft.

Deadlier AA missiles - proximity explosions will cause the aircraft to shake. The strength of shock depends on the speed and weight of aircraft.

Deadlier Sea Eagle - performance has been modified to give higher initial cruising altitudes for the missiles, allowing launches from the shoreline.

The better performance of the missiles has also allowed more realistic and effective patterns of attack on shipping.

A better iron bomb - bomb flight characteristics have become more realistic due to slight changes in the drag calculations. The CCIP predictor now provides a more realistic

release position allowing various bomb strike patterns to be explored.

Fast cannon selection - shift and return will automatically select cannons. This feature has been added for owners of ThrustMaster and other programmable joysticks.

Correct predictor sight - the AA predictor has been upgraded to include a 'snake' predictor, as in the real EuroFighter. The end of the snake furthest from the range clock shows the nearest point of the shell's travel.

The centre of the range clock is the furthest point of travel. With a little practice, you will be able to hit aircraft under difficult circumstances.

Deadlier cannon - your cannon is now more effective against aerial targets. At last, you'll be able to deal with bombers more easily.

SAMs and AAA in campaign are now more dangerous, and AAA should have less effect upon frame-rate.

More air defences - SAMs and AAA will be much

NEW FEATURES FOR EF2000 V2.0

ENHANCEMENTS TO THE ORIGINAL EF2000

more evident as you fly to targets. In addition, targets will be much more heavily defended.

More persistent air defenses - AAA and SAMs now conserve their use of ammunition and so remain a threat for longer.

Non-freezing TIALD display - this will no longer freeze when the last bomb is dropped.

Free-fall jettison - dumping all stores will not trigger rockets and missiles. These items simply fall off the plane and drop to earth.

Improved enemy tactics - when enemies fire missile salvos, they are more widely spaced and therefore more difficult to spoof. Be prepared to change your evasion tactics. You may find that you have to be more alert when missiles are heading your way.

Target lock maintenance - there is now no loss of target lock when changing AA weapons. This means that you won't break concentration when cycling weapons.

IR missile accuracy is now affected correctly by

target aspect and engine heat - try to get behind your target before firing.

JTIDS color coding - we have added several extra color codes to help you determine the type of aircraft shown on the JTIDS. The new codes are shown as dots in the center of each aircraft symbol. A white dot denotes a refueler; and a yellow dot denotes AWACS and JSTARS aircraft. Enemies (red symbol) of greater threat to yourself contain an orange dot. Friendlies containing an orange dot are your escort; those with a blue dot are the strike aircraft, and friendlies with a red dot are wild weasel aircraft.

DAMAGE ENHANCEMENTS

More visible damage - external damage to the aircraft now occurs on both wings, in several stages of severity.

Cannon strikes visible - hit an enemy plane and a small explosion will tell you that you've scored a hit - not necessarily a kill, however. The next level of damage is to make the bandit smoke, and with further hits the enemy plane will explode violently.

FLIGHT ENVELOPE ENHANCEMENTS

No more high-speed stalls - the problem of sudden and often fatal altitude loss at around Mach 1 has been eliminated.

Stores now influence flight - because the EF2000 is an inherently unstable fly-by-wire plane, the flight computer is able to compensate largely for the influence of external stores. However we have modeled the effect of stores on aircraft mass and drag, producing noticeable effects at low speed with maximum weight. Reduced twitching in Accelerated Time (Shift T)

- in this mode computer-controlled aircraft now have a slightly slower response to prevent them from rapidly pitching up and down as they fly along.

CAMPAGN ENHANCEMENTS

Optimising certain elements of the campaign has given a much improved frame rate.

Dangerous neutrals - neutral aircraft (blue) will now fire upon you when you intrude into neutral airspace.

NEW FEATURES FOR EF2000 V2.0

ENHANCEMENTS TO THE ORIGINAL EF2000



A more extensive campaign - Finland and Russia can now be invaded, the neutrals may also ally with you at a later stage of the campaign.

Ships galore - anti-ship missions now occur in the Campaign. Be careful, they are well defended with SAMs, and at sea there is no terrain to hide behind.

More enemies to fight through - there are more long-range strategic CAPs in Campaign. Be prepared to 'go stealthy' to avoid contact.

Deadlier opponents at airbases - when approaching enemy airbases in Campaign, the enemy fighters will scramble to intercept you. Approach with caution.

Plane arming screen - now available in campaign single and network play. Load up with your favorite weapons.

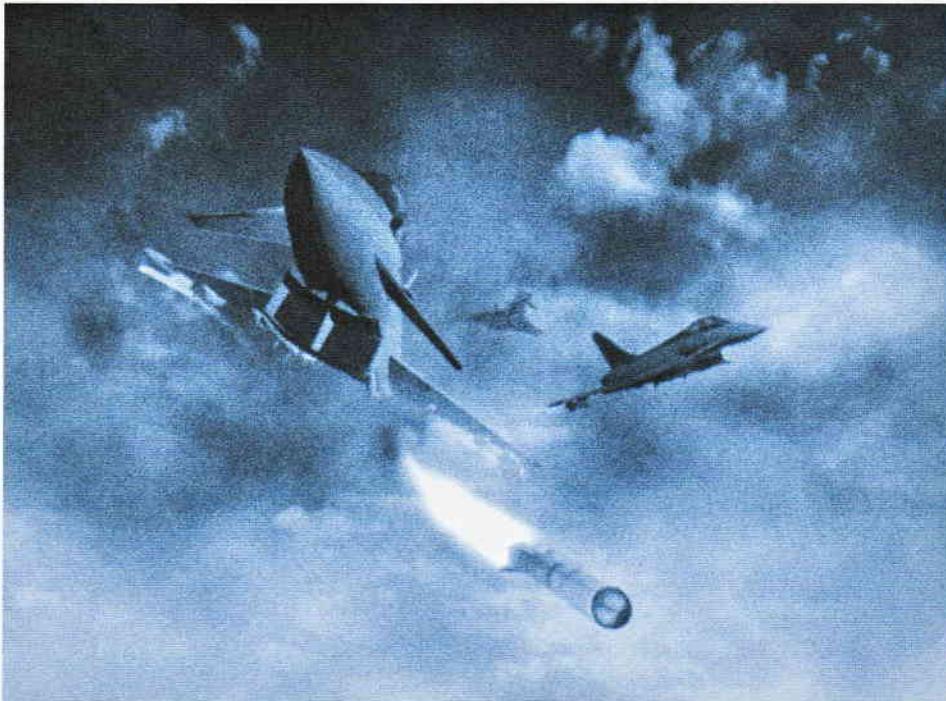
More detailed mission debriefings - you'll find out more about your exploits, and we have included debriefings for wingmen in the campaign.

NEW FEATURES FOR EF2000 V2.0

ENHANCEMENTS TO THE ORIGINAL EF2000

Time on target (TOT) is now included in the in-game mission briefing for simulator missions (<0> on the keypad).

You may also find the campaign automatically views eight hours for a number of days. this is not a bug, it is because your bases are decimated. Losing the War is often the result. However, do not give up - the neutrals may ally with you, and give you a fighting chance.



NEW FEATURES FOR EF2000 V2.0

ENHANCEMENTS TO THE ORIGINAL EF2000

MULTIPLAY ENHANCEMENTS

Eight player bonanza - now you can play with up to eight players in Network Campaign.

Improved Campaign debriefing in multi-player and single player - now you'll see your flight's route on map, and see markers where targets were destroyed.

Missiles in King Of The Skies - The server may now arm all planes with the load - out of their choice.

Refueling for all - all players can now refuel in Multiplayer games. It's demanding formation flying, especially at night.

Weapons firing off planes - as weapons are fired in MultiPlay, they will be removed from the firing aircraft. Now you will be able to see whether your opponent is fully armed.

Timeskip in network - any player can do this, in either campaign or simulator missions.

CAP together - four player CAP missions can now be played in the network.

Opponent and wingman names visible - names under 'locked' network players are now available in all network games (press shift N) to toggle these on and off.

Accelerated Time in network - any player can switch it on, in both campaign and simulator missions. If one player switches to accelerated time, anyone else can switch it off.

Arming screen in network campaign - load-out with your preferred weapons before flying.

NEW FEATURES FOR EF2000 V2.0

OTHER ENHANCEMENTS TO THE ORIGINAL EF2000

OTHER ENHANCEMENTS

The following have been added as alternatives for people using ThrustMaster equipment:
(Note, they do not work with the numeric keypad.)

- <alt 1> chaff.
- <alt 2> flares.
- <alt 3> radar scan range up.
- <alt 4> radar scan range down.
- <alt 5> radar Azimuth change.
- <alt 6> change radar mode.
- <alt 7> DASS range up.
- <alt 8> DASS range down.

New ground-attack command for wingmen - use the 'running-in' command and your wingmen will attack ground mobiles.

A smoother world - you'll see less 'rips' in the terrain for a steadier, smoother picture.

A more convenient set-up - in-game configuration settings will be saved automatically after one selection.

Safer low-level flying - when ground collision is imminent, a 'pull-up' voice warning is given, and a break 'X' is drawn on the HUD.

Loading times are visualised - there is an extending bar to indicate progress of software loading.

AWACS information is now more accurate.

Mission fixes - several missions were not working in the right way, and these have now been fixed. Problems included incorrect attack patterns, and improper weapons delivery.

No more stacked vehicles - ground vehicles no longer appear on top of each other in Campaign.

Emergency reference cards now available - damage systems are no longer swamped by the distorting MFD effect. Individual warning messages can be read correctly on the right-hand MFD.

Stealth improvement - radar is dissociated from the weapons selection. If you are flying with radar switched off, selecting S-225 or AMRAAMS will not turn the radar back on automatically.

No more limitless fuel - the plane will no longer fly above 60,000 ft and burn no fuel. You'll need to rethink your fuel strategy!

The 'MISSILE' warning that appears when you are threatened by a missile is now followed by a letter (I), or (R) to indicate the kind of missile tracking your plane.

The color of enemy IR missiles has been changed to orange on the DASS.

EF2000 FEATURES

EF2000 – THE NEXT GENERATION

Like the real EF2000, this simulation was designed to be different, to be the best in its class. Here are just a few of the features that we added with that goal in mind. . .

AN IMPROVED VIRTUAL COCKPIT

We threw out the traditional approach to PC cockpits and built a full 3-D 'virtual cockpit' that's as close to the real thing as possible with current technology. We squeezed an enormous amount of information into a small area without sacrificing too much realism. So now you can glance down at full-screen displays, look over your shoulder and launch an ASRAAM in a close-turning dogfight, or be amongst the first to test your skills in beyond-visual range combat using the top-secret ECR-90 radar and S-225 stealth missiles. And for anyone with fast machines, our SVGA mode delivers visuals that come close to costly military simulations.

A FRIENDLIER INTERFACE

We felt our interfaces should be fun to use, without getting in the way of what you want to

do. After a while, most pilots just want to hit a

few keys to get to their favorite part of the simulation. So EF2000 offers an easy-to-use menuing system that lets you get around fast, but offers plentiful game choices and greater flexibility in configuration.

IMPROVED PILOT AI

A great deal of time has gone into perfecting the way that computer controlled planes fly. We turned to the best books for advice, like R.E. Shaw's 'Fighter Combat and manoeuvring', and some of the best pilots. Jaguar units at R.A.F. Coltishaw provided us with expert advice on single-seat ground-attack missions, while an ex-F4 pilot supplied the finer points of air-defense tactics, especially in Norway. The result is an enemy who will constantly gauge your movements and act accordingly, piecing together myriad textbook manoeuvres into fluid dogfighting tactics. For these reasons, you can expect the air combat in EF2000 to be tough but exciting. Learn how to use your weapons and wingmen correctly, and you will enjoy mastering one of the world's most advanced aeroplanes.

UP-TO-DATE AVIONICS

Modern combat planes are getting so sophisticated that avionics designers are constantly searching for new ways to make the pilot's life easier. So instead of getting tougher to manage, modern combat planes will be easier to handle than ever. This trend is reflected in EF2000. You'll not only be amazed at what you can accomplish, you'll be surprised how easily it's all done.



EF2000 FEATURES

EF2000 – THE NEXT GENERATION

WINGMEN AT YOUR COMMAND

These days, few fly alone. In fact, air combat is all about multi-plane tactics, which is why we have developed a realistic method of wingmen control. And don't worry if you're a novice. The system has a beginners and advanced mode of control, to help you build confidence in commanding a flight of Europe's most advanced multi-role combat plane. In 'Beyond Visual Range' (BVR) combat, you'll discover that commanding wingmen and interpreting radar is a lot like playing 3-D chess. In close-up dogfights, you'll be glad of the extra help. You're going to need it!



BETTER 3-D ENVIRONMENTS

Improvements in hardware and software mean that one day, in the not-too-distant future, we'll be able to offer 3-D environments that rival those of the best military simulators. EF2000 already includes radical improvements to our 3-D engine, which provide highly detailed and realistic static scenery and moving objects. Furthermore, we have texture-mapped the entire world of four million square kilometers - and it's not all the same. Far from it. Check out the fjords in Western Norway. Zoom low over the marshy lowlands of Finland. Skim the dense forests and snowy mountain regions of the North Cape. EF2000 is also a 3D travel brochure! You'll need some time, but fly around and enjoy the views.

IMPROVED FLIGHT MODELS

Although EuroFighter is still a highly classified project, our aeronautical engineer has deconstructed available plans and created a flight model that's as accurate as possible in the circumstances (our consultant RAF pilots like it). We supplemented information from

British Aerospace with US Datcom files on aerodynamics and pilot advice on practical fly-by-wire handling characteristics. What's more, we have carefully modeled the flight characteristics of allied and enemy planes, so you can expect planes like the MiG-29 to perform as they would in real life.

NETWORKING FOR MULTI-PLAYER ACTION

Nothing is better than flying with or against another person. A great many TFX fans asked us to consider networking and serial communications in future products, and here it is. Up to eight players have access to our virtual combat environment, with several game formats to choose from. In fact multi-player EF2000 is so much fun, we strongly recommend you try it for yourself as soon as possible. Those of you interested in making a hobby out of it might want to contact our web site (www.did.com) for links to virtual squadrons. They organize regular meets and competitions using networking flight simulation programs.

EF2000 FEATURES

EF2000 – THE NEXT GENERATION

WARGEN - A MORE COMPLETE SIMULATION

A true simulator doesn't just model planes, weapons and scenery accurately. It must recreate the entire environment of conflict in order to create a true picture of how a modern multi-role aircraft might be used in future wars. In order to build this standard of realism into EF2000, we turned to the wargamers and military tacticians for input. By building our own 3-D wargaming engine that operates under AI control to a set of likely strategic conditions, we have been able to recreate the kind of tactical environments that EuroFighter was designed to fly in. Each time you play the campaign, you'll never see exactly the same moves by enemy or allies. Which means you'll be playing against our wargaming intelligence, not pre-determined game structures.

BETTER SOUND

In the flying environment, sound is not just there for the atmosphere. In a real aeroplane, many cues are received from physical sensation in response to forces such as rapid deceleration. In a PC simulator, the least we

can do is provide an audible cue to tell you that something is happening that you cannot feel or see; for example, that your airbrake is out, or that your afterburners are on. A great deal of time and effort has gone into the soundscape for EF2000, which we believe should add even greater depth to the gameplay. Listen carefully as you fly.



SUPER VGA

At DID, we are aiming to produce flight simulations for the entertainment market that

will rival military simulations costing a great deal

more. One step towards this goal is adopting Super VGA as a standard. In EF2000, all menus are in SVGA, but in-game visuals are available in both 320 x 200 and 640 x 400 resolutions. Even if your machine is too slow for in-game SVGA, switch over and take a look at what you're missing. It's got to be worth an upgrade!

THE EF2000

WHY, HOW AND WHERE IT WAS DEVELOPED.



GROUP CAPTAIN NED FRITH (RAF retired), head of EF2000 marketing at British Aerospace, ex-RAF test pilot and Operational Requirements Officer at the MOD explains a little about the background, development and specification of the EF2000.

"The Eurofighter program began in 1983, with a desire to produce an aircraft that could be used worldwide for defense well into the 21st century. This aircraft would be able to win against all current and projected threat aircraft.

The Eurofighter program started life as a collaboration between UK, France, Germany, Italy and Spain. However, France ultimately pulled out of the program, and the formal development phase began in 1988 in Spain, Italy, Germany and the UK. The EF2000 development was served by the Experimental Aircraft Program (EAP), which was funded largely by the U.K. After extensive ground trials and 259 sorties, some at over Mach 2, the EAPs development work was complete in mid 1991.

THE EF2000

WHY, HOW AND WHERE IT WAS DEVELOPED.

EAP and other technology demonstrators played a key role in the development of the EF2000 and although they cost over £190m, they saved £850m and a year of development time, so they were undoubtedly a good investment. We learned a lot about the airframe, avionics and engine features from these demonstrators before commencing development of the EF2000.

A turning point in the program came in 1992 at a meeting of the 4 countries' defense ministers at which they agreed "...on the essential elements of a political, strategic and economic approach to the new European Fighter Aircraft". They also agreed that the service entry point would be the year 2000 for the Royal Air Force and 2002 for the Luftwaffe, and the name EF2000 was created.

It is important to understand the requirement for the EF2000 in the context of the perceived threat. Defining this threat is the start point of any new military requirement and clearly no weapons system can claim to be successful, no matter how cheap, if it stands no chance of winning. Parity is not good enough.

Obviously, a great deal has changed since the threat was first defined for the development of EF2000. While there is no longer a direct threat from the Warsaw Pact, the risks to security are

now many faced and even less predictable. The technology that made up the Warsaw Pact threat still exists and could still be used by those who inherited it, or by those who will buy it. Accurate



THE EF2000

WHY, HOW AND WHERE IT WAS DEVELOPED.

prediction becomes impossible, as was demonstrated by the fact that no one was able to foresee either the Falklands War or the Gulf War, even three months prior to the event. And one thing which became clear after the Gulf War was the dominant influence of air power.

A threat has two main elements, intention and capability. EF2000's service life could stretch from 2000 to 2035 and no politician can predict the intention of other nations even a few years in advance. Yet the certainty is that the developments of the MiG-29 Fulcrum and those of the excellent SU-27 Flanker could be available to an adversary. Whereas a military capability takes a long time to evolve, political change resulting in an intent can happen, relatively, overnight. It is therefore imperative that we continue in development of our response to any potential threat, and continue with the objective of winning.

EF2000 has always been a multirole fighter. Air superiority is required to provide a secure base, to defend airfields, troops and assets generally. Local air supremacy is required over the enemy territory to allow troops to take ground, and all

the elements of Offensive Air Support will be needed to help the ground forces.

Reconnaissance is required to assess threats. The EF2000 will be a multi-weapon platform providing for all these roles, whether on behalf of NATO or in other groupings, such as those in the Gulf conflict in which the RAF participated.

The EF2000 is a single seater, twin engined, delta canard, although a proportion of the fleet will be two seat, dual control. It has 13 store stations, three of which are wet, and an internal gun on the starboard side. The architecture will allow future 'smart' weapons to be carried with little modification. The main aerodynamic and thrust criteria for the EF2000 are determined by turning capability at high altitude and high supersonic Mach numbers, and by subsonic manoeuvrability at sea level. It is from these criteria that the aircraft meets the requirement to operate from a short runway strip.

For air combat, a mixture of at least 10 future medium range and advanced short range missiles can be carried, with four of the medium range missiles housed in low drag, radar stealthy under-fuselage stations. For attack

missions, combinations of seven air-to-surface weapons and six air-to-air missiles are possible, along with external fuel tanks and the internal gun. One of the under fuselage missile stations will be used when a laser designator pod is carried.

The two wingtip pods are an integral part of the wing and house part of the Defensive Aids Sub System (DASS) countermeasures equipment. EF2000 also has good radar stealth features. Besides the recessed weapons, the low frontal radar cross-section (RCS) is with a realistic operational load.

The airframe surface is only 15% metal. Extensive use has been made of load-bearing carbon fibre composites and aluminium lithium, resulting in a 30% weight saving over previous construction methods. This obviously has an important bearing on performance.

To operate from ill-prepared bases, the EF2000 has a strengthened undercarriage, built-in entry system for the pilot, an on-board oxygen generation system and an auxiliary power unit for running the nuclear, chemical and biological

THE EF2000

WHY, HOW AND WHERE IT WAS DEVELOPED.

filter system and for the autonomous check out, alert and start up.

Unprecedented attention has been paid to the man/machine interface to allow pilots to think less about the operation of the aircraft and more about the tactics of the conflict. The quadruplex fly-by-wire control systems give the pilot carefree handling, ensuring that he cannot stall or overstress the aircraft. An intelligent Ground Proximity warning system (GPWS) further enhances the safety and operational capability. The pilot also has a button which will automatically return the aircraft to a wings level, nose up attitude in the event of disorientation after a high G force manoeuvre. This will undoubtedly save a number of lives and aircraft over the years.

There is an advanced Infra Red Search and Track system (IRST) to compliment the ECR90 multi mode Pulse Doppler radar with multi-track target-while-scan capability and high resistance to jamming. A helmet mounted sight and display will also help the pilot to exploit the new missile systems. With the Advanced Short Range Air-to-Air Missiles (ASRAAM) and the helmet sight, the

pilot will be able to engage targets 'over-the shoulder'.

To make life easier for the pilot in the cockpit, all the important switches needed in combat are mounted on the throttle or stick. The holographic Head-Up Display (HUD) and three head down displays (HDD), which are viewable even in bright sunlight, help the pilot to assess the air situation easily.

Subsystem management is automatic with the pilot intervening only when absolutely necessary. Using Direct Voice Control for some non safety-critical systems, such as the allocation of targets or requesting the fuel state, further reduces pilot workload.

All in all, the EF2000 has been developed with the pilot in mind, requiring him to extend the minimum effort to digest the maximum information and enabling him to concentrate on the tactics of the conflict.

As I said earlier, parity with an enemy is not good enough. To this end, the EF2000 has been



THE EF2000

WHY, HOW AND WHERE IT WAS DEVELOPED.

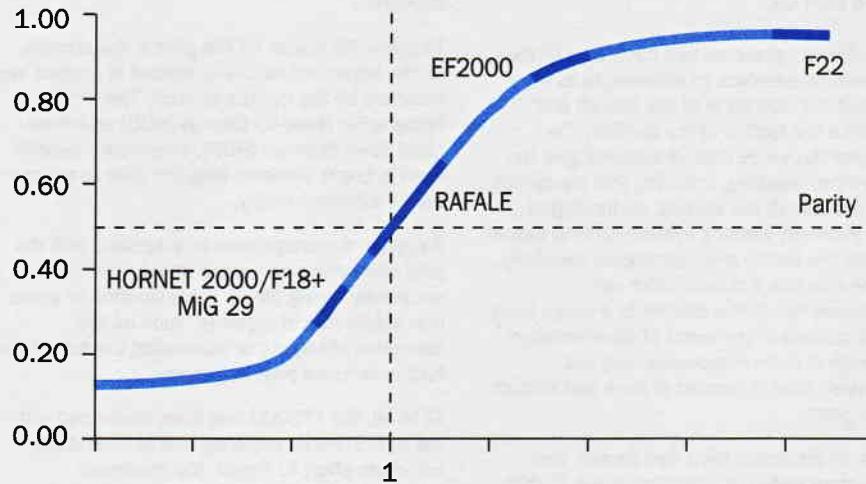
designed to outperform the projected threat aircraft in both Beyond Visual Range (BVR) combat and close 'dogfight' style combat.

Comprehensive operational studies, including manned simulations, have pitted EF2000 against potential opposition from expected upgrades of the MiG-29 Fulcrum and the SU-27 Flanker. The studies also included other modern combat aircraft. Whilst details of these studies must remain classified, the EF2000 performed favourably in both BVR and close combat situations.

One way of expressing the BVR capability is to look at an air combat effectiveness rating graph. This is calculated using information from the studies and uses the worst case scenario as an opponent, in this case an upgraded SU-27 Flanker. A score of 1 on the graph means that you would always win against the SU-27, while a score of 0 means you would always lose. A score of 0.5 indicates parity, or 50:50.

As you can see, the EF2000, with a score of 0.82 is well within the 'Always Win' sector and is bettered only by the U.S. F-22. It should be noted, however, that this aircraft is twice the cost of the EF2000 and does not have the air-to-

BEYOND VISUAL RANGE COMBAT - 1 VERSUS 1



BVR Combat Parameter Ratio Vs BVR Projected Threat

surface capability of the EF2000.

One of the main reasons for the excellent performance of the EF2000 is that it can out-turn the SU-27 Flanker and its developments at both

subsonic and supersonic speeds and it will also out-accelerate them. In fact, the EF2000 will accelerate and climb from runway alert to Mach 1.5 at above 35,000 feet in less than 2.5 minutes. At high altitude, carrying four medium

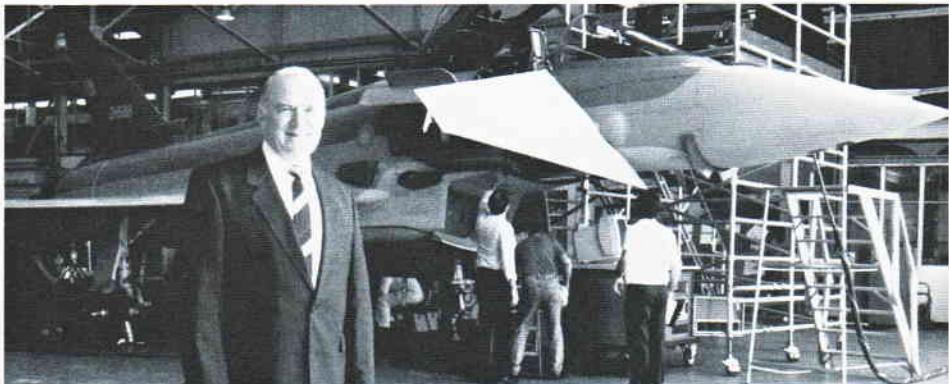
THE EF2000

WHY, HOW AND WHERE IT WAS DEVELOPED.

range and two short range missiles, the aircraft will cruise above Mach 1 without the use of reheat. At low level, in just 30 seconds, it can accelerate from 200 knots to Mach 1.

The new multi-role fighter's ferry capability of about 2,000 nautical miles, without mid air refueling, will be a useful feature for world wide deployment. With dispersed operation in mind, the aircraft has an impressive short-field performance. For example, with the two Eurojet turbo-fan engines delivering just over 40,000lb of thrust, the take off distance with full internal fuel, gun, ammunition, four medium range and two short range missiles, is only about 300 metres, and the aircraft is airborne in less than seven seconds.

On Sunday 27 March 1994, on a bright day in Bavaria, Peter Weger, the chief test pilot of MBB, took off for the first flight of the prototype EF2000. this was an important milestone in the development of the aircraft. Subsequently there have been many flights of further prototypes and the EF2000 is now well on track for delivery to the RAF in the year 2000.

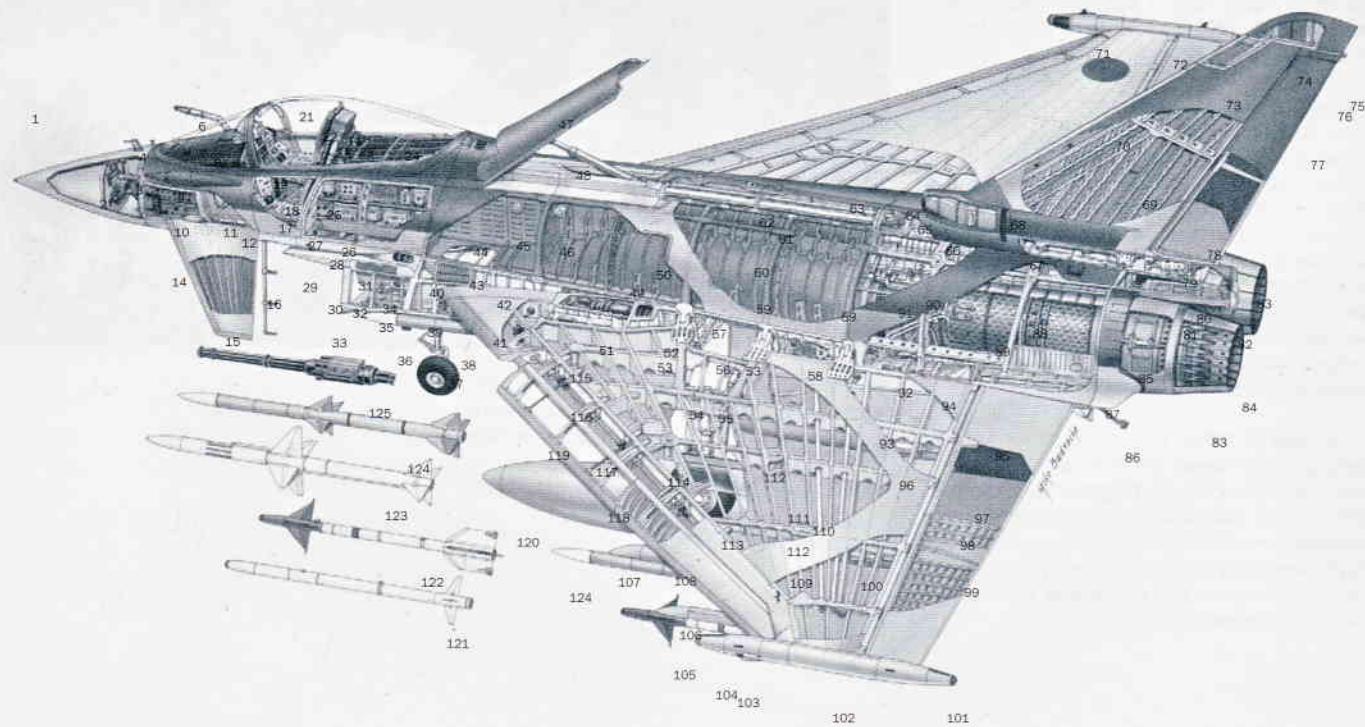


This aircraft represents a major development in aircraft technology and will provide the best air defense worldwide well into the 21st century.

I hope you enjoy flying it!"

Group Captain Ned Frith

EUROFIGHTER 2000



EUROFIGHTER 2000

- 1 Glass-reinforced plastic (GRFP) radome
2 GEC-marconi avionics ECR 90 multi-mode pulse doppler radar scanner
3 Scanner tracking mechanism
4 Pitot head
5 Temperature probe
6 Retractable flight refuelling probe
7 GEC-Marconi Avionics head-up display
8 Instrument panel shroud
9 Forward looking infra-red (FLIR)
10 Radar equipment module
11 Rudder pedals
12 Foreplane hydraulic actuator
13 Pivot bearing
14 Port canard foreplane
15 Foreplane diffusion bonded titanium structure
16 Retractable boarding steps
17 Side console panel with engine throttle levers
18 Control column, Bodenseewerk Geratechnik quadruplex digital fly-by-wire system
19 Instrument panel with Smiths Industries full-colour head-down-displays
20 Rear view mirrors
21 Upward hinging cockpit canopy
22 Martin-Baker Mk 16A 'zero-zero' ejection seat*
23 Cockpit pressurization valves
24 Canopy rear decking
25 Avionics equipment bay
26 Fuselage strake
27 Sloping cockpit rear pressure bulkhead
28 Air conditioning plant beneath avionics bay
29 Boundary layer splitter plate, bleed air perforations on lower surface
30 Port engine air intake
31 Bleed air spill louvers
32 Intake central divider
33 Variable capture area articulated intake lower lip
34 Canopy external release
35 Intake lip hydraulic actuators
36 Lower UHF antenna
37 Aft retracting nose undercarriage
38 Forward fuselage semi-recessed missile carriage
39 Pressure refuelling connection
40 Air conditioning system heat exchanger exhaust
- 41 Fixed inboard wing leading edge
42 Fuselage lower longeron
43 Intake trunking
44 Forward fuselage fuel tank, port and starboard
45 Gravity fuel fillers
46 Canopy hinge point
47 Dorsal airbrake
48 Airbrake hydraulic jack
49 Centre fuselage integral fuel tanks
50 Fuel tank access hatch
51 Auxiliary power unit (APU) cannon bay on starboard side
52 Ammo magazine, cross feed to starboard cannon
53 Titanium wing panel attachment fittings
54 Main undercarriage leg pivot mounting
55 Hydraulic retraction jack
56 Main undercarriage wheel bay
57 Carbon-fibre composite (CFC) centre fuselage skin
58 Secondary Power System (SPS) equipment bay, airframe mounted gearbox
59 Machined wing panel attachment main fuselage bulkheads
60 Fuselage upper longeron
61 Dorsal spine fairing air and cable ducting
62 Anti-corrosion strobe light
63 Starboard wing integral fuel tank
64 Wing tank fire suppressant foam filling
65 Heat exchanger ram air intake
66 Engine bleed air primary heat exchanger
67 Heat exchanger exhaust shield
68 Fin CFC skin panel
69 Aluminium-lithium (Al-li) 'sine-wave' fin spars
70 Al-li leading edge
71 Starboard navigation light
72 Wing tip active jamming pod
73 HF antenna
74 Upper UHF/IFF antenna
75 Tail navigation light
76 Fuel jettison
77 Rudder
78 Rudder honeycomb core
79 CFC skin panels
80 Rudder hydraulic actuator
81 Brake parachute stowage
82 Parachute door
83 Engine nozzle shroud panels
- 84 Variable area afterburner nozzle
85 Afterburner nozzle actuator (4)
86 Emergency arrester hook
87 Tailpipe sealing plates
88 Rear engine mounting
89 Eurojet EJ2000 afterburning low-bypass turbofan engine
90 Forward main engine mounting spigot
91 Fuel system piping
92 Engine accessory equipment
93 Port wing integral fuel tank
94 Rear missile housing
95 Port inboard elevon
96 Inboard elevon hydraulic actuator in ventral fairing
97 Elevon honeycomb core
98 CFC skin panels
99 Outboard elevon all-titanium structure
100 Outboard elevon hydraulic actuator in ventral fairing
101 Rear RWR antenna
102 Port wing tip active jamming pod
103 Ventral cooling air section
104 Port navigation light
105 Forward RWR antenna
106 Outboard missile pylon
107 Intermediate pylon
108 Port leading edge slats
109 Wing panel CFC skins
110 Cable conduits
111 Multi-spar aluminium alloy wing internal structure
112 Pylon mounting hardpoint
113 Port mainwheel
114 Leg door mounted landing/taxiing lamp
115 Inboard stores pylon mounting hardpoint
116 Front spar
117 Slat operating torque shaft and screw jacks, central hydraulic drive motor
118 Al-li slot rib structure
119 Slat guide rails
120 External fuel tank
121 BAe advanced Short-Range Air-to-Air Missile (ASRAAM)
122 AIM-9L Sidewinder air-to-air missile
123 BAe Sky Flash intermediate range air-to-air missile
124 AIM-120 AMRAAM, advanced medium range air-to-air missile
125 Mauser 27mm cannon, mounted in starboard wing root

EF2000 V2.0 INSTALLATION (DOS)

GETTING STARTED

Note: Although Graphics+ only runs in DOS, it must be set up and run from Windows 95.

MINIMUM SYSTEM REQUIREMENTS

120 MHz Pentium compatible processor.
System Memory: 16 MB of RAM, with 5 MB EMS free.
Hard Drive: with at least 12 MB free.
Conventional Memory: at least 500 KB free.
Graphics: VESA compliant SVGA graphics card and SVGA colour monitor.
CD-ROM Drive: one single or double-speed
DOS: MS-DOS 5.0 or higher.

RECOMMENDED SYSTEM SETUP

For best results with EF2000, you should have the following:
120 MHz Pentium compatible processor.
16 MB RAM with EMS (expanded memory) manager.
MPC level 2 compatible CD-ROM drive with quad speed.
Hard drive with at least 5 MB free after installing the game files.
A fast VESA compliant SVGA graphics card with PCI or VESA local bus.

Joystick, CH FlightStick Pro, ThrustMaster Flight Control System (FCS or F-16), ThrustMaster Weapons Control System (WCS or TQS).
A Microsoft compatible mouse.
Sound Blaster AWE32 or Gravis Ultrasound.
A 3Dfx or Rendition equipped 3D accelerator card.

VESA GRAPHICS SET-UP

Some newer graphics cards are VESA SVGA compliant in hardware. However, the majority of cards require a driver to be installed first. To do this, find the installation software that was included with your computer system or graphics card, and locate the VESA driver. If you have no luck, updated drivers are often found on BBS. Alternatively, copy the file UNIVBE.EXE from the EF2000 CD-ROM to your root directory, and type UNIVBE at the C:\ prompt. Note the message printed on your screen. If all is well, it will have registered the chip-set of your card, and you should be able to run EF2000. If this fails, then contact the supplier or manufacturer of your graphics card for the correct driver, and notify Digital Image Design.

MEMORY TIPS

EF2000 requires 500 KB of conventional memory, which may be a problem with some system set-ups. Please be aware that 500 KB is actually 512 KB (1 KB = 1,024 bytes). To check how much conventional memory you have free, type MEM/C at the DOS prompt. Memory allocation on IBM compatible PCs is a complex business, so please consult your DOS manual for advice.

HOW TO WIN MORE MEMORY

The easiest way to get enough memory to run EF2000 is to create a boot disk and use it to start your computer when you want to play. When installing EF2000 you will be asked whether you want to make such a disk. Make sure that the CONFIG.SYS and AUTOEXEC.BAT files of the boot disk contain the drivers necessary to run your CD-ROM drive and your mouse.

Have a formatted 1.44 MB floppy disk ready if you want to make a boot disk. In addition, check your CONFIG.SYS file to ensure that it has the DOS=HIGH command. This is very important, as DOS cannot be loaded high without it. If you

EF2000 V2.0 INSTALLATION (DOS)

GETTING STARTED

have Terminate-and-Stay-Resident (TSR) programs - such as mouse drivers, network drivers, DOS shells and RAM disks - make sure they are loaded into high memory with the DEVICEHIGH (in CONFIG.SYS) or LOADHIGH (in AUTOEXEC.BAT) commands. Consult your DOS or expanded memory manager manual for precise details. Some TSRs will not load into high memory. Make a boot disk which excludes these TSR programs.

WARNING. BEFORE CHANGING YOUR CONFIG.SYS OR AUTOEXEC.BAT FILES, (SYSTEM FILES) ALWAYS COPY THEM TO A BOOTABLE FLOPPY DISK! IF ANYTHING GOES WRONG, BOOT YOUR COMPUTER WITH THIS DISK AND COPY THE SYSTEM FILES BACK TO THE HARD DISK, REPLACING THE FAULTY SYSTEM FILES.

The EMM386 memory manager included with MS-DOS 5.0 or 6.0 should be adequate. If not, try using a commercial EMS manager such as the type supplied with QEMM by Quarterdeck. Third-party EMS managers often use less conventional memory and improve your ability to load TSRs into high memory. Commercial EMS

managers can also provide you with additional expanded memory without modifying your CONFIG.SYS file. However we cannot accept responsibility for any problems encountered with such third party memory managers.

If you have DOS 6.0 or higher, use the memory optimizer called MemMaker. Simply type MEMMAKER and press Enter at the DOS prompt. MEMMAKER will alter your CONFIG.SYS and AUTOEXEC.BAT files to make your setup more memory efficient. MEMMAKER will try to load as much into high memory as possible. If it will not remove TSRs that cannot be loaded high. If, after running MEMMAKER, you still don't have enough conventional memory free, you should edit your CONFIG.SYS and AUTOEXEC.BAT files to avoid TSRs that cannot load high (type REM before the line which loads the TSR). Refer to the DOS 6.0 manual for more details on MEMMAKER and editing system files.

TO INSTALL EF2000

NOTE: EF2000 requires that several files be installed on your hard disk.

1. Place the CD-ROM in the CD-ROM drive.

2. Make sure that the CD-ROM drive is the current drive. (Type the letter of that drive usually D: or E:, followed by a colon, then press ENTER.)
3. Type the word 'INSTALL' and press ENTER.
4. Follow the on-screen instructions.
5. We recommend you run the built-in diagnostics routines to check that your hardware is fully compatible with the software.
6. We also recommend that you calibrate your joystick.
7. Making a boot disk is always a good idea too, as this can help resolve any hardware/software conflicts quickly.
8. Once the installation and set-up routines are complete, the game is ready to play. Switch to the hard disk where your EF2000 directory is installed, and type 'EF2000'.

CONFIGURATION AFTER INSTALLATION

To change hardware configuration after running the install program, change to the EF2000 directory and type 'CONFIG'. A screen appears that allows you to modify the entire set-up. Once you have made changes, be sure to press the 'SAVE' button before returning to DOS.

EF2000 V2.0 INSTALLATION (Win 95)

To install EF2000 for Windows 95 to your computer, first place the CD into the CD-ROM drive. If the autorun feature is enabled, the set-up program will run automatically. If the autorun feature is disabled, run the set-up program directly from the CD-ROM drive, or click on START, then RUN and type D:\setup.exe (where D: is the CD-ROM drive).

The set-up program will run through the various options and parameters required for the partial or full installation of EF2000 for Windows 95.

Once the Installation is complete the game can be started by clicking on START, then PROGRAMS, followed by D.I.D., and finally the EF2000 executable.

UNINSTALLING EF2000

EF2000 can be uninstalled by clicking on ADD/REMOVE PROGRAMS in the control panel window. Select EF2000 from the list and click on the ADD/REMOVE Button. this will delete the game from your hard drive and remove the shortcut and program folder. If all the program

files are not removed, normally all the game specific files are located in PROGRAM FILES\DIGITAL IMAGE DESIGN\SEF2000\. There may also be a temporary file called EF2000. \$\$\$ in the root directory. Deleting these files will completely remove EF2000 from your computer.

NOTE. Before deleting any files manually, first apply the automatic uninstall procedure.

ON-LINE GRAPHICAL HELP

Included with the game is a graphical help file - a virtual ground-school for trainee pilots. this gives information about the operation of EF2000, using images directly from the game. It even allows simulations of features like the TIALD laser-guided bombing system, making it easy to familiarise yourself with its procedures. In game, context sensitive help is available by pressing ALT F1. Opening the help file will pause the game while you read. After closing the help file or clicking on the EF2000 window you will need to press P to unpause the game.

Alternatively the help file can be viewed out of

game by clicking on START, then PROGRAMS, followed by D.I.D., and finally ON-LINE HELP.

WINDOWS 95 SPECIFIC KEYS

Windows requires that some keys are used to control windows functions. For example, ALT-TAB will let you switch to another application. For this reason, any reference to the ALT key within the game will usually refer to the RIGHT ALT key. The LEFT ALT key is used for Task switching (LEFT ALT - TAB) or for Full screen mode toggle (LEFT ALT - ENTER)

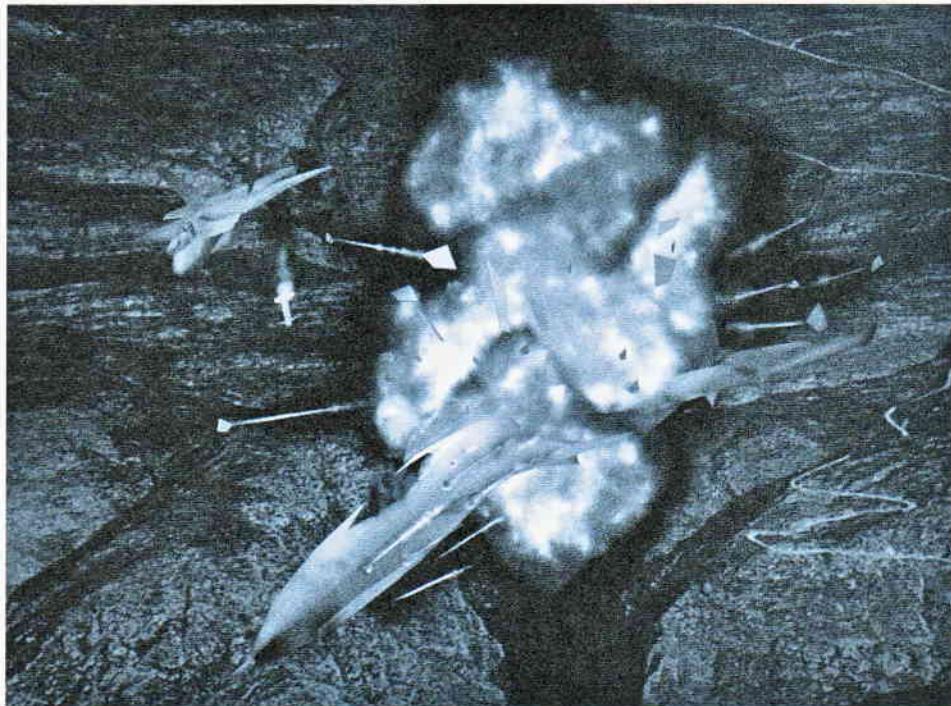
EF2000 V2.0 INSTALLATION (Win 95)

CONFIGURING EF2000

Hardware configuration is now handled by Windows 95. The joystick can be configured from within the control panel, using software provided by joystick manufacturer or the default Microsoft set-up procedures. Sound cards are also controlled by the windows environment. If you experience difficulties with any hardware or peripherals, please consult the hardware manuals or Windows 95 documentation.

SETTING OPTIONS FOR EF2000

On installation you will be prompted for desired detail levels, sound set-ups etc. If you wish to change these settings at a later date simply re-run the install procedure. The install program will ask you if you want to change any settings. The game does not have to be re-installed for these changes to take effect.



GRAPHICS+

RUNNING GRAPHICS+ IN A WINDOWS ENVIRONMENT

The Graphically enhanced version of EF2000 V2.0 is a DOS program. Due to its size the program may only run reliably within a windows environment.

CONFIGURING A WINDOWS 95 DOS BOX

1. Click with your right mouse button on an empty area of your Windows 95 desktop.
2. From the menu, select 'New'.
3. From the submenu, select 'Shortcut'.
4. In the 'Command line' edit box, type the drive, path, and filename of the games batch file. e.g. C:\EF2000\EF2000.BAT
5. Type a name for the shortcut. e.g. EF2000 V2.0 Graphics +
6. Now select an icon for the shortcut.

The shortcut will now be on your desktop. Click with your right mouse button on the newly created shortcut.

Select 'Properties' from the menu.

On the 'Program' tab page :

1. Ensure that the 'Working' edit box specifies the drive and path in which the game files are located. e.g. C:\EF2000
2. Put a check in the 'Close on exit' checkbox. Should you encounter any problems running the game, this can be unchecked so that any errors returned to the DOS box can be reported.

On the 'Memory' tab page :

1. Set 'Initial environment' to 2048.
2. Put a check in the 'Protected' checkbox.
3. Set 'Expanded (EMS) memory' to None.
4. Set 'Extended (XMS) memory' to None.
5. Put a check in the 'Uses HMA' checkbox.
6. Set 'MS-DOS protected-mode (DPMI) memory' to 65535.

On the 'Screen' tab page :

1. Select the 'Full-screen' radio button.
2. Uncheck the 'Dynamic memory allocation' checkbox.

On the 'Misc' tab page :

1. Uncheck the 'Allow screen saver' checkbox.
2. Move the 'Idle sensitivity' slider to low.
3. Uncheck all of 'Windows shortcut keys' checkboxes.

Finally, click on 'OK'. The shortcut is now configured and can be run by double clicking it.

GENERAL 3D CARD CONTROLS

ALT F7 - Decrease gamma correction

ALT F8 - increase gamma correction

GRAPHICS+

RUNNING GRAPHICS+ IN A WINDOWS ENVIRONMENT

3DFX BASED CARDS

Although this game is run from Windows 95, it is not a native application. This means that GLIDE.DLL and SST1INIT.DLL (3Dfx's proprietary Windows 95 DLLs) are not used have no bearing whatsoever on the product's performance.

When running on some systems, the game's sound effects may be heard to stutter. Should you encounter this problem, the 3Dfx wait should be increased as per keys below until the sound resumes normal operation. The default is to not wait at all.

ALT - Decrease 3Dfx wait.

ALT + Increase 3Dfx wait.

It should be noted that the above keys must be pressed repeatedly - they do not auto repeat.

RENDITION V1000 BASED CARDS

The Rendition V1000 version of the game utilises the Windows 95 display drivers. Some older versions of these drivers fail when used by

a DOS program. Always ensure that the most recent drivers are installed and selected.

ALT F9 - Toggle shape anti-aliasing on/off. This results in mobile shapes such as planes and tanks having their outlines smoothed.

ALT F10 - Cycle gamma correction mode. Initially gamma correction affects red, green and blue simultaneously. By changing the gamma correction mode, subsequent presses of ALT F7 and ALT F8 can be made to affect red, green and blue components individually. The available modes are RGB (simultaneously), R (individually), G (individually), and B (individually).

EF2000 CONTROLLERS

SETTING-UP YOUR PREFERRED INTERFACE

KEYBOARD

The cursor control arrows may be used to control the EF2000's direction of flight. This may be a convenient option for portable computers, but we strongly recommend a joystick for flight control. See 'Key Summary' for an overview of all key controls.

ARROW KEYS: Pitch up, pitch down, left and right.

MOUSE

The installation program auto-detects the presence of a mouse driver, and utilizes the driver if found. EF2000 supports Microsoft compatible mouse drivers. A mouse is necessary for selecting various control options during the game.

N.B. A mouse cannot be used for controlling aircraft movement.

LEFT-BUTTON: Select/deselect function.

RIGHT-BUTTON: Equivalent to the ESC key.

SINGLE JOYSTICK

A joystick provides a higher degree of control compared with the keyboard. this option is activated by selecting 'One Joystick' when editing the EF2000 CONFIG file, or when in the SET-UP screen.

JOYSTICK MOVEMENT: back to pitch up, forward to pitch down, left and right for sideways motion.

BUTTON 1: Fires the selected weapon.

BUTTON 2: Toggles selected weapons.

JOYSTICK WITH THROTTLE

The joystick and two buttons function in the same manner as in the 'One Joystick option'. this joystick has an extra control in the form of a throttle wheel or lever, which controls the EF2000 engine power. The throttle device takes precedence over the keyboard throttle, which is disabled.

JOYSTICK MOVEMENT: Back to pitch up, forward to pitch down, left and right for side movement.

BUTTON 1: Fires the selected weapon.

BUTTON 2: Toggles selected weapons.

THROTTLE WHEEL: Adjusts the EF2000 throttle.

THRUSTMASTER FLIGHT CONTROL SYSTEM

EF2000 supports the ThrustMaster Flight Control System, which consists of a standard pistol-grip type flight stick, a four position hat controller, and four buttons. The flight stick portion of the Flight Control System functions in the same manner as a standard joystick.

The hat is used to control simulation points-of-view. when you are in the pilot's cockpit, the hat is used to control your in-board point-of-view. All of the corresponding keyboard controls remain active.

JOYSTICK MOVEMENT: Back to pitch up, forward to pitch down, left and right for side movement.

EF2000 CONTROLLERS

SETTING UP JOYSTICKS WITH WINDOWS 95

JOYSTICK SECTION

Your joystick should be Windows 95 compatible and set up in accordance to the instructions provided by the joystick manufacturer. To set up a joystick, open the control panel and click on the joystick icon. If the joystick has software drivers supplied, then these should provide an option within the joystick set-up.

If you are using a joystick that doesn't provide Windows 95 drivers then you will have to set up your joystick in a generic way. For instance, if you have a joystick with a built in throttle, select either 3-axis 2 button joystick or 3-axis 4 button joystick. There is also a custom setting in joystick set-up. This will allow you to configure Windows 95 with the correct set-up for your type of joystick. For more information on configuring joysticks within Windows 95 please consult your Windows 95 and joystick literature.

PROGRAMMABLE JOYSTICKS

If your joystick is programmable and does not have Windows 95 drivers or programming software, the joystick will still need to be configured for Windows 95 however.

To configure Thrustmaster F16 and TQS for Windows 95, open the joystick section within the control panel then select "2 button flight yoke w/throttle" and follow the instructions.

Programming the buttons can be performed with the included CS Commander software. Files for button set-up are supplied in the "JOYSTICK" folder.

EF2000 CONTROLLERS

SETTING-UP YOUR PREFERRED INTERFACE

THRUSTMASTER F-16 & F-22 FLIGHT CONTROL SYSTEM

One of the latest Flight Control Systems from ThrustMaster, modeled on the real sticks. It also closely resembles the centrally positioned joystick of the EuroFighter, and is therefore a good choice for use with EF2000.

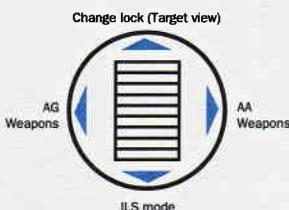


1 Afterburners On/Off



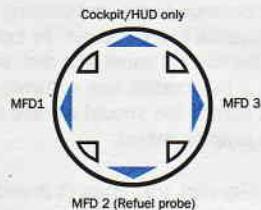
2.

3. Virtual track On/Off

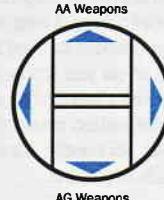


4.

5.



6.



7. Pinky button – commands in brackets.

8. Hi-res/Lo-res

9. Release weapon

NOTE. All ThrustMaster configurations are suggestions only.

EF2000 CONTROLLERS

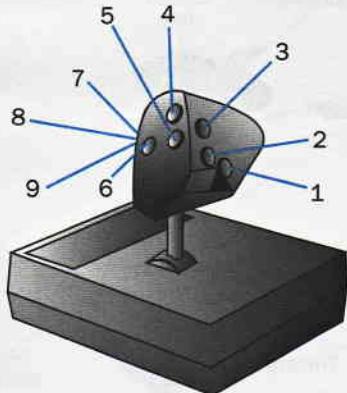
SETTING-UP YOUR PREFERRED INTERFACE

THRUSTMASTER WEAPON CONTROL SYSTEM

The ThrustMaster Weapon Control System replaces many keyboard functions with a convenient one-handed controller. It includes a throttle lever, six push buttons, and one rocker switch. There is no set-up choice for the WCS in the configuration file or SET-UP screen; it is activated by attaching it to your computer and

keyboard. To activate, follow the installation instructions included with the unit. The Weapon Control System is a keyboard emulator that simply duplicates the entry of certain keys. Setting specific dip switches to the "on" position configures the WCS unit for EF2000. See addendum - THRUSTMASTER CONFIG FILES.

1. Map toggle
2. Chaff
3. Flares
4. Engine start left
5. Engine start right
6. Gear up/down
7. Rocker positions;
8. Rocker up: Wheel brakes
9. Rocker middle: N/A
9. Rocker down: Airbrakes

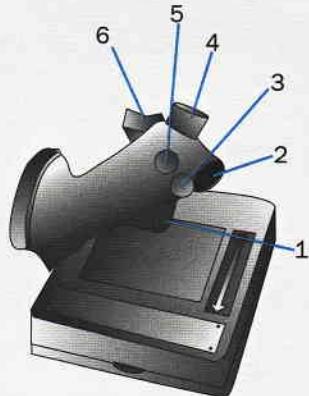


EF2000 CONTROLLERS

SETTING-UP YOUR PREFERRED INTERFACE

THRUSTMASTER THROTTLE QUADRANT SYSTEM

This is the latest throttle system from ThrustMaster. It features a thumb-trackball, which is ideal for use with the EF2000 in-cockpit graphical user-interface (mouse controlled MFDs).



1. Trackball
2. N/A

3. Afterburner

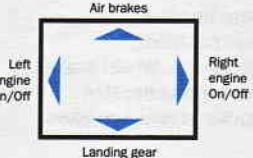


4. N/A

5. Defenses



6. General



CH FLIGHTSTICK PRO

this is an excellent and affordable joystick which is highly recommended for use with EF2000. It has a coolie hat, several buttons and a built-in throttle

JOYSTICK MOVEMENT: Back to pitch up, forward to pitch down, left and right for side movement.

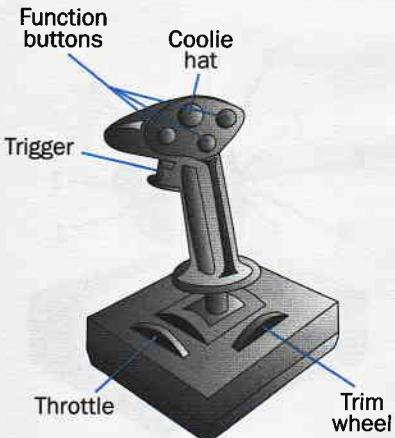
BUTTON 1: Fires the selected weapon.

BUTTON 2: Select weapon

BUTTON 3: Cycles targets in radar, HUD and Padlock view.

THROTTLE WHEEL: Adjusts the EF2000 throttle

COOLIE HAT: Activates various views



EF2000 QUICK START

HOW TO USE THIS HANDBOOK

GETTING STARTED FAST

This manual starts by giving a few tips on how to get in the air fast. However, we hope that you will eventually take the time to read this handbook, and understand some of the amazing concepts that are going into a new generation of fighter aircraft like EF2000. Every section has been thoroughly researched, and it's not just a book of how to work the game. It has been written to give you a better understanding of why planes like EF2000 are built, and why they are built the way they are.

SOME GENERAL HINTS

Writing a manual to cater for everyone is no easy task. Some people want plenty of background information, others want the relevant gameplay facts, and a few simply want the key guide. We have tried to keep everyone happy, by writing for every type of player.

NOTE: in the sections covering key commands, there are two types of keys shown: standard keyboard types and Multi-Function Display keys from within the game.



If you can't wait to get airborne, we suggest that you go to the simulator and select free flight. This will give you a chance to explore the beautiful scenery that stretches over four million square kilometers. The next section contains a few tips on how to get in the air fast.

If you have any ideas or additions that you feel would be useful for EF2000 pilots, please send them to: The EF2000 Project Manager, Digital Image Design, Tannery Court, Tanners Lane, Warrington, Cheshire, WA2 7NR, England.

EF2000 QUICK START

SO YOU WANT TO FLY NOW?

If you can't wait to get airborne, go to 'Quick Combat'. Alternatively, for a little sightseeing in the four million square kilometer world, go to 'Simulator' and select the 'Free-flight' and choose a location.

- * Experiment with the control method you have chosen. If you are not sure whether this is set correctly, select the appropriate controller from the set-up menu.
 - * Experiment with the throttle settings (+ and - keys, or other controller if fitted)
 - * Experiment with AG weapons by pressing 'backspace' to make new selections.
 - * Experiment with AA weapons by pressing 'ENTER' to make new selections
 - * SPACEBAR or the joystick releases
- weapons, unless they are the type that needs a target lock-on.
- * Press 'B' to extend the airbrake and see what happens. Don't slow down too much, however.
 - * Fly around, try a few rolls and loops, just to get the feel.
 - * If you lose too much airspeed, activate the reheat (afterburner) by pressing the * key. Turn off the reheat by pressing '/'.



EF2000 QUICK START

QUICK CONTROL FAMILIARIZATION

If you can't wait to fly before discovering all the amazing EF2000 systems, here's a quick key guide to get you airborne and down again with the minimum of fuss.

[]	Engines ON/OFF	Space	Fire weapon
+ -	Throttle UP/DOWN	Enter	Select AA weapon
B	Airbrake ON/OFF	←	Select AG weapon
* /	After burner ON/OFF	P	Pause
W	Wheelbrake ON/OFF	G	Landing Gear UP/DOWN
Shift	Ejection (press twice)	Shift Q	Quit
Esc		Shift S	Skip to next event

THE EASY VIEW GUIDE

7
SCROLL
VIEW
LEFT

8
HUD
VIEW

9
SCROLL
VIEW
RIGHT

4
WARNING
PANEL

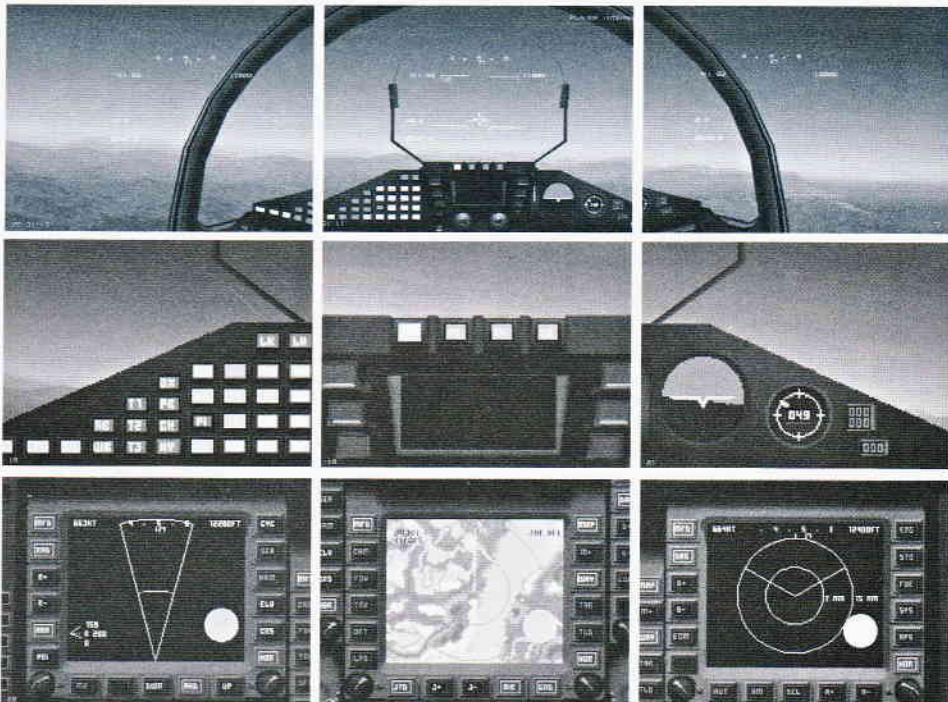
5
IRST

6
HORIZON
&
COMPASS

1
MFD 1

2
MFD 2

3
MFD 3



Each of the nine numeric Keys represents a key view
in EF2000

EF2000 KEYS

KEY SUMMARY

GENERAL IN-GAME CONTROLS

ALT D
Changes the detail level in the game.

KEY `
Select set-up menu.

ESC
Leave set-up menu or load/save game screen.

KEY P
Pause game, but still have access to the cockpit functions.

ALT R
Switch resolutions in game.

SHIFT C
Cycle browse plane views.

GENERAL AIRCRAFT CONTROLS

KEY G
Retracts or lowers the landing gear.

KEY < OR >
Move rudder left and right (in the air).

ENGINES

KEYS [and]
Left and right engines on/off.

KEYS + and -
Throttle up/down.

NUMERIC KEYPAD *
Afterburner on.

NUMERIC KEYPAD /
Afterburner off.

BRAKES

KEY B
Airbrake on/off.

KEY W
Wheelbrake on/off.

SHIFT B
Brake chute deployed.

ALT B
Brake chute jettisoned.

KEY < OR >

Activate nose-wheel steering (on the ground).

WINGMEN

NUMBERS 1-9
Select or execute wingmen menu/command.

TAB
Select or close wingmen menu/command

KEY Y
Confirm ability to execute an order or request.

KEY N
Confirm inability to execute an order or request.

MFD AND SYSTEM VIEWS

NUMERIC KEY 0
Select mission briefing summary.

NUMERIC KEY .
Select large map. Press ESC to exit.

NUMERIC KEY 1
Select MFD 1.

EF2000 KEYS

KEY SUMMARY

NUMERIC KEY 2

Select MFD 2.

RIGHT MOUSE BUTTON

Return to head-up view.

HOME KEY

Radar scan range up.

NUMERIC KEY 3

Select MFD 3.

DRAG MOUSE TO SCREEN EDGE

Moves the view around the cockpit.

END KEY

Radar scan range down.

NUMERIC KEY 4

Select warning panel.

CTRL & LETTER

Select the MFD functions by using a combination of CTRL and letters instead of the mouse.

PAGE UP KEY

Radar azimuth change.

NUMERIC KEY 5

Select IRST screen.

MFD SYSTEMS

KEY C

Cycle prioritized targets during BVR combat.
(also cycles short range targets during close combat mode).

PAGE DOWN KEY

Change radar mode.

NUMERIC KEY 6

Select artificial horizon and compass.

ALT HOME/END KEYS

Alter DASS range.

NUMERIC KEY 7

Scroll left in 60 degree steps.

KEY J

Select JTIDS.

NUMERIC KEY 8

Select full HUD view.

KEY M

Moving Map.

NUMERIC KEY 9

Scroll right in 60 degree steps.

SHIFT W

Select next waypoint.

MOUSE BUTTONS

Pan down to MFDs.

KEY R

Toggle radar on/off.

ALT W

Select previous waypoint.

EF2000 KEYS

KEY SUMMARY

HUD KEYS

KEY U
Cycle HUD contrast.

ALT H
Cycle HUD declutter.

SHIFT '
Refueling HUD mode.

ENTER
AA HUD mode.

BACKSPACE
AG HUD mode.

KEY I
Landing HUD mode.

SHIFT M
Toggles mini MFDs when in full cockpit view.
Also displays mini JTIDS.

SHIFT N
Toggle on/off display of network and wingmen
names (as in King Of The Skies).

EVENT KEYS

SHIFT T
Accelerated time for the whole environment.

KEY P
Pause game, while still having access to
cockpit functions.

SHIFT S
Skip to next event of interest. NOTE: skips to
point prior to refueling and landing, or
completes these events if pressed again. Does
not work if a threat is near by. Also cancels
Time Skip.

SHIFT ESC x 2
Eject.

SHIFT Q
Quit EF2000.

WEAPON KEYS

ENTER
Scroll through the AA weapons.

BACKSPACE

Scroll through the AG weapons.

SPACEBAR

Fire weapons (also depends on controller type).

SHIFT J
Jettison fuel tanks.

ALT J
Jettison air-to-ground stores.

KEY C
Cycles through targets.

KEY X
Cycle weapon lock (as with 'C', but only selects
enemy aircraft).

KEY Z
Lock on nearest enemy.

SHIFT G
Toggle auto-cannon.

SHIFT RETURN
Select cannons.

EF2000 KEYS

KEY SUMMARY

TIALD LASER BOMBING KEYS

KEY T

Select TIALD laser-guided bombing sight.

RIGHT SHIFT CURSOR

Slew IR or TV image.

SPACEBAR OR JOYSTICK BUTTON 1

Release weapon.

SET-UP KEYS

KEY ~

Access the SET-UP screen.

ESC OR RIGHT MOUSE BUTTON

Leave SET-UP.

AUTOPILOT & FLIGHT ASSISTANCE KEYS

KEY A

Activate/deactivate autopilot.

ALT A ONCE

Select Autopilot mode 1 waypoint.

ALT A TWICE

Select Autopilot mode 2 heading, altitude & speed.

ALT A 3 TIMES

Select Autopilot mode 3 tracking.

ALT A 4 TIMES

Select Autopilot mode 4 autothrottle.

KEY L

Auto leveller.

MFD +/-

Adjust speed in Autopilot mode 4.

KEY C

Cycle track in Autopilot mode 3.

SHIFT W

Select next waypoint in Autopilot mode 1.

ALT W

Select previous waypoint in Autopilot mode 1.

KEY V

Activate Night Vision (NVG).

OTHER KEYS

INSERT

Release chaff manually.

DELETE

Release flares manually.

KEY ~

Deploy refueling nozzle, enter refueling mode.

SHIFT ~

Switch to refueling HUD mode.

KEY I

ILS mode for landing.

EF2000 KEYS

VIEW SUMMARY

MAIN COCKPIT VIEWS

KEY F1

Cycles between the cockpit and HUD view and the HUD only view.

SHIFT A

Overlays DASS and radar in HUD only view.

NUMERIC KEY 8

Restore the full forward cockpit view.

MFD VR COCKPIT VIEW

SHIFT F1

Full cockpit view with MFDs.

WIDE ANGLE VR COCKPIT

KEY F2

Wide angle cockpit for dogfighting.

CHECK YOUR SIX

KEY F3

Executes a rear looking check on the sky.

GLANCE LEFT NUMERIC KEY 7

Pan left in sixty degree steps.

GLANCE RIGHT NUMERIC KEY 9

Pan right in sixty degree steps.

PLAYER EXTERNAL VIEWS

KEY F4

Toggles between a standard external view, and several pre-set camera views.

SHIFT F4

A satellite or God's eye view of the world.

WINGMAN VIEWS

KEY F5

Cycles between a full wingman view, wingman and player, player and wingman, and a wingman's cockpit view.

SHIFT C

Cycles between wingmen.

FLY-BY VIEWS

KEY F6

Your fly-by, or you and nearest missile.

SHIFT F6

Selected target fly-by or, if no target selected, browse plane.

TARGET VIEWS

KEY F7

Cycles between a full target view, target and player, player and target, and a view of the target and his target.

SHIFT F7

Browse ground targets (use 'C' to cycle).

WEAPONS VIEWS

KEY F8

Missile sequence.

SHIFT F8

Cycles between external views of the missile and a weapon's eye view.

VR PADLOCK

KEY F10

Padlock view:

a) View padlock - should always eyeball tracked targets, even if a radar guided weapon is selected.

b) Padlocks runway when in landing mode, or ground targets in AG.

EF2000 KEYS

VIEW SUMMARY

KEY F11

Wingman padlock:

Toggles between wingman padlock, wingman target padlock and wingman threat padlock.

KEY F12

Missile padlock.

LOOK AT MFDs

NUMERIC 1

View MFD 1.

NUMERIC 2

View MFD 2.

NUMERIC 3

View MFD 3.

LOOK AT OTHER COCKPIT PANELS

NUMERIC 4

View warning panel.

NUMERIC 5

View IRST.

NUMERIC 6

View artificial horizon and compass.

MANUAL SCROLLING VIEWS

SHIFT PLUS CURSORS

Scroll around the cockpit or external view.

EXTERNAL VIEW ZOOM

SHIFT PLUS NUMERIC 7 OR 1

Zoom external views.

HUD ON AND OFF

ALT H

Declutter HUD view.

TOGGLE TARGET VIEW MODE

KEY C

Cycle selected track.

TAB

Select or close wingmen menu/command mode).

BROWSE PLANE VIEWS

F9

External of any aeroplane, the selected plane and the player, and the selected plane and its target.

SHIFT C

Cycle browse plane (any plane within 50 nm).

SHIFT X

In browse mode, show previous plane.

ADDITIONAL CONTROLS

KEY S

Send message in network game.

SHIFT L

Show last message.

ALT M

Toggle between MIDI & CD music.

ALT N

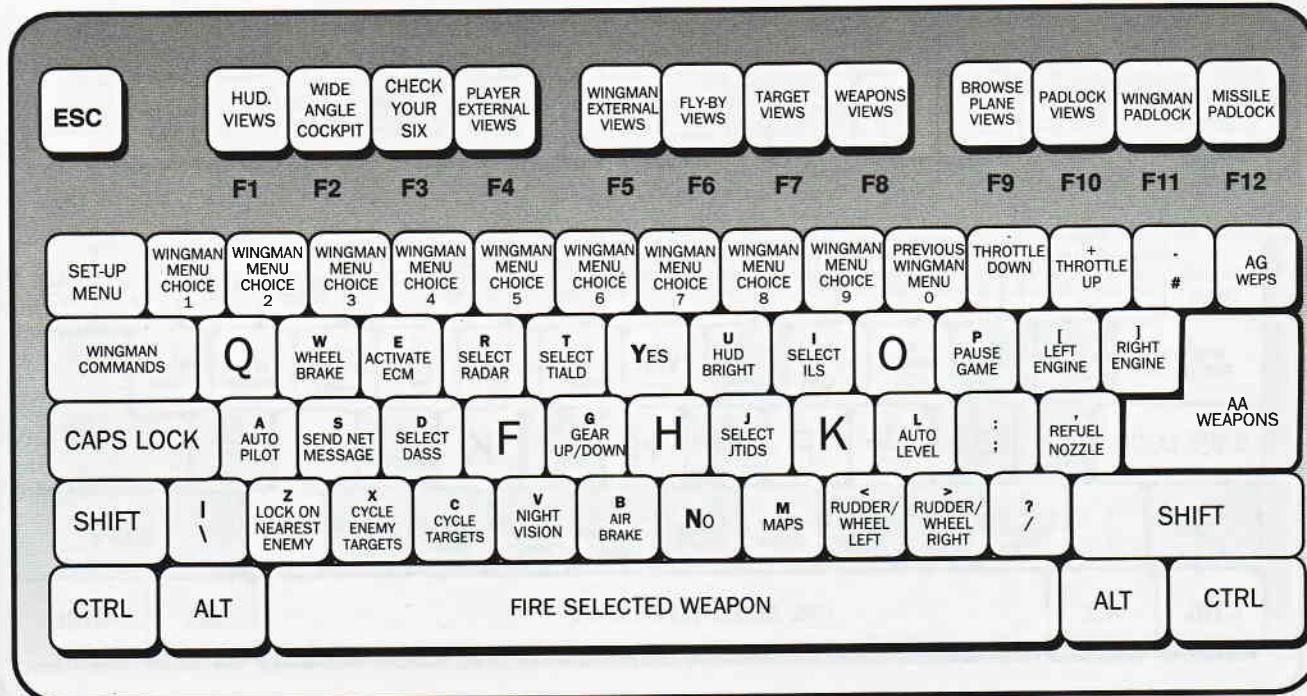
Play next track on CD.

ALT RETURN

Toggle between windowed or full screen game (in Windows 95 version only).

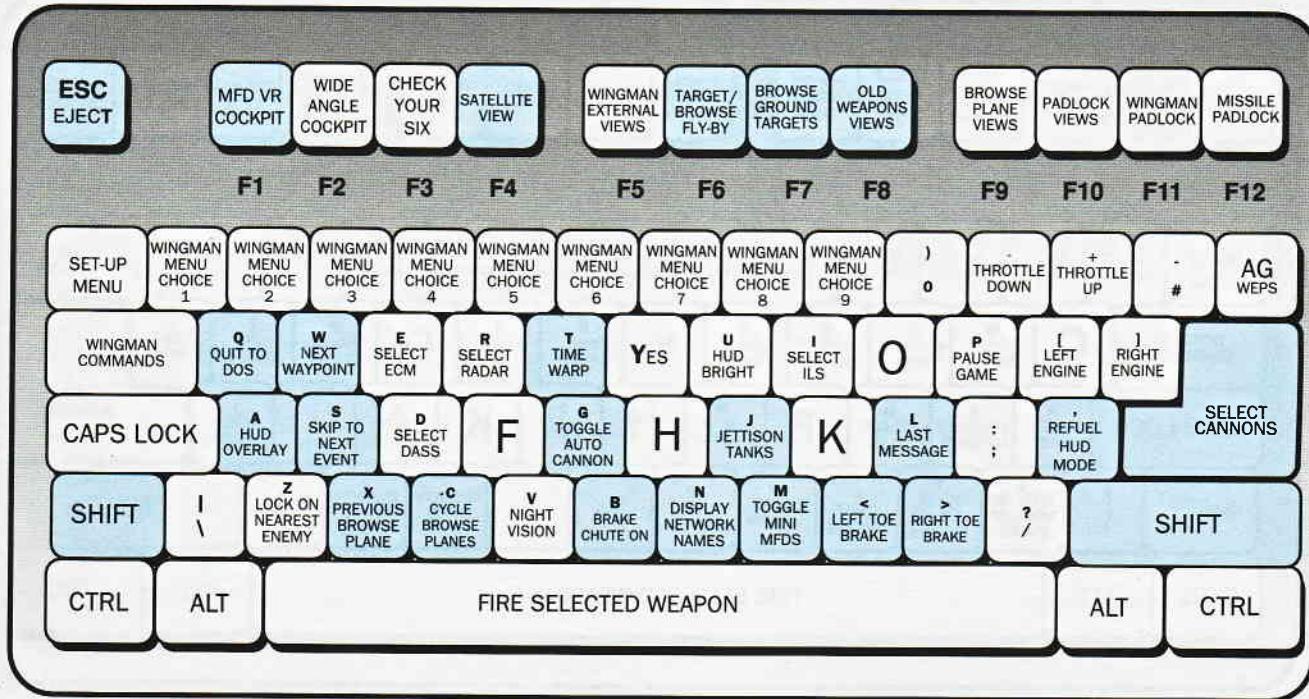
EF2000 KEYS & VIEWS

UNSHIFTED KEYBOARD



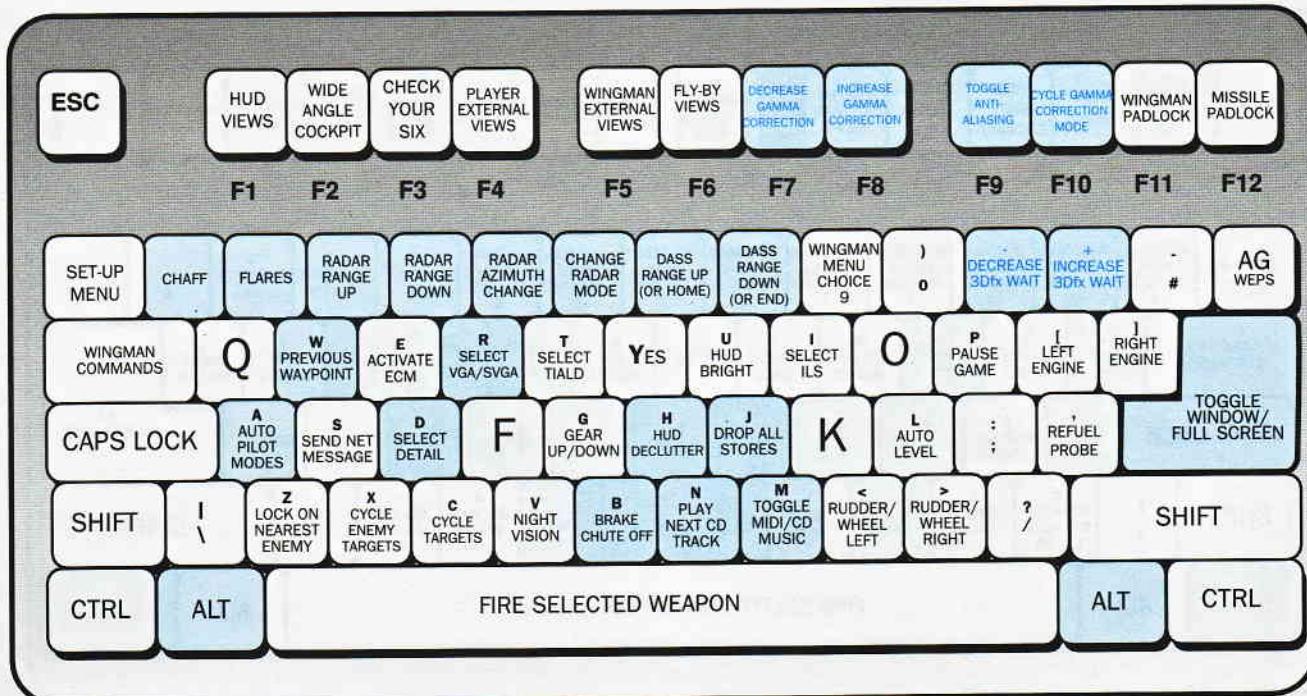
EF2000 KEYS & VIEWS

SHIFTED KEYBOARD



EF2000 KEYS & VIEWS

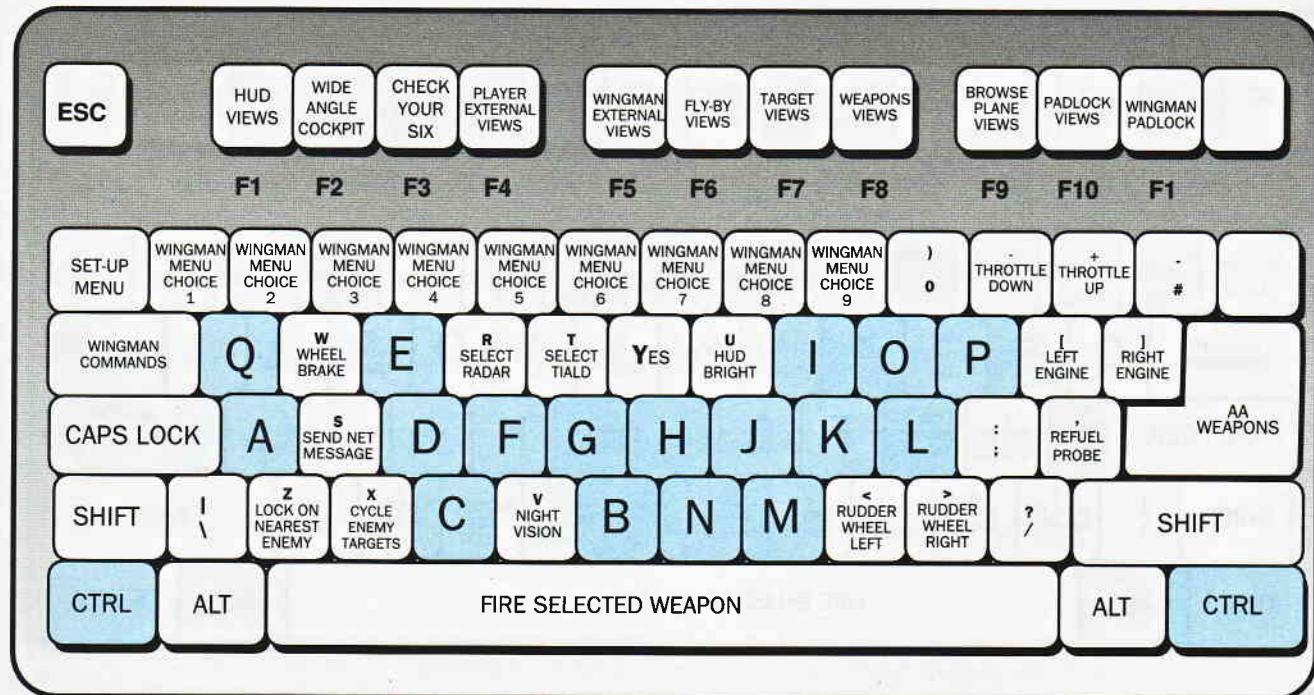
ALT KEYBOARD



WORDING IN BLUE INDICATES KEYS USED WITH 3D ACCELERATION ONLY.

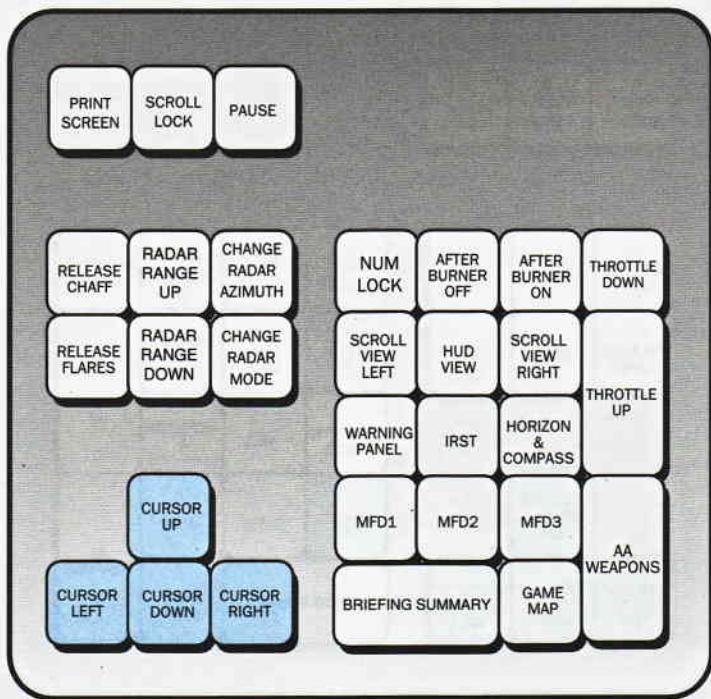
EF2000 KEYS & VIEWS

KEYBOARD MFD CONTROLS WITH CTRL



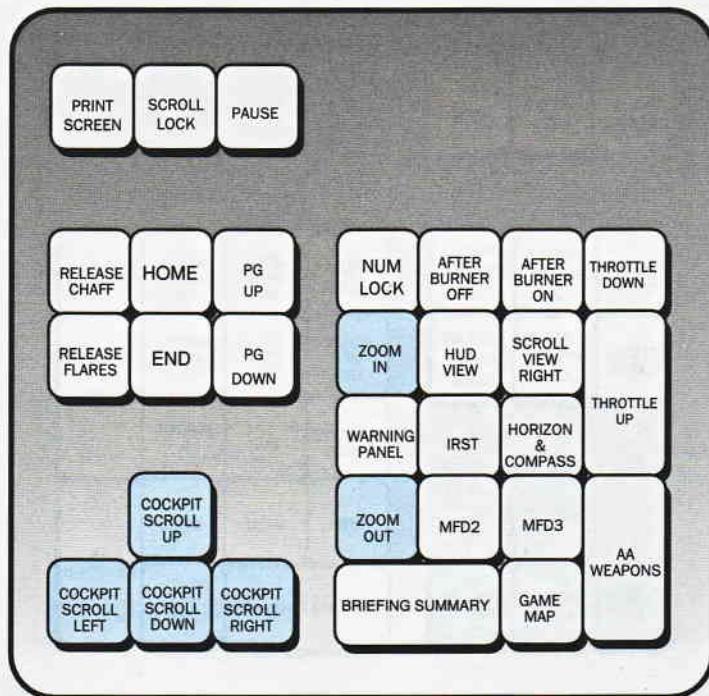
EF2000 KEYS & VIEWS

EXTENDED KEYBOARD UNSHIFTED



EF2000 KEYS & VIEWS

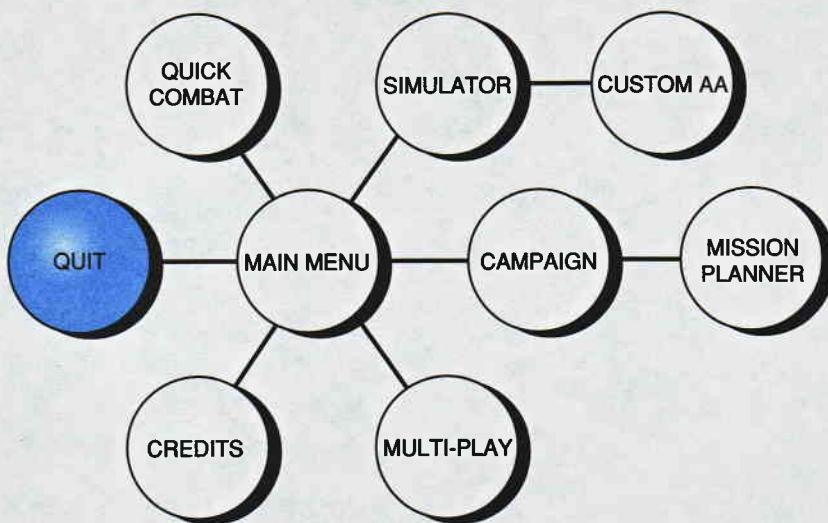
EXTENDED KEYBOARD SHIFTED



EF2000 GETTING STARTED

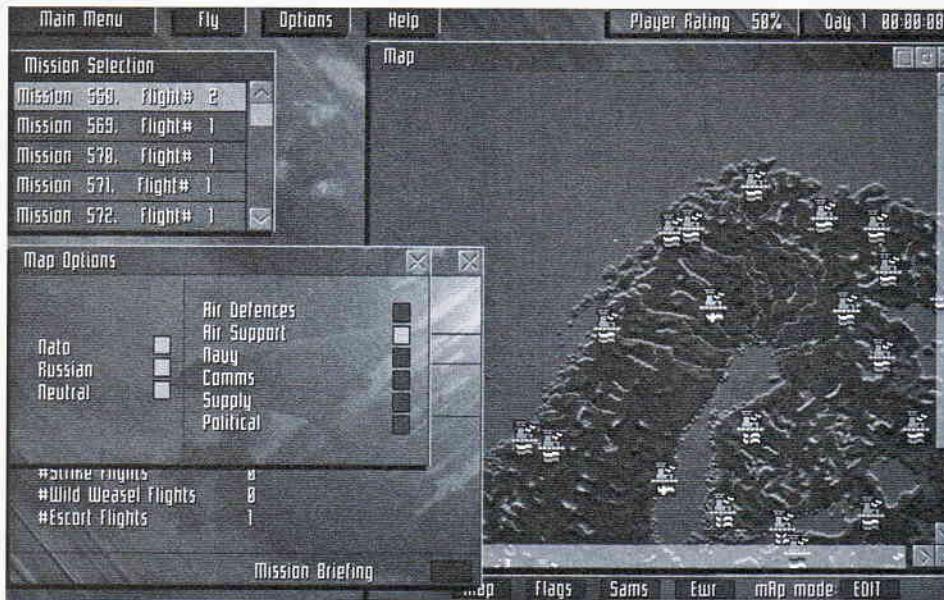
OVERVIEW - FINDING YOUR WAY AROUND EF2000

This diagram shows the major modules in EF2000. When you enter the program for the first time, you'll go straight to the configuration screen. Here you will be able to set up vital hardware and software parameters. See the Technical Notes for tips on settings for different types of PC systems. Next, you will be taken to the 'MAIN MENU'. From here, you can choose to enter one of several modules: the Quick Combat section, which is a fast and furious shooting spectacle; the Simulator, where you will practice all the manoeuvres you will need to play EF2000 effectively; the campaign section, where you will take part in a massive air/land battle; Multiplay, which allows you to join network games. Quit will take you back to the O/S. When you enter any of the modules, it's always possible to return to the main menu simply by pressing the MAIN MENU button in the top left-hand corner of the screen.



EF2000 GETTING STARTED

THE DID DESKTOP



The DID desktop

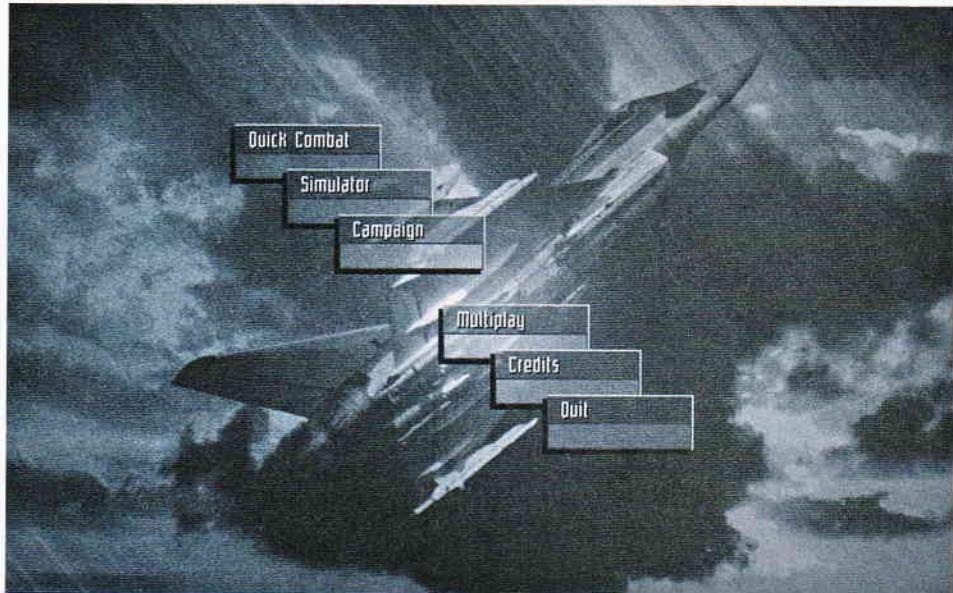
A new feature for DID products is a desktop style interface with menu folders, to help expert and beginner alike navigate the many features of EF2000. We have tried to make it as intuitive as possible, and ensure every aspect of the program is easily accessible.

A variety of icons are available in the interface to control the functionality of the menus. The small X in the top left hand corner will close the menu. In some cases, it is possible to overlay windows in order to see more information or make comparisons. A small icon of overlaid pages enables you to bring the current window to the front or send it to the back of the display. On scrolling windows, arrow icons are available on the right and bottom of the screen. On resizable windows, a small arrow in the bottom right corner will allow you to expand or shrink the window. A special icon in the top right hand corner will expand the window full-screen.

EF2000 GETTING STARTED

MAIN MENU

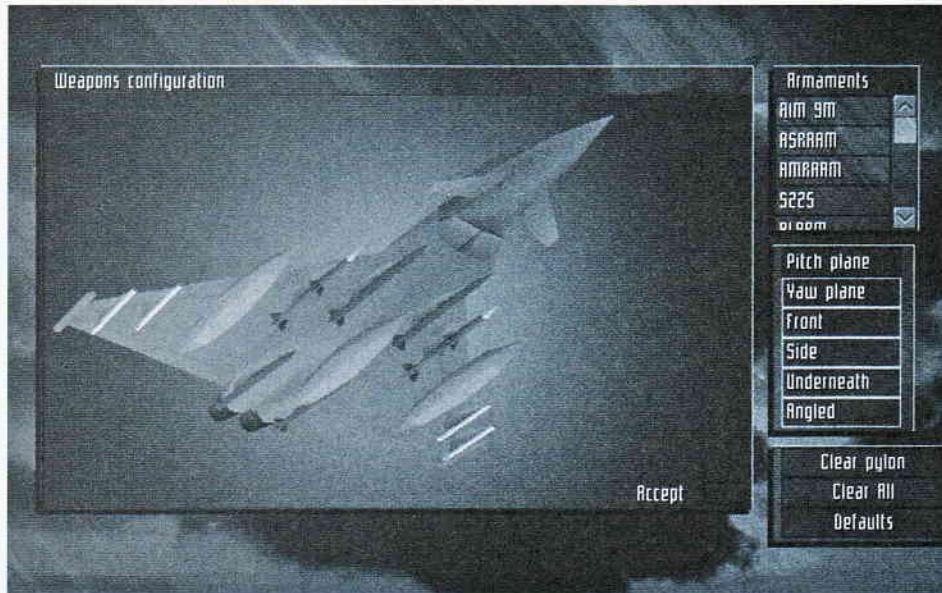
From here you may enter any module of the software. Press QUIT if you wish to leave EF2000. While using the interface, you can always return here if you wish to retire to the O/S.



The main menu

EF2000 GETTING STARTED

WEAPONS ARMING



The arming screen

In this screen, you will be allowed to review the default weapons load, and re-arm the plane. The process is straightforward. . .

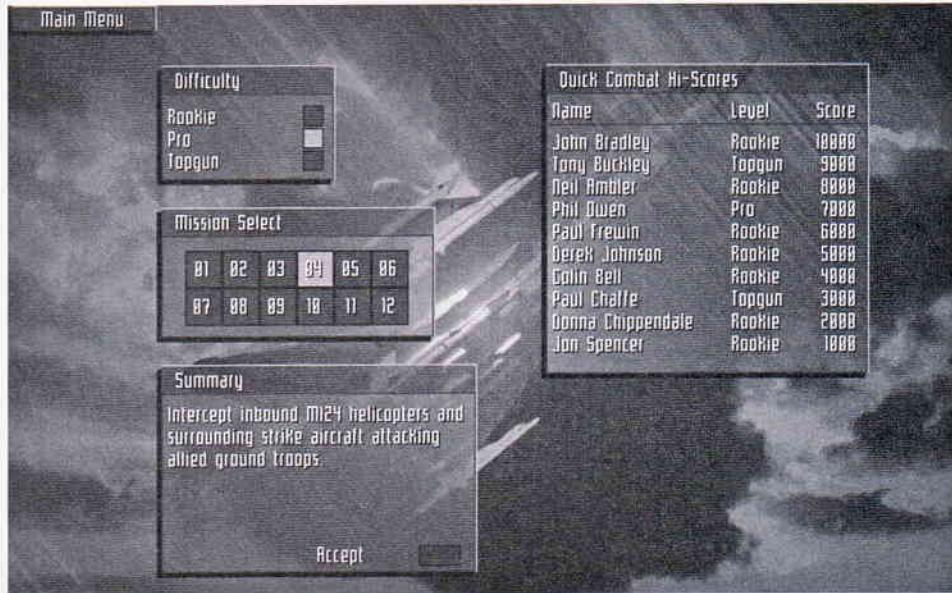
1. From the top right-hand window, select your desired weapon. An image of the chosen bomb or missile will be visible in a window.
2. Move your cursor into the main arming screen, and the chosen weapon will be placed by the cursor.
3. Place the weapon on the pylon by simply positioning the cursor over the green box and click the left mouse button. Red boxes indicate that the weapon may not be placed on that pylon. Note that you need only arm one side of the plane, and weapons are automatically placed symmetrically.
4. If you would like to view the plane from various angles, click on the view keys.

EF2000 GETTING STARTED

QUICK COMBAT

Quick Combat is a section of the simulation designed to drop you right into the action, with the kind of weird and wonderful missions that are only possible in a simulation. It's there for fun, and to help you chill out after a hard day by letting you blast hell out of everything and anything. Pressing Quick Combat on the main menu will bring you to the selection screen. From here, you may set the difficulty level for the missions, which will affect the quantity and quality of the air and ground based threats. You may elect to start at mission 1 and progress to mission 12, or jump in wherever you like. A brief summary of what will happen will be given, and on the map you will be able to see where the mission will take place.

If you do well, you will enter the next level automatically. If you lose and you have a high score, you will get the opportunity to enter your name in the high score table. If you do not have a high enough score, you will simply be returned to the Quick Combat menu.



The Quick Combat menu

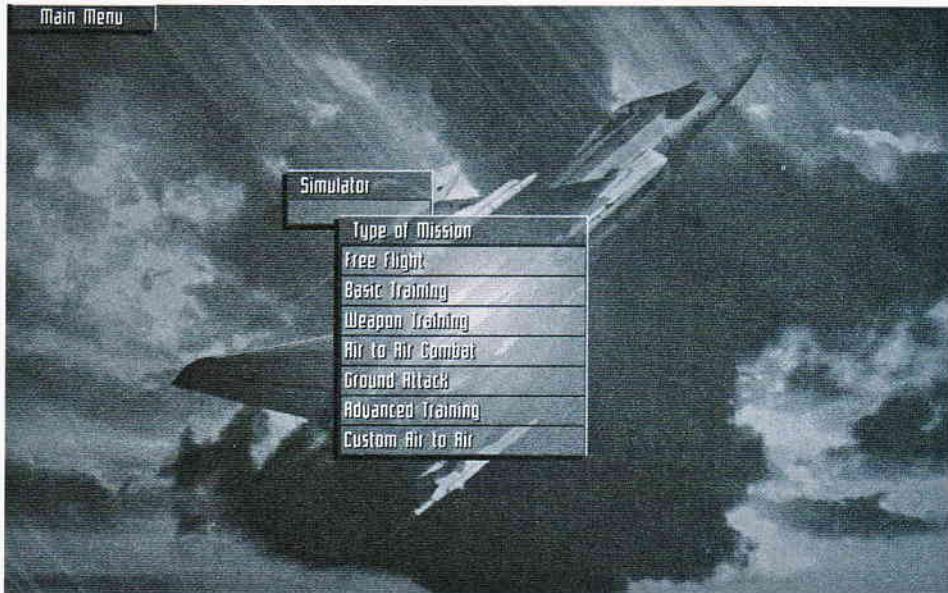
EF2000 GETTING STARTED

SIMULATOR

The simulator section has been designed to let you practice the skills you need to be a top EF2000 pilot. The missions are specially designed, and give you a taste of the many faceted gameplay in EF2000. Time spent in the simulator is time well spent when you decide to enter a campaign.

Your first choice is the mission type. This produces a sub-menu showing the ground-school curriculum. Choose an item from this menu and you will be presented with another list containing specific missions. Choose a mission and you will activate the briefing window. Read this carefully to decide what is required.

Now is your first chance to decline the mission, or accept if you want to try it out. After pressing 'accept', you will see the 'parameters' menu, which allows you to adjust the way the mission looks and plays. Work down the list, activating the desired check boxes. Before accepting, decide whether you want the default weapons, and whether you want to see the weapons set-up.



The simulator menu

After accepting mission and deciding to review the weapons, you will be taken to the arming screen. Here you will be able to adjust your weapons load, and review available missiles and bombs. Finally, press the accept key to begin the mission.

CUSTOM AA COMBAT

MAKING YOUR OWN DOGFIGHT MISSIONS

CUSTOM AIR-TO-AIR

The custom air-to-air section of the game allows you to hone your dog fighting skills against a variety of opponents; both Allied and Russian planes. The custom Air-To-Air option can also be played multi-player with each of the human players flying EF2000s in one of the flights.

The following aspects of your mission can be changed:

#PLANES

This option allows you to set the number of planes that are present in a flight. For enemy flights this can range from 1-6, for allied flights this number ranges from 1-8.

GUNS ONLY

Selecting 'Yes' will remove all AA missiles from the selected flight.

ALLIED PLANES

This flight slot displays information on the allied flight. It tells you how many planes make up this flight and their weapons load. Select this

slot if you wish to change the parameters for your flight. Only EF2000's are available to fly in this slot.

ENEMY PLANES

These four flight slots are similar to the Allied Planes flight slot. Each slot allows you to select a plane type (not just EF2000's), the number of planes in a flight and AA weapons or guns only. Any slots that have 0 planes will be ignored. To select a type of plane for each slot click on the 'Enemy Type' window.

LOCATION

Select one of several locations for your dogfight to take place. It's possible that you may not have seen some of these locations before.

RANGE

The range selections allow you to specify the starting distance between your flight and that of the opposing flight. This is very useful for perfecting your Beyond Visual Range (BVR) combat technique.

TIME

This selection allows you to select the time of day that your dogfight will take place. The 'Day' selection will provide you with better visibility than the 'Twilight' and 'Night' options.

WEATHER

This selection will change the weather effects within the game environment. Selecting 'Good' will provide you with good visibility and no cloud layer. Selecting 'Fair' will provide you with a cloud layer and fair visibility. However selecting 'Poor' will reduce visibility and provide a cloud layer.

HEIGHT

Select a starting altitude for each flight

POSITION

Select a starting position: head to head; you chasing the enemy (advantage); or vice versa (disadvantage).

CUSTOM AA COMBAT

MAKING YOUR OWN DOGFIGHT MISSIONS

DIFFICULTY

The difficulty selection allows you to adapt your mission to your level of skill. Three levels are provided: 'Rookie' 'Pro' and 'Top Gun'. The difficulty levels change the accuracy of the weapons used within the engagement. The 'Rookie' and 'Pro' levels reduce the accuracy of enemy missiles and increase the chances of player missiles hitting their targets. If the user selects 'Top Gun' then all the missiles within the simulation will be modeled with real world accuracy.

ENEMY TYPE

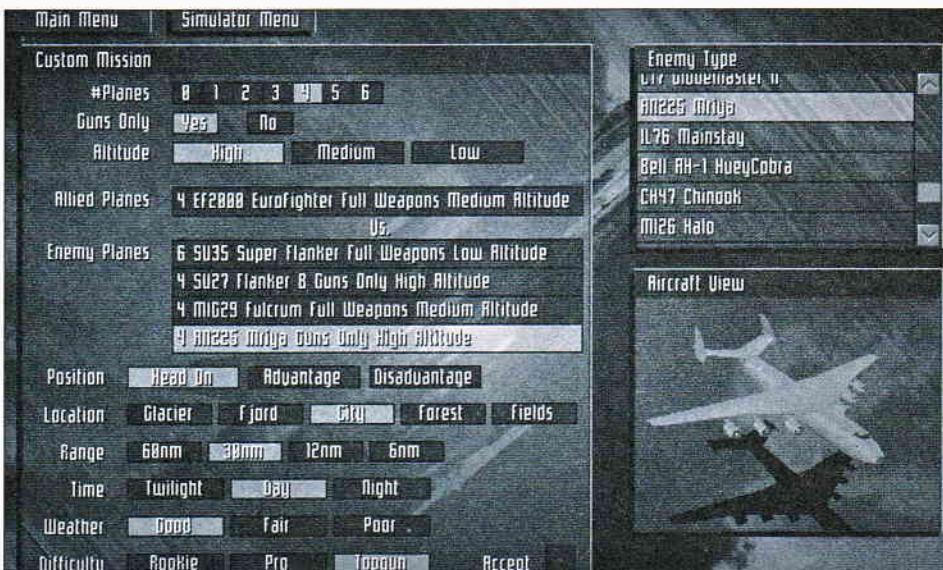
It is within this section that you will select the type of plane that the enemy flight will be equipped with. The player can choose to face off against allied planes as well as those operated by the Russians and Neutral countries. Each plane has particular characteristics and capabilities. Newer pilots may choose to practice on unarmed planes such as the IL-76 Mainstay or IL-78M Refueler and then try a lower quality fighter such as the MiG-21. Experienced pilots might like to try their hand at trying to defeat a top of the line F-22 or

SU-35 with guns only. Each time you select an enemy type, a spinning model of the plane will appear in the enemy view window.

After you have finished making your choices select 'Accept' to enter the arming screen then

push 'Accept' once more to enter the mission.

NB: In a network game, players will receive default weapons and they will not enter the arming screen.



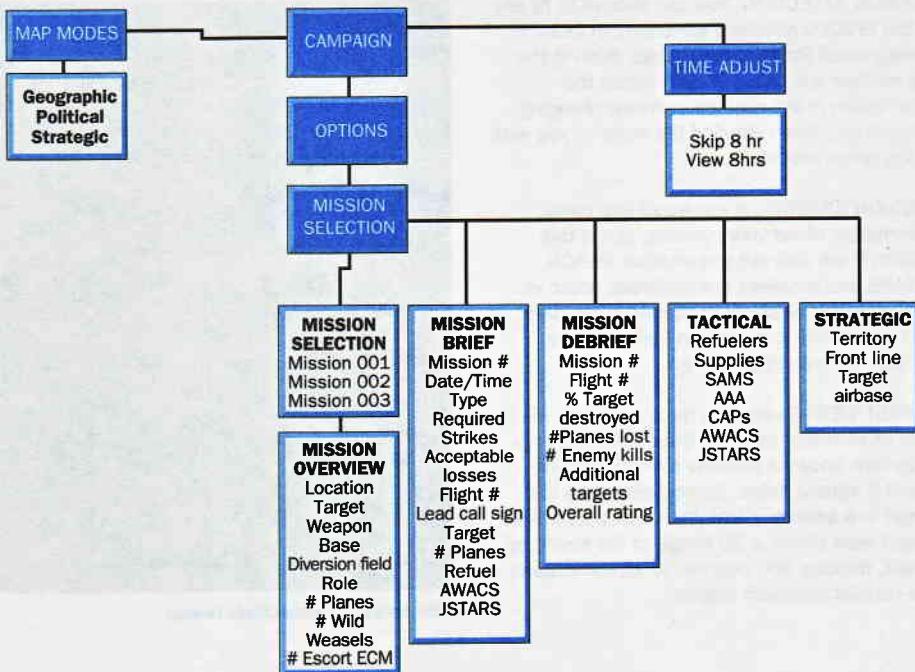
The custom AA combat menus

EF2000 GETTING STARTED

CAMPAIGN

In campaign, you are joining a complex simulation of a war environment. You therefore have access to a great deal of information about your flight, your forces and the enemy. The entire campaign is managed by a non-linear Artificial Intelligence system which operates using modern doctrine on aerial warfare. For a complete description, turn to the campaign section of this manual.

The moment you choose 'Campaign' from the main menu, a combat environment is set-up in the world. You then enter the campaign interface, with various menus at your disposal.



Campaign menus

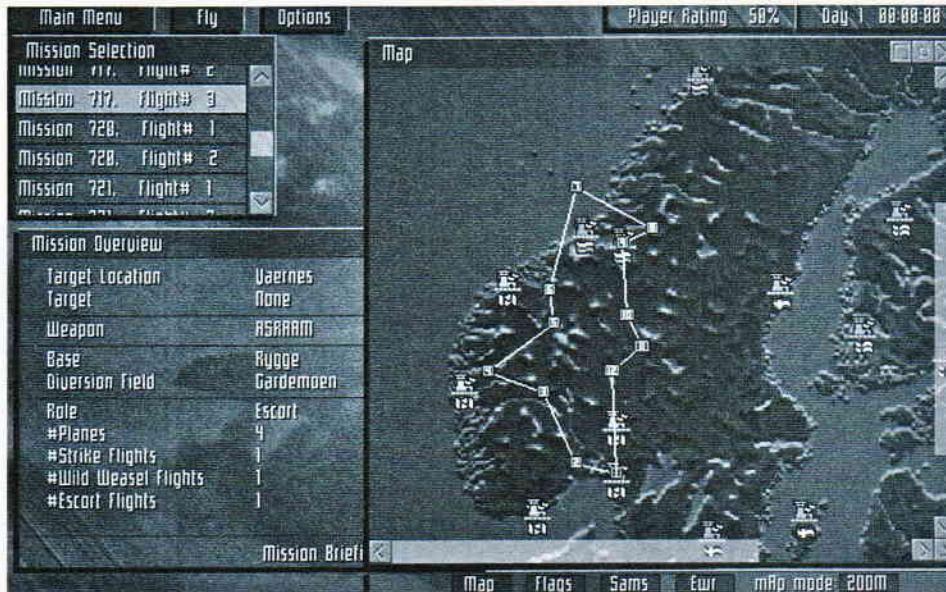
EF2000 GETTING STARTED

MISSION SELECTION

MISSION SELECTION: You can choose to fly any of the EF2000 missions generated in EF2000. Simply scroll through the choices given in the top window and click. You will notice the information in the mission overview changing accordingly. When you find the mission you wish to fly, press accept.

MISSION BRIEFING: If you would like more information about your mission, select this option. It will also tell you whether AWACS, JSTARS and refuelers are available, which in turn affects your ability to access JTIDS data, and your ability to engage in fuel intensive combat such as dogfighting.

TARGET VIEW: Select this menu, and you will be able to view your target in three different ways. Area view shows a satellite picture covering about 3 square miles. Zoom view shows the target in a square of less than a quarter mile. Target view shows a 3D image of the specified target, rotating 360 degrees to let you assess the various approach angles.



The mission selection menu

EF2000 GETTING STARTED

MISSION SELECTION

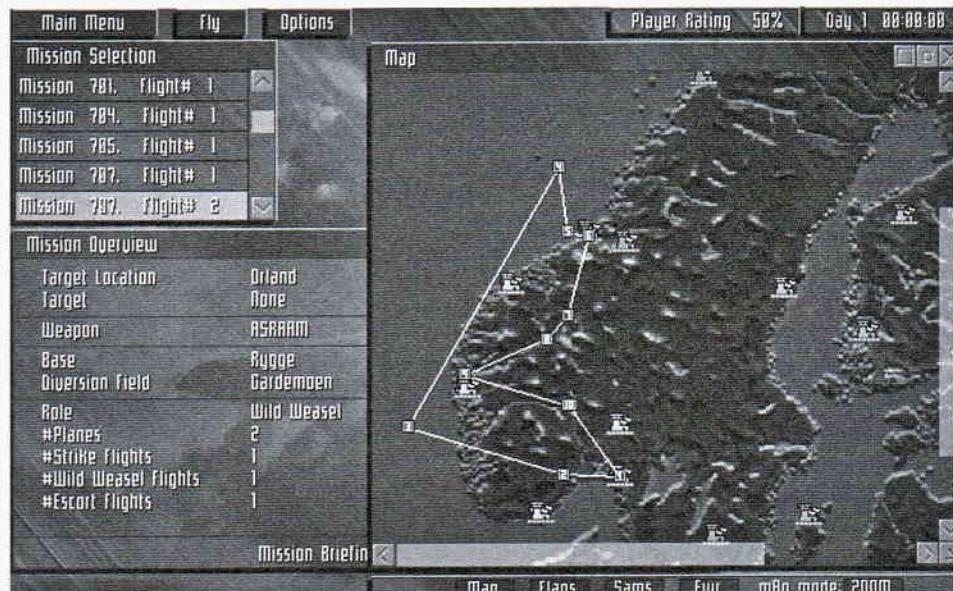
MISSION DEBRIEF: After flying your mission, check the debriefing form to see how well you did. You may also select any of the EF2000 debriefing forms, to see how well your colleagues performed.

TACTICAL: Overlays vital information on the map concerning coverage by AWACS, JSTARS, SAM sites, AAA sites, and refuelers. Also shown is the supply status at the different airbases.

STRATEGIC: Overlays to show which territory is in enemy or allied hands, where the front line or forward edge of the battle area (FEBA) is located, and which airbase is currently the focus of attention.

TIME

TIME ADJUST: In EF2000 you don't have to start your campaign at the beginning. Skip through by days, to the point you desire. The WarGen artificial intelligence will fight all the battles in-between, and set up the world correctly for the given time. Use this feature with caution if you don't want to lose the war!



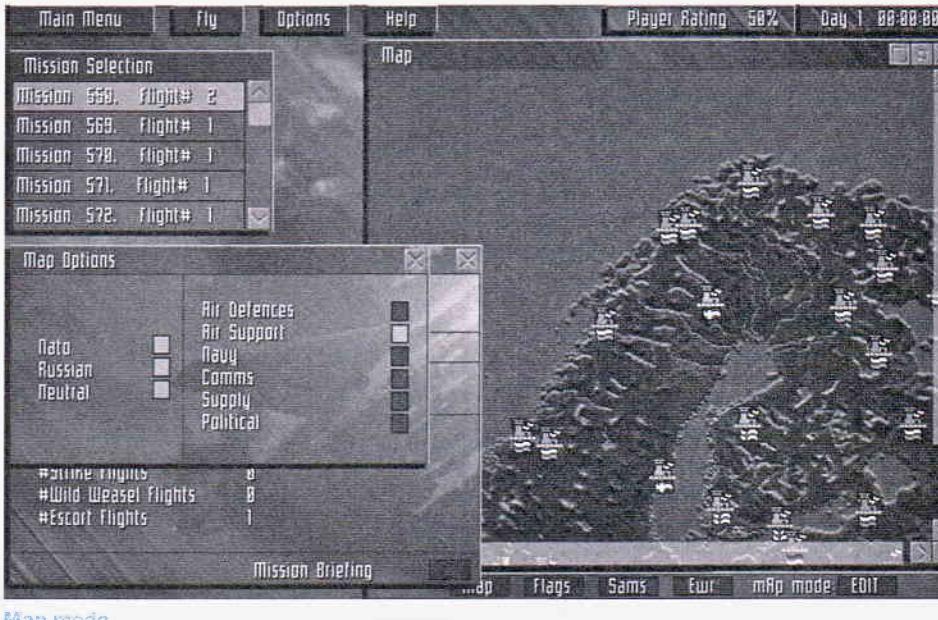
Campaign overview

EF2000 GETTING STARTED

MISSION SELECTION

MAPS

MAP MODE: Gives you access to three types of map. Geographic gives the general topography of the region. Political shows the disposition of territories and shows major towns and cities. Strategic is a composite map of electronic intelligence from JSTARS and satellite images, and shows major vehicle movements within the world. Tactical and strategic information from the Options menu will be overlaid on these maps.



Map mode

THE TACTICAL MISSION PLANNER

INTRODUCTION

In EF2000, we designed the campaign intelligence to provide the player with selections of pre-planned missions, with correct attack profiles and associated escort packages. The idea is to maximise the time you spend flying, rather than planning. However, many of you felt that the right to plan missions should remain firmly in your hands. With EF2000 this is precisely what you get. The fully featured Tactical Mission Planner lets you decide which targets to take out first, and which targets need softening-up with planes like the F-117 Stealth Fighter. It is your choice whether to fly high and save fuel, or low to avoid enemy EWR and SAM radar.

You will define your own Air Tasking Orders, and execute them with tactical skill. Best of all, using the myriad of camera views in EF2000, with their new motion-enhancing inertia effect, you'll be able to see the action unfold like never before. Watch A10's clear the SAM sites before you arrive on the scene. Check the damage as F-15's bomb high value targets, while you keep watch for the deadly Russian CAP.

NEW DIFFICULTY SETTINGS

After Start New Campaign, you have the possibility to choose a difficulty setting for the Campaign. A level setting from 1 to 10 is selectable, 1 being Rookie, 7 Pro and 10 TopGun. In addition, there is a toggle switch to allow your performance to influence the progress of the campaign.

The level settings are global for the whole of the campaign, i.e. no changes are possible in game. The performance of a player is calculated using an average of the last 4 overall percentage mission scores. If the player has an average of 70% then the campaign base capture is set to give them an advantage. The advantage is proportional to the amount over 70%.

If the players average is below 30%, then the base capture is set in favor of the Russians. Again the lower the average, under 30%, the worse the disadvantage.

Also if you eject and save the pilot, rather than crash into the ground or get blown up, you get a better mission score.

N.B. Ejecting cannot be performed in a network game.

THE TACTICAL MISSION PLANNER

MAP AND TOOLBAR

In addition to the three standard maps used in Campaign, there is a topological map. This is useful for planning a waypoint route to follow valleys, and terrain mask your flight from enemy radar. The map screen also contains a handy toolbar for ease of use. Buttons perform the following operations:

MAP: this button cycles through the four types of map.

FLAGS: Toggles flags depicting target nationality on and off.

SAMS: Highlights SAM coverage - useful for planning routes.

EWR: Plots the Early Warning Radar coverage.

FUEL: Toggles NATO refueler icons. this is available in the mission planner only.

MAP MODE: (ZOOM and EDIT) In ZOOM mode, left mouse clicks in the MAP view will zoom in and right clicks will zoom out of the map.

In EDIT mode, you will be able to move your waypoints on the MAP view.

NOTE:

Each toolbar option has a shortcut key, indicated by the capital letter; e.g. U for Fuel.

DEBRIEFING SCREENS

EF2000 features thorough debriefings on ALL aircraft in the mission plan. You will be able to see which plane has scored hits or enemy kills, or has been killed by the enemy. The same type of debriefing detail is also found in the simulator section of the game.



The mapping toolbar - making it easy to use the mapping features.

THE TACTICAL MISSION PLANNER

MISSION PLANNER MENUS

The following menus are available in the Tactical Mission Planner

- Strike type: For choosing a mission type and target position
- Base: For picking a take-off base
- Targets: For assigning different targets to each member of the strike flights
- WP: A waypoint editor for planning the mission route
- ATC: Air traffic control, for determining take-off time and weather.

STRIKE TYPE

This screen is used to pick the type of mission you want to fly, and where the relevant target is located. On the left of the screen is a list of different mission types ranging from airfield and port strikes to AWACS and refueler kills. Clicking on one of these will show the available target locations for each type of mission chosen. Then all you need to do is click on the map to choose which target you wish to attack. In the bottom left is a window which gives the operational status of the specified target and a value. this shows the number of times that this target has been attacked (either by you or someone else).



Fly the most tactically important missions - or just your favorite types.

THE TACTICAL MISSION PLANNER

MISSION PLANNER MENUS

BASE

This screen allows you to choose a take-off base and specify the composition of the different flights in the mission. Whenever you click on a base in the map, information about that base is shown in the windows on the left. Simply choose a base with enough free EuroFighters to fly the mission (this could be as little as one if you're feeling brave). When the war gets under way, you may notice that EuroFighters disappear from the vulnerable front-line bases. This is a precaution to ensure that enough survive to prolong the fight.

Once a base has been chosen, you are able to select other planes to accompany you, each with a different mission type if you wish. These include Strike 2, Wild Weasel and Escort. To assign an aircraft to a flight, simply click on an empty slot. To clear an aircraft just click again on the highlighted slot. You choose the type of aircraft you wish to fly the mission; e.g. F-22s for escorts. Notice that the number of available slots is sixteen. You may assign a maximum of four aircraft to each flight.

We strongly advise that you select appropriate aircraft for the different mission types. This is because the AI calculates mission success upon the appropriateness of the aircraft for the job. So it would be unwise to select the slow, unwieldy tankbusting A-10 as your escort on a deep strike mission. Conversely, an F-117 Nighthawk is an excellent choice for an additional strike package, and an ALARM equipped Tornado is fine for Wild Weasel missions. Read the original manual for clues on the types of mission profiles best suited to different aircraft types.

Note: The player does not need to use all the free EuroFighters, however each different flight can only have a maximum of four aircraft. For the network game, all players must have an aircraft and a role.

Campaign Menu				
Strike Type	Base	Targets	WP's	RTC
Base: Kristiansand				
Number of EFA's: 46				
Unassigned EFA's: 16				
Mission Roles		Aircraft Type		
Name	Strike1	Strike2	WW	Escort
EFA				
F-14				
F-15				
F-16				
F-18				
F-22				
Tornado				
Harrier				
JAS-39				
F-117				
F-111				
A-10				

Choose accompanying aircraft.

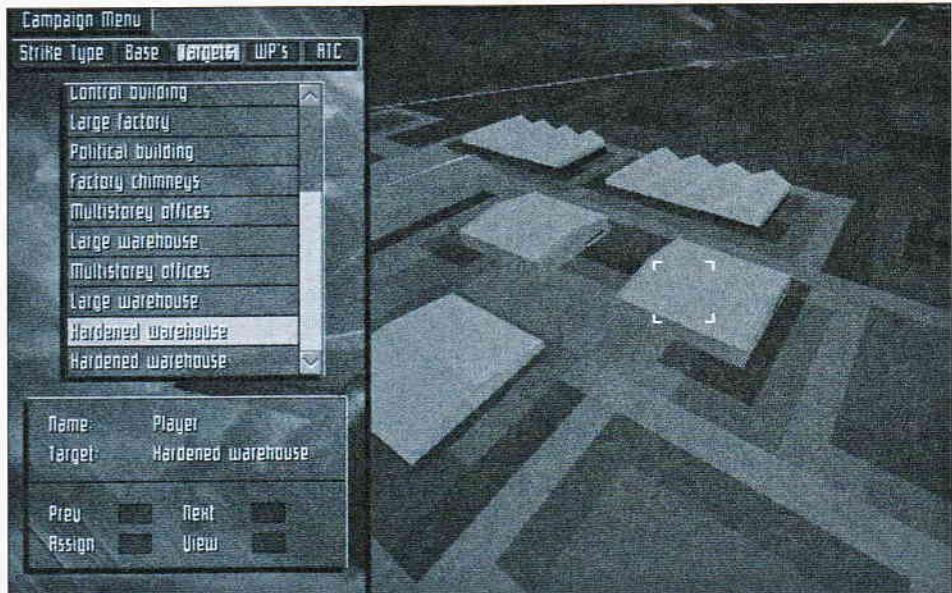
THE TACTICAL MISSION PLANNER

MISSION PLANNER MENUS

TARGETS

In this screen you will be presented with a 3D view of the chosen target area. On the left is a window containing all the individual targets in this area. Clicking any of these will cause the camera to fly to that particular target. In the bottom left corner is a window that is used to assign different targets to each of the members of the strike flight. The NEXT and PREV icons cycle around the strike members. The ASSIGN icon assigns the currently displayed target to that player. VIEW will display the target that a player has designated.

Note: Each member of the strike flight must have a target.



Assign individual targets to every strike plane in your mission.

THE TACTICAL MISSION PLANNER

MISSION PLANNER MENUS

WAYPOINTS

This screen allows the player to define a waypoint route for the mission. Waypoints are placed by clicking on the map. To add a new waypoint simply right-click on the map. If you are over an existing waypoint, right-clicking will remove it.

Waypoints can be dragged by holding down the left button on the appropriate waypoint. To insert an intermediate waypoint simply click on one of the small red boxes between each pair of waypoints.

In the bottom left of the screen, you'll find a window which is used to set the height of each waypoint. This is done by clicking in the box at the required height for each waypoint. The actual height can be seen in the window above, e.g. HEIGHT 13500. This value also changes to the height of a waypoint on the map when it is moved.



EF2000 pilots have the flexibility to control their own route and tactics.

THE TACTICAL MISSION PLANNER

MISSION PLANNER MENUS

If a waypoint is dragged over the strike area it will turn into a red triangle, therefore defining the strike waypoint. Waypoints can also be dragged over refuelers to define refuelling points. These points are shown using a green circle.

As the route is being defined the route information window is constantly updated. This shows the route speed setting, length and approximate duration of flight at the current speed.

There is also a fuel bar which gives the player an approximation of how much fuel is required to fly the route. This bar takes into account the speed, length and height of the route but is still only a rough guide as to the amount of fuel required.

Each diagonal line on the fuel bar represents an external fuel tank. It is therefore possible to estimate the number of fuel tanks required for the route. Note: Fuel estimation does not take into account the use of afterburner.

Note: A route must have a strike point assigned and the previous waypoint must be free to be used as the initial point, i.e. The previous waypoint cannot be a refuelling waypoint or take-off base.

AIR TRAFFIC CONTROL (ATC)

The Air Traffic Control screen allows the player to choose a take-off time for the mission. This takes into account weather and lighting conditions for each particular time of day.

The player can now click on the FLY MISSION button to go into the main game and fly their newly created mission.

Campaign Menu			
Strike Type	Base	Targets	WP's
Takeoff	1.O.T	Landing	Weather
00:10	02:10	04:11	Poor
00:50	02:50	04:51	Poor
01:30	03:30	05:31	Fair
02:10	04:10	06:11	Fair
02:50	04:50	06:51	Fair
03:30	05:30	07:31	Good
04:10	06:10	*08:11*	Good
04:50	06:50	*08:51*	Good
05:30	07:30	*09:31*	Fair
06:10	08:10	*10:11*	Poor

Fly Mission

Study the weather conditions, then pick your departure time.

THE TACTICAL MISSION PLANNER

MISSION PLANNER MENUS



If you make a mistake setting up a mission, EF2000 tells you how to correct it.

HELP

There are a few dependencies in the mission planner; for example, you cannot click on the TARGETS screen without first picking a target. For all cases such as these, a warning box will appear to tell you why a particular operation cannot be performed and will suggest how to remedy the situation. When the FLY MISSION button is pressed the mission planner will check through the mission and report any errors and their solutions.

THE TACTICAL MISSION PLANNER

BATTLE STATISTICS

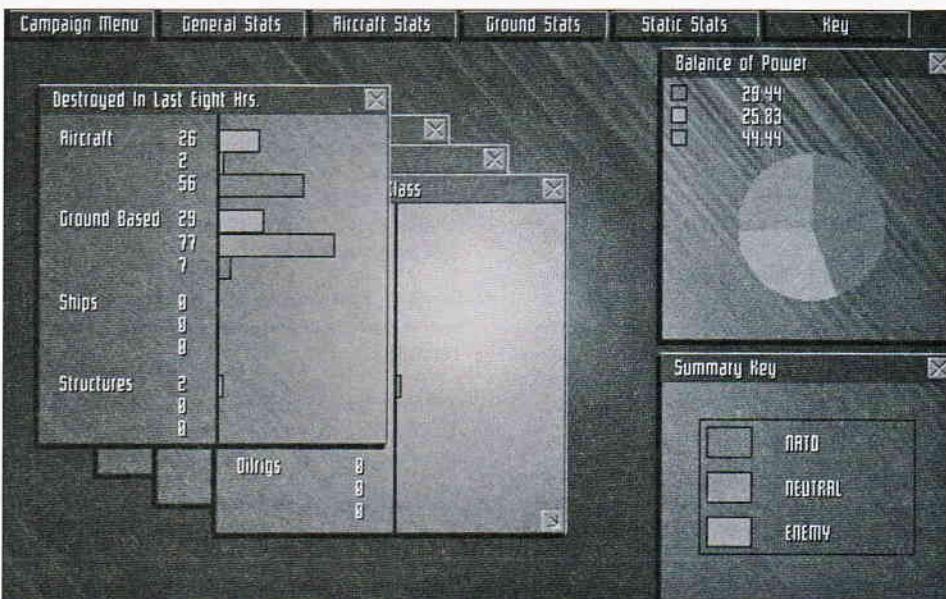
At the end of any campaign mission, the player has access to a comprehensive screen of battle statistics. For example...

- * Balance of power
- * Vehicle losses
- * Targets hit
- * Plane losses

At the end of a campaign, these figures are saved to a file on your hard drive. Each subsequent campaign is appended to the end of this file, giving you a record of your performance. The file is called SUMO.TXT and can be printed out as a plain text file, or imported into any word processor.

In addition, you get a record of all collision events which occur in an 8 hour period. Statistics lend a whole new dimension to campaigning in EF2000. For the first time you can measure your success (or failure) against previous performances, or against your friends. Check our Web Site for details of Campaign Competitions.

Note: when you start a new campaign, the SUMO.TXT files are overwritten.



Statistics give you a comprehensive overview of your performance in Campaign.

THE TACTICAL MISSION PLANNER

THE CAMPAIGN - EXTRAS

AUTOSAVE: The current Campaign state is automatically saved at the end of each mission or view 8 hour period. When you re-enter Campaign, you will be asked if you would like to resort to the previously saved game. NOTE. Only one Campaign state can be saved at any one time.

MAP ZOOM: Place the mouse pointer over the campaign map and click with the left button to zoom in. Clicking the right mouse button reverses the zoom function.

TARGET ICONS: Target types are represented by icons available in the MAP option. A full explanation of each symbol can be found on the map which accompanies the manual. You have the choice of showing NATO, Russian or neutral targets, which are colour coded green, red and blue respectively.

SYMBOL FOR COMBAT AIR PATROLS (CAP): For those of you new to combat flight simulation, a CAP comprises two or more aircraft flying a circuit over a high value target or near to an expected point of penetration by enemy aircraft. The circuit is such that the CAP aircraft cover

360 degrees of sky with their radar, leaving virtually no blind spots. CAP aircraft will fly for four hours and then land after being relieved by fresh fighters. On the map they are represented by small crosses, and are easily identified on the 8 hour view by their race-track flight paths.

SYMBOL FOR STRIKE PACKAGES: Large triangles on the map represent packages of aircraft with specific objectives. A typical strike package may comprise low-level bombers, SAM suppression aircraft, escorts and jamming aircraft.

SYMBOL FOR AWACS: Airborne Early Warning Aircraft are represented by a triangle with a line through it.

SYMBOL FOR AIR COMBAT AND GROUND STRIKES: Explosions on the map represent ground strikes, SAM kills and aerial combat.

SYMBOL FOR BASE CAPTURE: When any base is captured, its colour will change to reflect the new owners; e.g. a NATO base captured by Russians will turn from green to red.

VIEW 8 HOURS: When you select view 8 hours, you also have the possibility to highlight individual flights and their waypoints. These may be incremented individually or in steps of ten flights.

REFUELING AND TIME SKIP: When using time skip in campaign, you may be taken away from your waypoint route and positioned near to a tanker. You then have the choice to refuel, or if you press time skip, you will be taken back to your waypoint route.

NOTE: Due to the complexity of the data in Campaign, loading times may seem slow on some machines. Please be patient.

EF2000 GETTING STARTED

MULTI-PLAYER



One player must register as the server...

Up to eight players may participate in a network session of EF2000. To start a network game, one machine must be nominated as the EF2000 server. This is where all the decisions about the type of game will be made (Quick combat, simulation or campaign). Once a player has chosen a machine to be the server, that player should select 'Multi-play' from the 'Main Menu'. If all appears to be working, the server player should press the 'Listen for players' button. The satellite players should now select the 'Multi-play' menu and press the 'join' button.



...And the other players simply join in!

Once communications are established, the player lists will contain the valid players.

Now the server player should go to the 'Main Menu' and select the module and mission for the network session.

EF2000 COMMUNICATIONS (DOS)

INSTALLING EF2000 FOR NETWORK PLAY

There are now three options for communicating with other computers for linked gameplay.

These are:

- * IPX Network
- * Serial link
- * Modem

IPX networking will allow up to eight players to participate in campaign missions, while serial and modem allow two players to join in King-of-the-Skies competitions and simulator missions only.

IPX NETWORK

For network play, every participating PC must have a copy of the game installed. You also need to have the appropriate IPX and network card drivers loaded on each machine. However, it is not necessary to log on to the network. IPX drivers are supplied with Novell Netware, Novell Personal Netware and other proprietary network software. EF2000 will also work on a peer-to-peer network, with no server. This is the best

form of connection, because no other network traffic will compete.

STEP 1

First you need to allocate a network 'socket'. The socket is used by EF2000 to find other machines running the simulation. You will need to talk with your system administrator about this. Once you have a socket number, this must be entered in every machine which is to play the game. On a network without a server, any socket number besides zero may be used. Socket numbers are in hexadecimal, and you may use the letters A to F in addition to numbers 0 to 9. Alternatively the player on the game server may press 'Request socket from the network server', which then automatically allocates a dynamic socket number. All the other players must then use this socket number. This facility is not available on peer-to-peer networks.

IMPORTANT: sockets are used by many network applications and it is possible that there may be a conflict with other applications on big networks. Always check with your system administrator before attempting to start a network game. DID Ltd. and Ocean accept no

responsibility for any loss of data due to network conflicts.

STEP 2

To allow several network game sessions to be played simultaneously on the same network when only one socket number is available, different channel numbers must be selected for each session. For example, in session one all players use channel 10, while in session 2 all players use channel 15. However, it is always preferable to use different socket numbers instead of different channel numbers, if possible.

STEP 3

One player must be nominated to act as a server. It is preferable to use the fastest machine available for this purpose, although the workload is not excessive.

STEP 4

All players must first make sure that the IPX drivers are loaded, then run EF2000.

EF2000 COMMUNICATIONS (DOS)

INSTALLING EF2000 FOR NETWORK PLAY

STEP 5

Each player should select network MultiPlay.

STEP 6

The player whose machine is to be the server should check that the game server field says 'YES'; everyone else should check that it is set to 'NO'.

STEP 7

Each player should then check that the channel number is set to the one agreed.

STEP 8

Each player should now check the socket number is set to the one agreed.

STEP 9

Each player should check that the name field is set to the desired player name, or individual call-sign. These names will appear next to target track boxes in air combat, to help players identify one another.

STEP 10

The player on the server should click on 'Start-up' to wait for the other players to join, and everyone else should click on 'Start-up'.

STEP 11

When the player on the server has all the players show on the list on his screen, that individual should click on main menu and then select the desired game type (see page 73).

When the game has been selected a message will appear on each machine, and the mission will start to load. When the mission is loaded on all machines, the game will commence. If a problem occurs during transmission of the mission data to other players, it is possible to return to the MultiPlay screen by clicking on ABORT. This will reset the communications systems so that they can be linked again. If the game server clicks on 'Reset Network', everyone's comms-network system will be reset if they are connected. During mission transmission, the server will see the players' numbers light up if those players are not responding.

SEGMENTS ON LARGE NETWORKS

In order to connect different segments for the EF2000 network game, players should click on the 'Segments Icon' to open a sub-window in which up to four 8-digit hexadecimal network-segment numbers may be entered. These must correspond to all the segments which are to be connected. Sending data to other segments involves work for the network server (not the game server), which has to move the data from one segment to another. This may cause delays in data transfer and slow the network down for other users.

ABOUT THE NETWORK GAMES

When the player in charge of the server clicks on Quick Combat, it initiates a King of the Skies tournament, in which all eight players are pitched against one another in a free battle zone. Before playing you can elect to play in teams, or fly as individuals - it's your choice. Both fuel and weapons are limited. You will need to land in order to replenish both; touching down on the runway is enough to achieve this objective.

EF2000 COMMUNICATIONS (DOS)

INSTALLING EF2000 FOR NETWORK PLAY

If missions from the simulator are unable to cope with the number of players, they will not appear on the menu. We suggest limiting simulator missions to four players.

NOTE: In network-simulator missions, the leader is responsible for waypoint adjustment and selection. Other players can adjust the speed and headings to the selected waypoint.

DISCLAIMER ON WINBOND NETWORK CARDS

When testing the network version of EF2000, the Winbond WBPLUS Ethernet card was found to cause data storms, and so corrupt the network game. Unfortunately, at the time of publishing no fix was available. We therefore cannot guarantee satisfactory results with this card until further notice.

SERIAL LINK

This allows connection between two computers. You will need a NULL MODEM CABLE, which is designed specifically to connect two computers and is different from a cable used to connect a computer to a modem. You will also need two serial ports on both machines: one for the mouse and one for the serial cable. Serial port connectors can be either small 9 pin connectors or wide 25 pin male connectors (pins facing out). The mouse is usually plugged into a 9 pin connector. Don't confuse the serial ports with a female 25 pin printer connector (which has holes rather than pins).

Before buying a null-modem cable, make sure you know what size the free serial connectors are on both machines with their mice connected. If you already have a null modem cable with the wrong size connectors, you can buy a 25-to-9 pin adaptor. A printer cable, with pins on the connectors, cannot be used.

EF2000 COMMUNICATIONS (DOS)

SERIAL LINK MENUS

CONFIGURING THE SERIAL LINK SOFTWARE

The serial link window has several boxes to configure the connection.

PORT

The port number refers to the socket in which the serial cable should be fitted. This number may vary from 1 to 4. Ports 1 and 2 are usually available on most computers. Port 1 is often occupied by the mouse, and when its driver is being loaded (usually during PC boot-up), the software should tell you which port is being used. Failing this, the MSD command in DOS will provide the information. Note that the port number does not have to be the same on the two linked computers.

To change the setting in the EF2000 software, click on the box, type in the number, and press return. If you accidentally use wrong port the game may hang or the mouse may stop working.

BAUD

This is a figure used to describe the rate of data transfer. Higher settings give a faster data transfer rate. For simulator missions, it is best to use the highest baud rate that gives reliable results on both machines. Your computer's documentation should tell you which baud rate is possible for a given port. In King-of-the-Skies, slower rates are acceptable because there is much less data being sent. If the data for one game cycle can be sent in a shorter time than the actual game cycle duration, then there will be no slowdown.

If the speed is too slow, then the game will pause each game cycle until the data from the previous game cycle has finished being sent, causing irregular movements of the aircraft. In the EF2000 software, the baud rate must be the same for both linked computers, and must be set to match the slower machine.

PARITY

This is an extra bit sent with each byte by the serial port chip to detect transmission errors. The actual type of parity controls how the bit is calculated, and can be NONE (no extra bit), EVEN, ODD, MARK and SPACE. Parity works by setting a specific number of bits of data for every byte. EVEN parity means that if there is an odd number of data bits in the byte, the parity bit will be set to 1, therefore making an even number of bits. The receiving computer recalculates the parity and compares it with the transmitted parity. (So if the byte has two 1's corrupted to 0's, then using parity will not spot the error.) This setting must be the same for both linked computers. Since the serial/modem system has a 32-bit CRC error check, and parity is not a very good error detector anyway, we recommend setting parity to NONE.

STOP BITS

The stop bit is an extra end-of-byte marker sent after the usual stopbit. It is not necessary, so use OFF in the EF2000 software. This setting must be the same on both computers.

EF2000 COMMUNICATIONS (DOS)

SERIAL LINK MENUS

FIFO:

This stands for First In First Out, and is two buffers (for input, & output) on the serial chip. It allows several bytes to be received before the processor has to service the chip to empty the receive buffer, and several bytes to be sent before the processor has to refill the output buffer. Serial ports without FIFO have to service each received/sent byte. Using FIFO causes less processor overhead, speeding the game up slightly, and the serial link works more reliably and can be used at faster speeds. You will be unable to use FIFO if the comms system knows you don't have FIFO, or if your serial chip is one of the types known to have built-in hardware bugs in it's FIFO. The FIFO does not need to be set the same for both linked computers.

FIFO LENGTH

This is the size of the receive and transmit buffers in bytes. Longer is better, and you may use numbers greater than one up to around 14. The best settings will completely dependent on the two linked computers so it may be a case of trial and error before getting an optimum set-up.



EF2000 COMMUNICATIONS (DOS)

MODEM MENUS

MODEM

This allows connection between two computers with modems. Either an external modem, connected to a serial port, or an internal modem may be used.

The serial system is used to communicate with the modem using the serial settings. Modems attempt automatically to detect the settings being used to talk with them, and these settings do not need to be the same on both computers. The modems themselves decide what data rate the phone line can take. The serial port baud rate can usually be higher than the phone line baud rate.

If data is being sent to the modem faster than the modem can transmit it down the phone line then the modem tells the computer to stop sending for a while. This can cause the game to pause momentarily.

Settings to use are: Parity none, Stopbits disabled, FIFO enabled, with FIFO length 14 if possible. The port must be correct, and the baud higher than the modems' data speed. If the modem is not detected at the baud rate you

have selected, then the modem is checked for the highest baud rate downwards.

In the EF2000 software, the modem window contains several options that must be set up before modem play can be started.

INITIALIZATION STRING

This is the initialization code for the type of modem you are using. For most modems "ATZ" is OK. If you know the string that turns compression off, then use this. The delay in the data getting from one computer to the other will be reduced because the modem does not have to store it whilst it is compressed. However, if the game pauses a lot try turning it on.

DIAL METHOD

This is the method the modem will use to dial, Pulse or Tone. Tone is the newer method and is slightly quicker. Older telephone exchanges may not recognise tone dialling.

NUMBER

The number to dial. If you are using a internal phone system you may need to add a prefix to the number to get an outside line. This is often a 9, and is usually followed by a comma "," which causes a pause in dialling to allow the local phone system to pass on the call without losing the following digits.

HANG-UP STRING

This is the code the modem needs to hang up. It is usually "ATH0". (The last character is a ZERO)

EF2000 COMMUNICATIONS (DOS)

MODEM MENUS

STARTING MULTI-PLAY

To start the network and find other players click on start. If there is a problem an error window will be displayed. Press return to cancel it.

For IPX and serial connections other players should be detected in a few seconds. If nothing happens try checking settings and wiring.

For modem connections it takes longer. The internal serial hardware is initialised, then the link is made to the modem, then either the modem is told to wait for a call, or on the server the modem dials the number and waits for an answer. During this process the current stage, last string sent to modem, and the last modem reply are displayed in a window. The last modem reply may belong to the previous message. If the abort button is clicked the system is reset. It may be useful to enable the speaker on the modem so you can hear what is happening, since the modem may not reply until the connection is made or hasn't been answered.

Once the connection exists the computers exchange player information, the settings windows disappear and the players window opens. Non-servers are locked into this screen waiting for the server to choose a mission, and must click on 'abort' to quit. If one player resets, everyone else must also do the same and rejoin. It is also advisable for everyone to abort and rejoin if anything goes wrong with the connection or a machine crashes whilst flying.

The server keeps the 'main menu' icon which allows the server to go and select a mission. It also prevents any other players from joining in, the server must be on the multiplay screen for players to join. The 'restart network' icon sends messages to all players waiting for a mission and resets their comms system. They then have to rejoin.

EF2000 COMMUNICATIONS (Win 95)

FOR MULTIPLAYER GAMES

For EF2000 there are two options for communication with other players. These are IPX network and DirectP, which allows use of modems.

IPX

To set up 32 bit IPX networking, please refer to the previous section, EF2000 COMMUNICATIONS (DOS).

NOTE: If you wish to play IPX in Windows '95, a 32 bit requester will be required. This is included in the installation for EF2000. If you are unsure whether or not to install the requester please consult your network manager.

DIRECTP

DirectP has several options for connection to other machines. For each of these options the set-up procedure is the same. Every player should enter their name in the 'name' box located in the Multiplay menu.

One of the players must be the server machine. This is selected by clicking on the 'server' box until the word YES appears; all other players should have this set to NO.

Once the server machine has been established, the player on that machine controls the selection of missions.

The server then needs to select a service. To do this, the nominated player should click on the 'service' box; a selection of services will then appear. After selecting the service, the game name should be entered. Clicking on the 'game' box will allow this to be done.

After entering the name of the game, the nominated server-player should click on 'start-up'. When all the other players have joined, the server should then click on 'MAIN MENU'. This will take the server to the main screen where the mission is created as usual.

Others are able to join the game by firstly selecting the service which they wish to use, then clicking on the 'game' box. After a few seconds a list of games will be displayed. Players should then click on one of the games and then on 'start-up'. If no games appear it could mean that the server machine has not yet initiated a game. In this case the player should click on the 'game' box again.

If the game has been initiated then the player will see a list of all the other connected players. After all the players are in the game the server machine will select the mission to play.

DIRECTP NOTES

Currently there are four services provided by DirectP version 3. These are Winsock IPX, Serial, Winsock TCP and Modem. Winsock IPX is 16-bit and doesn't require the 32-bit requester to be installed. Modem requires the Client machine to call the Server machine. In the modem option a windows dialogue box is created when 'start-up' is selected. This can be seen by clicking on the Taskbar and selecting the dialogue box. Please refer to your Modem and Windows 95 documentation for operation of the modem. When the link is made the server machine will then perform the mission selection as previously described.

Total Entertainment Network (TEN)

(WIN 95 VERSION ONLY)

Total Entertainment are an Internet service provider (ISP) through which you can play multiplayer games via the Internet. In order to play EF2000 on TEN you must first install the TEN software. This software is provided on the EF2000 CD-ROM or can be obtained from the TEN website (www.ten.net). Please note: You need a modem to play on TEN.

TO INSTALL THE TEN SOFTWARE:

1. Insert the EF2000 CD into the CD-Rom drive.
2. Start EF2000.
3. Click on the TEN box in the main menu.
4. The game will terminate and the TEN setup program will commence. Follow the instructions on screen. Once the TEN software is installed you must register as a new user on TEN. To do this you must choose to start the TEN software at the end of the installation procedure.

If a box appears, this means that the

program cannot find the setup.exe file. Click on the box and enter the location of this file (e.g. d:\ten where d: is the CD-Rom drive).

After registering you will be presented with the TEN Arena. The Arena enables you to create a game, join an existing game and chat to other players.

Alternatively you can run the setup.exe in the \TEN directory on the EF2000 CD.

IF TEN SOFTWARE IS ALREADY INSTALLED:

You can connect to TEN by either selecting TEN from the Windows 95 Program menu or you can follow steps 2 and 3 as above. You will then be presented with the TEN login screen where you must provide your user name and password. On entering TEN you will be presented with the TEN Arena where you can create or join a game and chat to other players.

GAME SETUP

Once the game setup in the TEN Arena is

complete EF2000 will restart. All players will be presented with the 'Currently Linked players' screen. When all players are linked (i.e. all player names appear in the box on the screen) the server is then automatically shown the main menu from which they must select a mission for the game (i.e. King of the Skies/Quick Combat/and Simulator only).

On exiting the game you will be returned to the TEN Arena.

MULTI PLAYER QUICK COMBAT

MULTI-PLAYER KING OF THE SKIES

There are three new sections in multi-player quick-combat. These are:

SOLO
BASE DEFENSE
TEAM PLAY

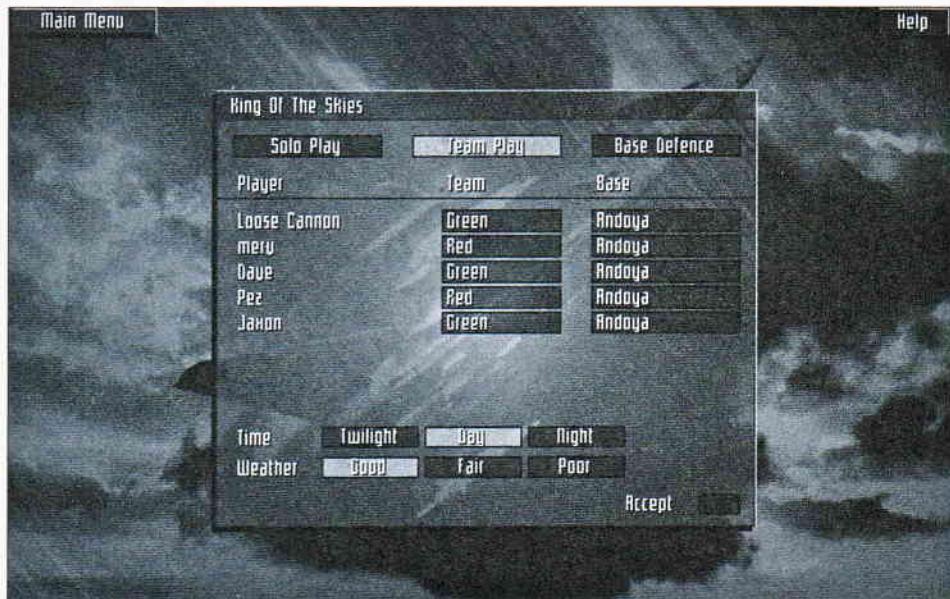
SOLO is similar to the original concept of King-of-the-Skies. In effect it is every man for himself. Every player has a kill score and a death score. For every successful kill a pilot makes his kill score will increase by one. If he is shot down or crashes into the ground then the death score is increased. Every time a kill or death happens, a table with all the players scores is shown.

BASE DEFENSE allows the server to choose teams and then to try and attack the opposing teams runway. Points are scored for successfully destroying any of the buildings in the complex. There is also a large bonus for landing on the enemy runway. Landing is defined as coming to a complete halt and turning off your engines on the runway. Additional points can be scored by attacking any ground mobiles in and around the enemy airbase.

TEAM PLAY is basically the same as solo but the server can select teams to fight each other.

Points are scored for a successful kill but are deducted for a deliberate death; e.g. crashing into the ground. The two teams are defined as

red and green and there are two runways from which to start. Shooting down friendly aircraft will cost points.



EF2000 GETTING STARTED

IN FLIGHT CONFIGURATION MENU

Once you are in an EF2000 flying session, you have access to a special configuration menu. This will allow you to change the several parameters without having to quit out. NOTE that SFX, SPEECH and MUSIC controls will only be available if you switch these features on during the initial game configuration.

CONTROLS: Joystick or keyboard.

SFX: Sound effects on or off.

SPEECH: Wingman, AWACS and other speech on or off.

MUSIC: Off, MIDI or CD music. CD music can be your own favorite audio CD.

CD CONTROLS: Lets you change tracks when playing CD music.

JOYSTICK SCALE: Determines the sensitivity of your joystick.

NOTE: CD and MIDI audio volume can only be adjusted through the software delivered with your soundcard, or through the card's own volume control.

WORLD DETAIL: High, medium or low, to suit the speed of your machine. Low detail: plain polygons, no smoke etc. Medium detail: textured polygons, shortened range for 3D. High detail: textures, maximum range for 3D, smoke afterburners etc.

G-EFFECTS: Switches black-out and red-out on or off.

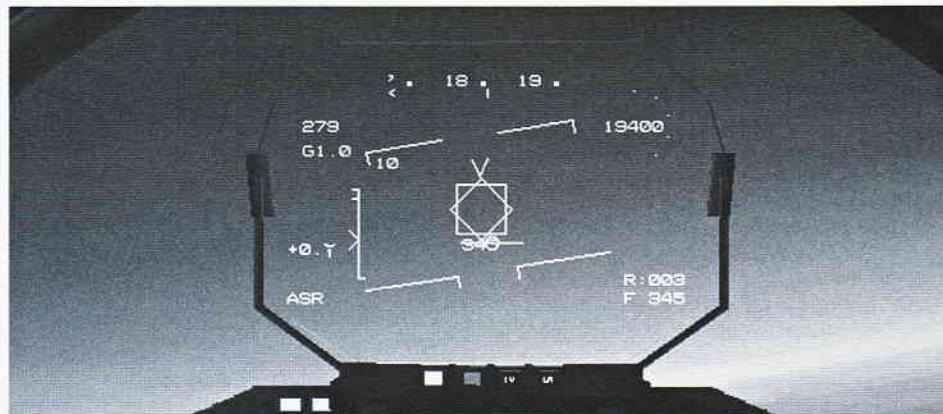
GEAR DAMAGE: Turns indestructible landing gear on or off.

PILOT AIDS: Switches on radar and DASS overlays in full HUD mode, and provides orientation arrows on the canopy for F2 and F10 views. These arrows point towards the HUD.

EXIT OPTIONS: Allows you to end the mission and return to the interface, return to the game or quit EF2000.

EF2000 VIEWS

AN INTRODUCTION TO THE VIEWS



EF2000 creates a visual impression of flight without using complex multi-window views. The key to this experience is 'the virtual cockpit' overlaid with an advanced 'helmet mounted display' (HMD). Together, they help to create a 3D 'virtual environment' that is fully compatible with a new generation of 'virtual reality' headsets now becoming available. EF2000 abandons the conventional approach to PC simulator cockpits, which place all the

instruments and head-up display in a fixed-forward view. Instead, we chose to look through the pilot's eyes, and create a three-dimensional virtual cockpit which works just like the real thing. All it takes is a few simple keystrokes to navigate around the cockpit, but to get the most out of the avionics you'll need to understand a few basic concepts about using 'head-down and head-up' displays in modern air combat.

INTERNAL VIEWS

Because EF2000 features a true 3D cockpit, a wide range of exciting internal views are available. Special views have also been developed for use in combat, to enhance realism.

EXTERNAL VIEWS

EF2000 has many cinematic viewing possibilities, to let you enjoy the action from a totally different perspective. Experiment with them in different situations, and soon you'll learn how external views can help improve your scores. For example, if you lose sight of your adversary during a dogfight, switch to the 'TARGET AND YOU' view to see where he is in relation to you. Or just select 'FLY-BY' to enjoy the view as you fly low over your airfield. You can even see what each side is up to as it prepares for war.

EF2000 VIEWS

EF2000 VIEWS IN USE



The advanced 'glass cockpit' (Shift F1)

'BEYOND VISUAL RANGE' (BVR) COMBAT

In a real fighter plane, where the pilot looks in the cockpit is totally dependent upon the changing air situation. For example, when using radar to initiate 'Beyond Visual Range' (BVR) combat at ranges above 100 nautical miles, the pilot has his head down in the cockpit to study radar or JTIDS pictures on the 'multi-function displays' (MFD's). He will glance-up occasionally, just to keep his eye on the outside environment and orientate himself. At long

ranges, the only way to track targets and launch BVR weapons is to monitor the displays.

THE 'PADLOCK VIEW' FOR CLOSE COMBAT

When an adversary comes into visual range, at anywhere between 30 and 20 miles, the pilot will prefer to keep looking out of the canopy, and perhaps glances at an MFD only briefly to confirm what he thinks he is seeing. In EF2000, the 'PADLOCK VIEW' has been specially designed to let you track targets and missiles visually. At first glance, it may look the same, but cycling through targets with the appropriate key will force your eyes to scan around the cockpit, locking on to any plane or missile within visual range. A fighter pilot watches his enemy in the same way, never forgetting the motto 'lose sight, lose the fight'. 'PADLOCK VIEW' also works with ground targets.

THE WIDE-ANGLE COCKPIT

In a dogfight, you need a wide field-of-view to track the enemy. In the real aircraft, you are able to glance easily around the sky, but in the confines of a PC screen, it's not so easy. The wide-angle view helps a lot. Try it!



The wide-angle cockpit view (F2)

EF2000 VIEWS

EF2000 VIEWS IN USE

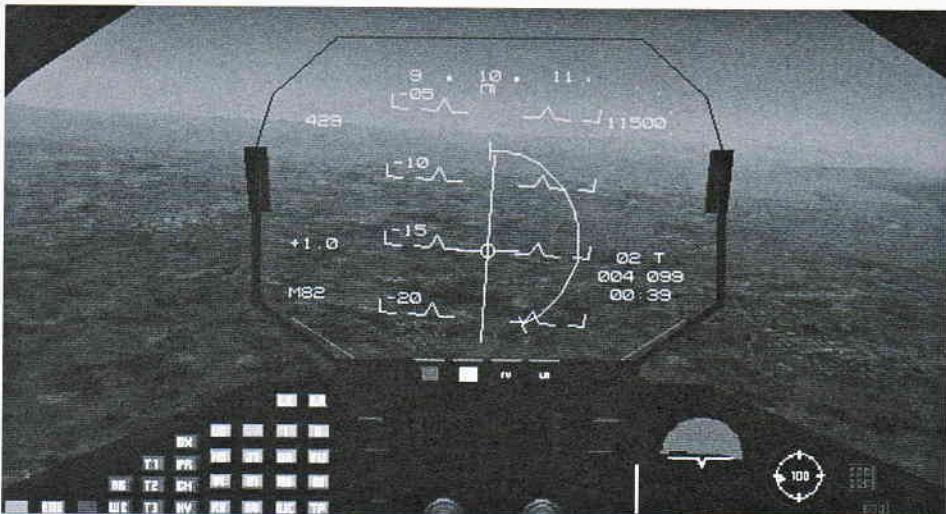
The 'PADLOCK VIEW' also slaves the targeting system of the 'ASRAAM' (Advanced Short Range Air-To-Air Missile), which you will be able to fire at an enemy even when you are looking over your shoulder.



Keep your eyes on the bandits without losing control of your plane, thanks to the unique EF2000 'PADLOCK VIEW' (F10)

EF2000 VIEWS

EF2000 VIEWS IN USE



The default view of the cockpit. Note the IRST screen under the HUD (F1)

HEAD-UP WITH COCKPIT VIEW

This is the default view in EF2000, and shows what the pilot sees when looking dead-ahead through the HUD. In this view, you will have access to both the HUD and the

'INFRA-RED SEARCH AND TRACK' (IRST) screen, which are both invaluable in combat within the 30 mile radius.

HEAD-UP ONLY VIEW

Modern fighter aircraft carry a video camera capable of taking pictures through the HUD. This view is exactly what the camera sees. It shows all the 'HEAD-UP DISPLAY' (HUD) symbology without the surrounding HUD and cockpit frame. This view also helps improve the frame rate on slower PCs. It's an extremely practical view in dogfights, and for approach and landing.



The 'HEAD-UP' view (F1)

EF2000 VIEWS

EF2000 VIEWS IN USE



Scrolling the view with Shift cursor.

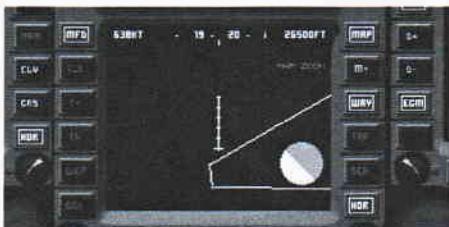
MANUAL SCROLLING VIEWS

The best and most natural way to check what's outside your cockpit is with your 'Mark 1 eyeball'. This is especially useful when there's time enough for sightseeing, but could prove tricky in combat situations.

'HEAD-DOWN' VIEWS

The EuroFighter has three 'Multi-Function Displays' (MFDs), which provide the pilot with a wealth of information about the air picture, the outside environment and the plane's systems.

Some of these screens need only a cursory glance; others require prolonged and careful study while flying the plane. You should practice switching between 'HEAD-UP' and 'HEAD-DOWN' views, because this will be important in difficult missions.

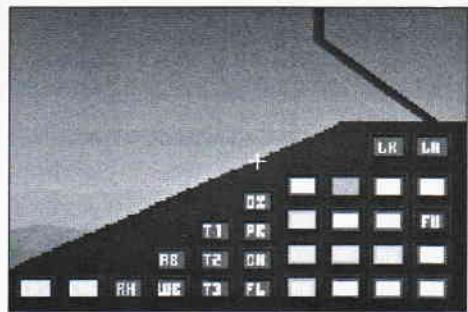


Heads down for radar, etc. (NUM 1,2,3)

To help you fly while looking at the MFD, check the 'ARTIFICIAL HORIZON' (see above). Use this together with the second line of information at the top of each MFD display, which shows your speed, heading and altitude. If you panic or become disorientated (which happens to real pilots too), simply press the 'L' key to return yourself automatically to level flight.

GLARE SHIELD VIEWS

You can access close-up views of the instrument panel sections shown in Head-Up mode. This includes the left-hand glare shield, with its bank of warning lights, the small IRST screen under the HUD, and the right-hand glare shield with its analog back-up instruments. The warning lights change colour, and give valuable indications to what is happening with the aircraft systems. It therefore pays to keep a close eye on them.



Close-up view of the warning panel (NUM 4)

EF2000 VIEWS

EXTERNAL VIEWS IN USE

EF2000 offers a wide variety of external views for you to enjoy. They are particularly useful in combat, to help you orientate yourself, or to observe the result of your tactics.

F3 - Executes a quick glance around the sky to check your six. This is handy when you have heard a missile warning, and want to check that an enemy aircraft has not sneaked up behind you.

F4 - Gives you access to a variety of external views of yourself, including several pre-set camera angles. Note that you will be able to zoom and pan in this view.

F5 - Shows you your wingman and toggles various views between him, you and his targets.

F6 - Fly-by views give you a dramatic and dynamic perspective on your flying- especially when a missile is chasing you! SHIFT F6 gives you access to browse plane fly-bys.

F7 - Access target views with this key, and watch what happens after you release your weapons.

F8 - A weapon's eye view, or external weapon view. Watch what happens when you drop cluster bombs!

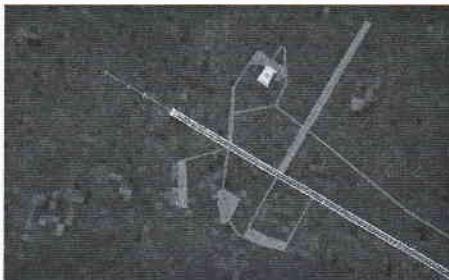
F9 - Take a look at any plane in the vicinity. Watch A10s killing tanks, or Tornados making airfield strikes.



F3 Check your six.



F4 Player external view.



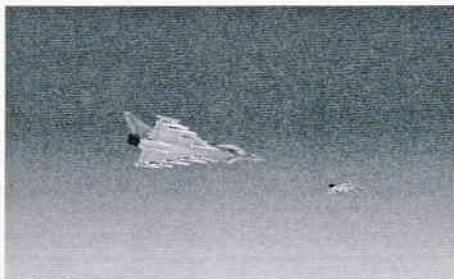
SHIFT F4 Satellite view.

EF2000 VIEWS

EXTERNAL VIEWS IN USE



F5 Wingman view.



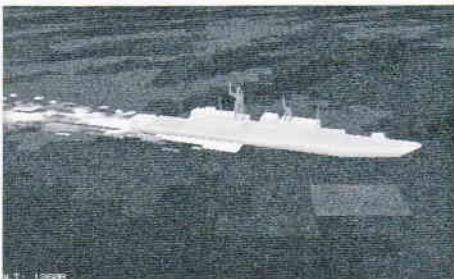
SHIFT F6 Wingman fly-bys.



F8 Weapon view.



F6 Fly-by views.



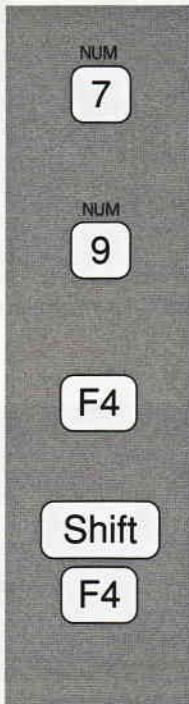
F7 Target view.



F9 Browse plane view.

EF2000 VIEWS

OPERATING THE VIEWS



EF2000 VIEWS

OPERATING THE VIEWS



WINGMAN VIEWS

PRESS 'F5'

Toggles between a full wingman external view, a view of the wingman and player and a view of the player and wingman.

PLAYER FLY-BY VIEWS

PRESS 'F6'

Lets you watch yourself fly-by. Also shows your plane and the nearest missile.

TARGET AND BROWSE PLANE FLY-BY VIEWS

PRESS SHIFT 'F6'

An external view that lets you watch your target fly-by, or the nearest browse plane.

TARGET VIEWS

PRESS 'F7'

Toggles between a full target view, target and player view, player and target view, and a view of the target and his target.



WEAPONS VIEWS

PRESS 'F8'

Toggles between a full external view of the weapon, a view of the weapon and target, a view of the target and weapon, and a weapon's eye view.

BROWSE ANY PLANE VIEW

PRESS 'F9'

Switches between views of any plane in the vicinity.

VR PADLOCK

PRESS 'F10'

Puts you in the full VR cockpit, and enables you to padlock onto any enemy plane within 30 miles. It should be used in conjunction with the target cycle controls and also gives you access to the ASRAAM sight. Press twice for missile padlock.

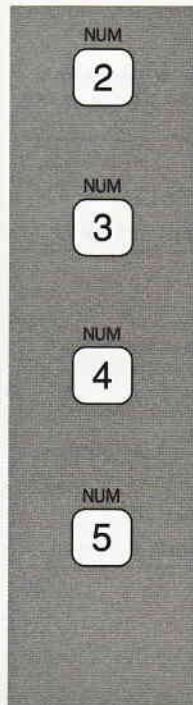
LOOK AT MFD 1

PRESS '1' ON THE NUMERIC KEYPAD

Lets you look at MFD1, used principally for radar.

EF2000 VIEWS

OPERATING THE VIEWS



LOOK AT MFD 2

PRESS '2' ON THE NUMERIC KEYPAD

Lets you look at MFD2, used principally for JTIDS and Moving Map Displays (MMD).

LOOK AT MFD 3

PRESS '3' ON THE NUMERIC KEYPAD

Lets you look at MFD 3, used principally for the Defensive Aids Sub-System and aircraft system displays.

LOOK AT LEFT-HAND GLARE SHIELD

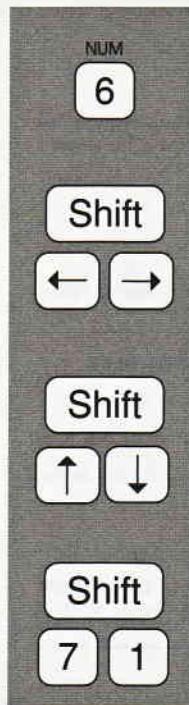
PRESS '4' ON THE NUMERIC KEYPAD

Lets you look at the warning lights clustered on the left of the cockpit.

LOOK AT THE IRST SCREEN

PRESS '5' ON THE NUMERIC KEYPAD

Gives you a close up view of the IRST display under the HUD.



LOOK AT RIGHT-HAND GLARE SHIELD

PRESS '6' ON THE NUMERIC KEYPAD

Lets you look at the analogue artificial horizon and compass, which you will need if the primary digital systems become damaged.

MANUAL SCROLLING VIEW HORIZONTAL

PRESS 'SHIFT' AND THE 'LEFT ARROW' OR 'RIGHT ARROW' CURSOR KEYS

This pans your view in the horizontal. It's great for sightseeing, but when there's danger about you should choose the padlock view.

MANUAL SCROLLING VIEW VERTICAL

PRESS 'SHIFT' AND THE 'CURSOR UP ARROW' OR 'CURSOR DOWN ARROW'

This pans your view in the vertical plane. This trick is especially useful in a turning fight to check your progress on the bandit.

EXTERNAL VIEW ZOOM

PRESS SHIFT AND '7' OR '1' ON THE NUMERIC KEYPAD

This lets you zoom in on external views, creating your own dramatic perspectives. Use in conjunction with the external view panning described next.

EF2000 VIEWS

OPERATING THE VIEWS



EXTERNAL VIEW PANNING

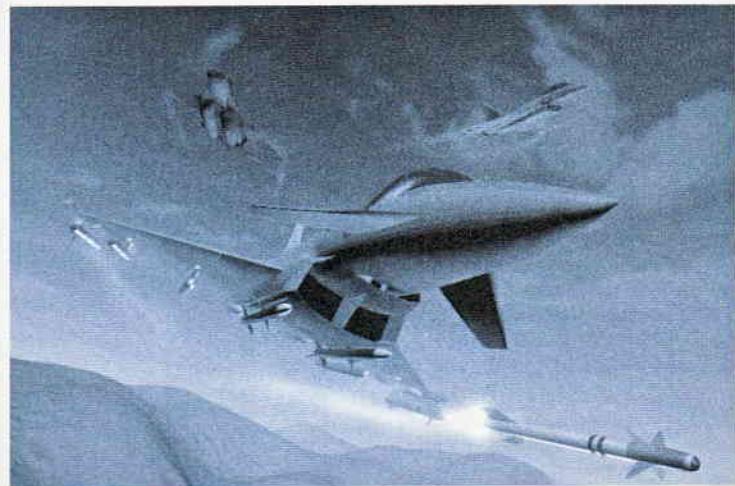
PRESS 'SHIFT' AND THE CURSOR ARROW KEYS

This lets you pan freely around the external views.

HUD DECLUTTER

PRESS ALT 'H'

This lets you remove detail from the HUD, to let you enjoy any of the cockpit views without excess clutter.



EF2000 VIEWS

SMARTVIEW MOTION CAMERAS

Watch any film about air combat, and you'll notice that the mid-air cameras are never totally steady. The net effect of this constant movement is to reinforce the sense of space and motion, and that is what we have tried to capture with a new set of camera views. Not only do cameras pan subtly around their subject, they cut automatically from one view to another, to ensure that you get the best of the action all the time. A SmartView mode is also available that uses AI to control the selection of views and cutting between views - a kind of virtual film director.

New views apply to the following keys:

F4 revised external views with improved camera panning and tracking.

F8 new missile views which show the various stages of launch from different angles. Standard missile views are still available if you press SHIFT F8.

Shift F6 gives a fly-by view of the currently targeted aircraft.



EF2000 VIEWS

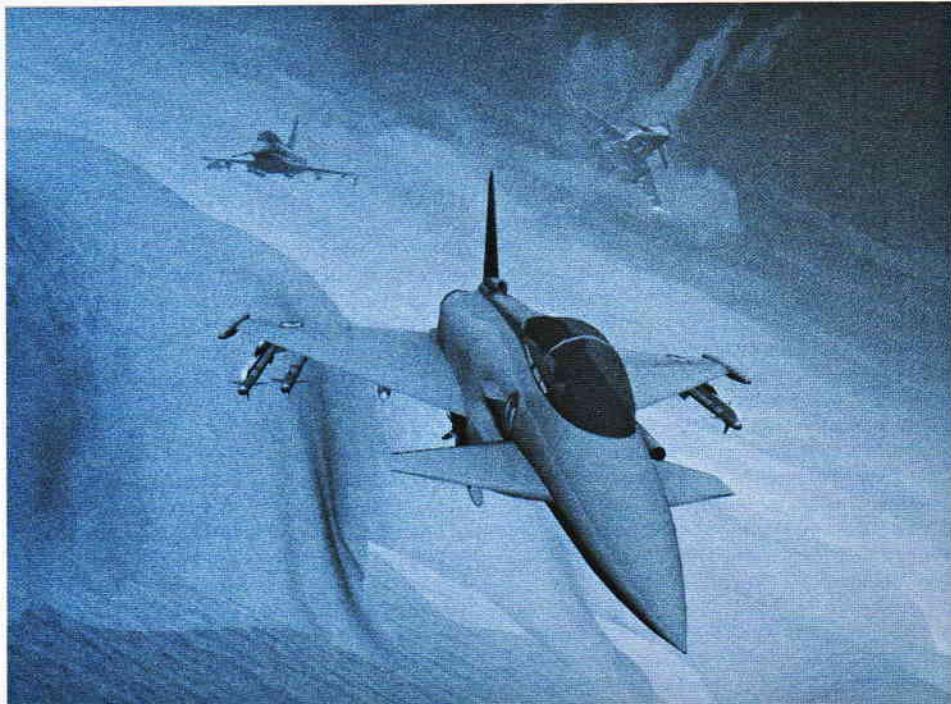
SMARTVIEW MOTION CAMERAS

ALT F6 this gives you a looped fly-by view, which is particularly exciting in dogfights and for stunt-flying.

SHIFT V SmartView virtual director brings you the very best of the action automatically. The event describes what is currently happening; e.g. BVR for beyond visual range combat. The view describes who is looking at who; e.g. Tornado - SU-27, means that the principle viewed aircraft is tracking an SU-27.

SHIFT F SmartView filter, which allows you to select the group of planes to be observed:

- All aircraft
- Your flight
- Your mission
- Allied aircraft
- Enemy aircraft
- Neutral aircraft



EF2000 AVIONICS

AN INTRODUCTION TO THE EF2000 AVIONICS

As combat aircraft became increasingly sophisticated in their ability to detect, kill or evade threats, so the pilot work load increased. In some cases, this meant that aircraft required two seats; one for the pilot; the other for a weapons and electronics officer or 'Wizzo'. However, the specification for EuroFighter stated the need for a single seat plane, capable of performing tasks that might otherwise have required a two-seater. This demanded a fundamental re-think on the pilot-aircraft interface, at all levels, from Flight-Control System (FCS) to flight instrumentation. Target detection needed to be stealthier, more accurate, and more powerful, yet more automated. Defensive systems would have to 'think' for themselves, taking whatever precautions the situation demanded. Weapons systems would have to be more appropriate to changing situations, and have the performance to beat a new generation of agile aircraft. Navigation systems would have to do far more than just point-out the right direction.

On top of this, the phenomenal improvements in roll-rate, turn and climb meant increasing physical demands on the pilots themselves. The onset of G in a Hawk training aircraft is bad

enough, but it is many times more severe in EF2000. This meant that accidents due to G-LOC (Gravity Induced Loss Of Consciousness) would be far more likely, and so recovery systems had to be installed as safety precautions.

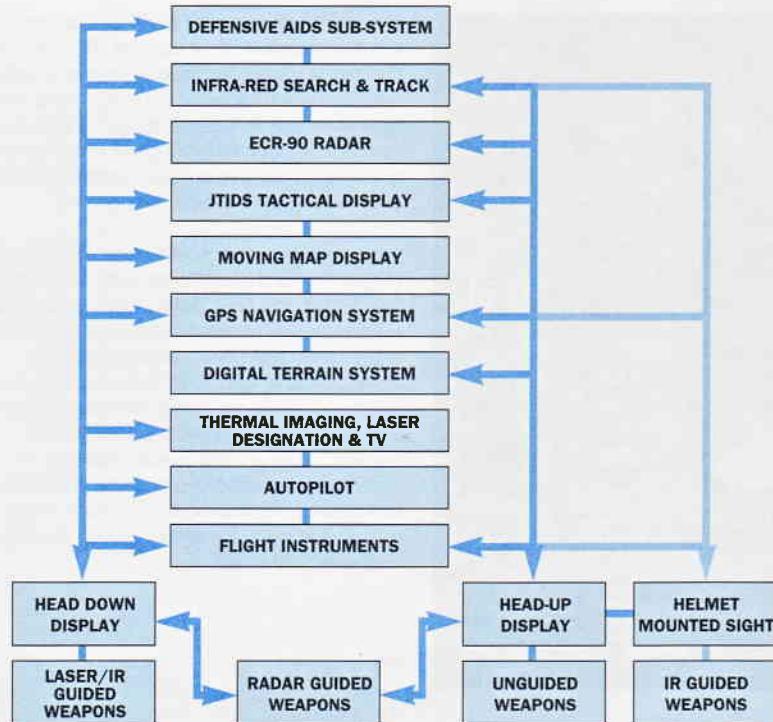
The EuroFighter's designers have tackled a great many of these problems in unique and novel ways. Not only is the aircraft easy to fly and virtually impossible to stall, its avionics provide a level of feedback never before seen in a multi-role fighter. That doesn't mean that EF2000 is simple to fly in combat – just a lot easier considering its awesome power and potential.

In EF2000, we have reproduced many of the systems found in the real EuroFighter, and laid them out in the cockpit as pilots would expect to find them. However, even if you choose not to employ the wealth of tactical data available to you, you'll still have a good chance of success by employing the basic systems. Because there is such a variety of systems to work with, you will also find your own special way of using them.



EF2000 AVIONICS

DISPLAY & WEAPON DELIVERY



Learn to use your autopilot first, and activate this while you practice with the other displays and systems.

Keep the Defensive Aids Subsystem (DASS) activated at all times: it does most of the work of defending your aircraft automatically.

Learn to use your wingmen properly: when the battle begins, you need all the help you can get. Using your wingmen correctly will take a lot of pressure away from you.

practice as much as possible using the simulator missions and the free-flight options.

Tips for Beginners

The diagram shows where the various weapons aiming systems will be displayed, and which avionics control those systems.

EF2000 AVIONICS

AN INTRODUCTION TO THE ECR-90 RADAR



ECR-90 - the most versatile fighter radar in the West

The advent of radar in fighter aircraft lead to the development of air combat 'Beyond Visual Range'. It meant that pilots were now able to 'see' the adversary electronically, long before he was visible to the naked eye. Radar guided missiles complemented fighter radar, giving pilots the means to conduct combat without ever setting eyes upon the opponent.

Until recently, radars could scan multiple targets but were unable to track more than one target at a time. New developments have overcome this problem, and are able to track many targets at once, returning data on speed, closing speed, altitude, aspect, range and bearing. By analysing the radar echoes and comparing them with a database of signals, today's radar is even capable of distinguishing aircraft types and prioritizing the threats. Furthermore, advances in signal processing have stretched detection ranges to well over 200 miles.

EF2000 AVIONICS

AN INTRODUCTION TO THE ECR-90 RADAR

'LOOK AND LEARN' RADAR

The ECR-90 is distinguished by its ability to portray a complex air picture in a simple graphical way that is easier for the pilot to understand. In addition, it automates many of the functions that would traditionally require a great deal of button pushing, such as changing modes. It is also closely integrated with an IRST (Infra Red Search and Track) system, which is able to track air targets passively, and supplement radar data when enemy jamming is in progress.

In the real EF2000, voice control will also enable the pilot to summon-up a variety of data, simply by asking. This allows pilots to learn about the air-picture without having to make complex radar adjustments.

No radar is perfect, and in EF2000 we have reproduced some of the problems. Firstly ECR-90 is a Pulse Doppler radar which cannot see fast, low-level enemies crossing its path at 90 degrees. Contacts may therefore vanish for brief moments. Secondly, different radar targets have a different Radar Cross Section, which means that big planes show up much more easily than small, fighter-sized planes.



A BRIEF HISTORY OF THE ECR-90 RADAR

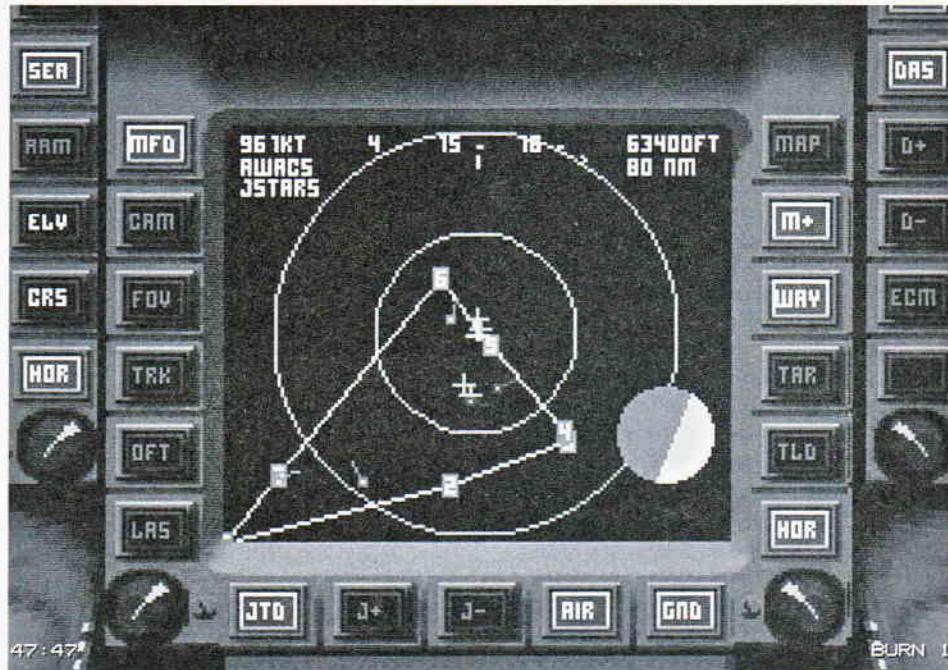
The ECR-90 radar for EF2000 has been developed by a consortium including Italy's FIAR Defense Division, Germany's Deutsche Aerospace and Spain's INISEL, lead by GEC-Marconi Avionics of Great Britain. ECR-90 is a 3rd generation coherent multi-mode radar based on the 'Blue Vixen' technology of the updated Sea Harrier. Signals are fed into a powerful processor, where many complex analyzes are made in real-time, before being displayed as graphical symbology on colour, raster-cursive displays. Information such as aircraft type, speed, closing speed, heading and altitude are complemented by threat prioritisation, correct weapon allocation, and plotting of the best tactical flight path for weapons release.

EF2000 AVIONICS

THE ECR-90 RADAR IN USE

CHOOSING BETWEEN RADAR AND JTIDS

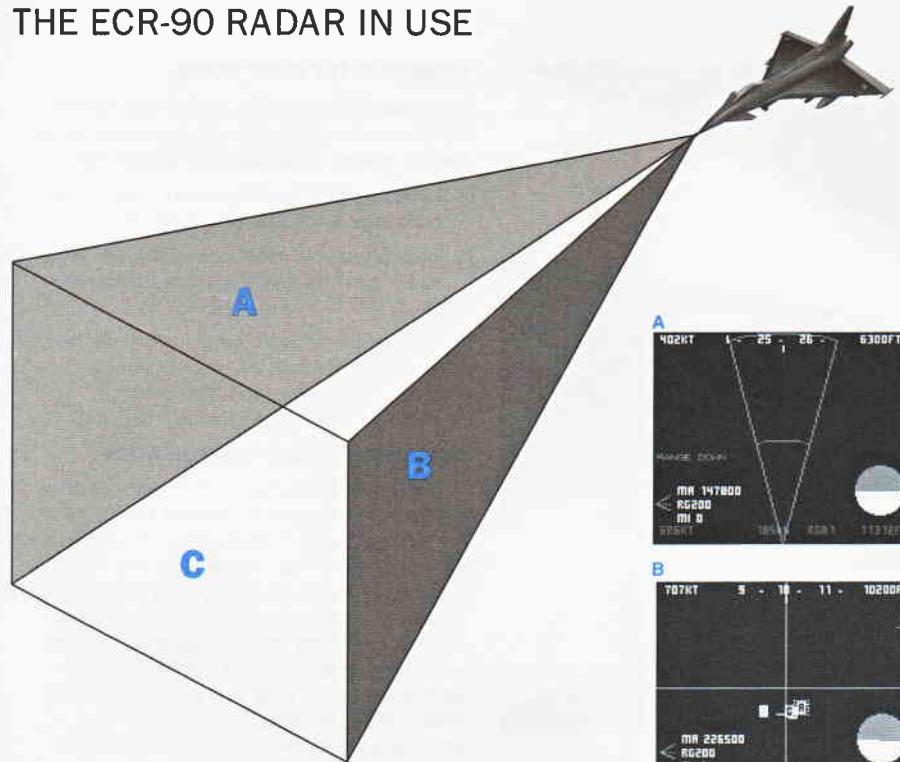
Each time you use radar, you broadcast your position to every passive radar warning receiver for miles around. For this reason, a great deal of money has been invested in stealthy detection technology which does not rely on using fighter radar. The result is JTIDS, which stands for the Joint Tactical Information Distribution System, and which is described in detail in this manual. In simple terms, JTIDS gathers data from every allied electronic sensor in the theatre of war, including Airborne Warning and Control Systems (AWACS), builds a composite picture and beams this direct into the cockpit. Which means you see what AWACS and other systems see, without giving your position away. JTIDS will only work if the appropriate intelligence gathering aircraft are airborne. If this is the case, use JTIDS for monitoring the air-picture, until you need radar for launching weapons. This will help prevent your early detection by enemy Early Warning



Using JTIDS instead of radar

EF2000 AVIONICS

THE ECR-90 RADAR IN USE



Viewing radar data from every angle

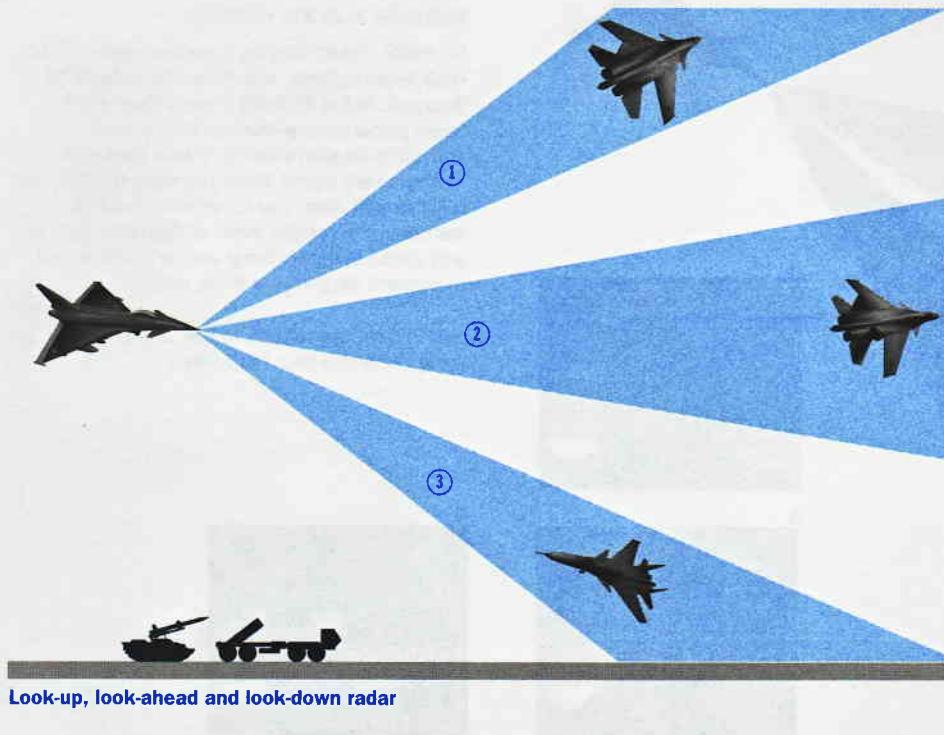
BUILDING A 3D AIR PICTURE

Normally, radars display a pseudo plan-view of their beam pattern, which can be difficult to interpret. In the ECR-90, three views of the beam pattern are available: A, the more conventional plan view; B, a side elevation, which is very useful when you need to analyze relative altitudes; and C, which is a cross section, or boresight view, of the radar picture and useful in determining enemy altitude and movement across your flight path.

NOTE: Centring targets in the 'C' view will bring them into your HUD view.

EF2000 AVIONICS

THE ECR-90 RADAR IN USE



LOOKING IN THE RIGHT PLACE

It is possible to alter the scan of the ECR-90 radar in order to provide optimum scanning of the sky ahead. Three settings are provided:

- ① Look-up mode, for detection of high-flying reconnaissance planes and bombers;
- ② Look ahead, for detection of aircraft likely to be flying roughly the same altitude as your aircraft;
- ③ Look-down mode for catching the devious low-flying bomber, intent on breaking through your defenses. The different mode is shown by a symbol in the MFD.

AUTOMATIC THREAT PRIORITISATION

In the real EF2000, the ECR 90 will prioritize the greatest threats, by dividing the range of each target by its closing speed, to give a Time To Go number (TTG). The smaller the TTG, the greater the threat. In EF2000, six targets are prioritized, in order to maintain the clarity of display, especially at low resolution. Targets with the smallest TTG are marked with the letters A, B, C, D, E, or F. If your mission is to detect bombers, the ECR-90 will also filter information to detect only that target type.

EF2000 AVIONICS

THE ECR-90 RADAR IN USE

WEAPONS SELECTION

Use the ENTER key to scroll through available AA weapons. Selecting the appropriate weapon depends upon range to target. At ranges of 70 nm or less, select S-225 as first choice, with AIM 120 AMRAAM as second choice; at ranges of 30 nm or less, select AMRAAM as first choice, ASRAAM as second choice. At ranges of 10 nm or less, select ASRAAM as first choice, or AIM 9M Sidewinder as second choice. At 2 nm or less, use the cannon.

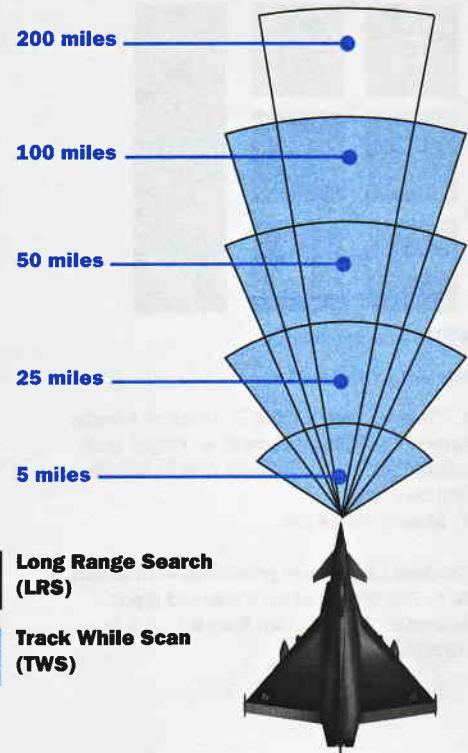
AUTORANGING RADAR (IDENTIFICATION FRIEND OR FOE)

The radar automatically discerns whether a tracked target is a friend or foe, and displays an appropriate symbol: red for hostiles, green for friendlies. The pilot does not have to worry about pressing an IFF button to interrogate a target.

Missiles are shown as yellow squares.

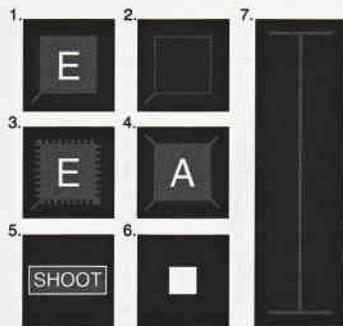
AUTORANGING RADAR

Once the radar has detected targets, it will employ Autoranging to keep the blips within optimum radar range. It works in much the same way as an autofocus camera, and relieves the pilot of another basic task. Autoranging is the default setting, but can be overridden by manual ranging.



EF2000 AVIONICS

THE ECR-90 RADAR IN USE

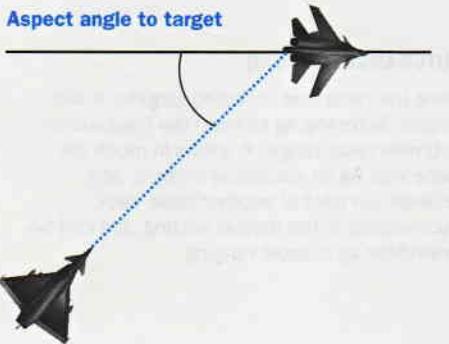


MFD radar symbology

RADAR SYMBOLOGY

1. Tracked target (red)
2. Tracked friendly (green)
3. Selected target
4. Target with missile allocated
5. Shoot cue
6. Missile (yellow).
7. Missile range bar.

Tracked targets are prioritized with letters A to F. The small tail on a tracked plane indicates the direction from which it is travelling.



One of the most important symbols on the radar is the missile range bar, which will vary in length depending upon altitude and your aspect to the target. Flying high and head-on to target gives the best range. When you have an AA missile selected, you must ensure that the target is within the reach of this line. Once the target is in range, the symbol will change to indicate a lock, and the 'SHOOT' cue will appear. If you or your wingmen decide to fire, an X will appear around the symbol to indicate that a missile has been allocated. You will then be free to engage another target.

JAMMING RESISTANCE

Since the introduction of radar, counter technologies have been developed to jam its signals and 'spoof' missiles. The two main methods are frequency jamming and chaff (see the section on the Defensive Aids Sub-System for more details). The ECR-90 employs automatic techniques to counter jamming and chaff, by comparing inputs from different sensors.

RADAR INFORMATION ON THE HUD

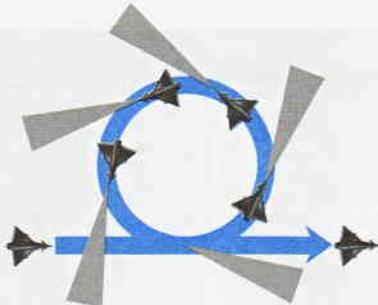
Pilots of single-seat aircraft cannot afford to spend all their time staring down into the cockpit, so there is a direct correlation between what is displayed on the MFD, and what is shown in the Head Up Display (HUD). For example, tracked targets are shown as boxes. For more information see sections on the HUD and using radar guided weapons.

EF2000 AVIONICS

THE ECR-90 RADAR IN USE

THE MANOEUVRING ATTACK SYSTEM

With the autopilot set to TRACK mode, your aircraft will automatically set its course towards any locked aircraft currently awaiting assignment of a weapon. With the autofire cannon, this will enable you to destroy targets at close range with devastating precision. This system was first tested in an F-15, and proved that it is possible to destroy violently manoeuvring air-targets at ranges up to two miles with the help of automated systems.



ACHIEVING FULL RADAR COVERAGE

Radar only scans a portion of the sky in front of you, so it is important to fly a circular course every twenty miles or so, in order to check that nothing has appeared behind you. To do this, make a note of your heading, then put the aircraft into a shallow turn. Try to maintain altitude as you do this by looking at the Horizon Ball in the MFD, and monitoring your altitude in the top right-hand corner of the MFD.

If you reach your original heading without detecting any bogeys, continue for another

Using radar to check your six

twenty miles or more and repeat the exercise. In Combat Air Patrol missions, you will fly a route that achieves all round coverage of your sector.

SEA EAGLE RADAR MODE

Selecting this Air-to-Ship weapon will automatically set the ECR-90 to a special SEA mode, which is a plan-only view. It will detect



Sea Eagle radar mode

surface ships at ranges up to 100 miles. Ship targets are selected in exactly the same manner as air targets, using the cycle button, and information on the ship type is shown at the bottom of the MFD in red.

Once you have achieved a lock, you may zoom the image to see a clearer picture.

EF2000 AVIONICS

OPERATING THE ECR-90 RADAR



EF2000 AVIONICS

OPERATING THE ECR-90 RADAR



ACCESS THE CORRECT MFD

PRESS '1' ON THE NUMERIC KEYPAD, OR 'R'

In EF2000, the three available views of the ECR-90 data are displayed on the left-hand Multi-Function Displays.

USE THE MFD

POINT AT MFD BUTTONS WITH THE MOUSE AND SELECT WITH THE LEFT-MOUSE BUTTON, OR USE CTRL AND LETTER KEYS

Once the MFD is active, you will have access to the various buttons around it by using the mouse or key sequence. When the mouse is over the MFD buttons, it has a box shape, which indicates that you can activate buttons by pointing and clicking. When the cursor is over the screen itself, it changes to a cross. At the top of the screen, the speed, heading and altitude of your aircraft are displayed. At the bottom of the screen, the speed, heading and altitude of selected target aircraft are displayed.

ZOOM SEA RADAR

PRESS 'Z' OF THE MFD

Allows you to zoom the Sea Eagle radar image.



SWITCH THE RADAR ON/OFF

PRESS 'RAD' ON THE MFD

If you don't have to use your radar, remember to switch it off, in order to avoid detection by hostiles. Radar 'off' is the default mode for you and your wingmen, so remember to ask them to activate radar when danger is approaching.

CHANGE RANGE AUTOMATICALLY

PRESS 'ARN' ON THE MFD

The default setting of the ECR-90 radar is with 'AUTORANGE' on.

CHANGE RANGE MANUALLY

PRESS 'R+' OR 'R-' ON THE MFD

From time to time, you may want to control the range manually, so simply press the appropriate key to increase or decrease range.

CYCLE BETWEEN LOCKED TARGETS

PRESS 'CYC' ON THE MFD OR PRESS 'C'

To interrogate different locked targets, press this key. The selected target is highlighted on the MFD, and the relevant information is shown in red at the bottom of the screen.

EF2000 AVIONICS

OPERATING THE ECR-90 RADAR



CYCLE BETWEEN AA MISSILES

PRESS 'AAM' ON THE MFD OR 'ENTER'

You may want to change the type of AA missile you are using, and override the automatic selection. As you switch weapons, you will notice the range bar changing in size to reflect the different ranges.

CHANGE TO ELEVATION VIEW

PRESS 'ELV' ON THE MFD

To get an assessment of relative altitudes, switch to the elevation view. It is a particularly important view when you are trying to improve missile ranges by gaining altitude.

CHANGE TO CROSS-SECTION VIEW

PRESS 'CRS' ON THE MFD

When chasing an enemy using the plan view radar, and the target makes a sudden move to the left or right, switching to the sectional view will show you whether he is diving for cover, or zooming in preparation for a return attack.

CHANGE TO LOOK-AHEAD MODE

PRESS 'AHD' ON THE MFD

To return to the default look-ahead setting after using one of the other settings.



CHANGE TO LOOK-UP MODE

PRESS 'UP' ON THE MFD

To search for high-flying targets, such as bombers or reconnaissance aircraft, select the look-up mode.

CHANGE TO LOOK-DOWN MODE

PRESS 'DWN' ON THE MFD

To capture fast, low-level interdiction flights by enemy aircraft, switch to the look down mode.

prioritize TARGET TYPE

PRESS 'PRI' ON THE MFD

To determine which of the tracked targets are bombers, select this mode. It is designed for missions where your priority is to stop enemy interdiction.

SEA EAGLE MODE

SELECT SEA EAGLE USING THE 'BACKSPACE' KEY OR 'SEA' ON THE MFD

Selecting this Air-to-Ship weapon will automatically set the ECR-90 to a special SEA mode, which is a plan-only view. It will detect surface ships at ranges up to 100 miles. Selection of targets uses exactly the same method as AA weapons.

EF2000 AVIONICS

AN INTRODUCTION TO THE JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM



JTIDS - integrating battlefield data

An important trend in tactical display systems is to provide all combatants with an up-to-date picture of enemy and friendly positions in the entire theatre. This means collecting data from all major sensors operating in the battle environment, integrating them into one picture, then relaying that picture directly to the pilots and commanding officers. The sensors are principally AWACS, the Airborne Warning and Control System, and the Joint Surveillance and Target Attack Radar System, which was first battle-tested in the Gulf War. Secure transmission of the data to all parties is handled by the Joint Tactical Information Distribution System (JTIDS).

The advantages are that the combatants do not have to rely on radar (which gives their position away) and that they have access to information on what's going on around them, which could never be done with localized sensor systems alone. Another major advantage is that force commanders can be sure that everyone involved is getting the same big picture, and is able to react swiftly to changing local conditions.

EF2000 AVIONICS

AN INTRODUCTION TO JTIDS

AWACS

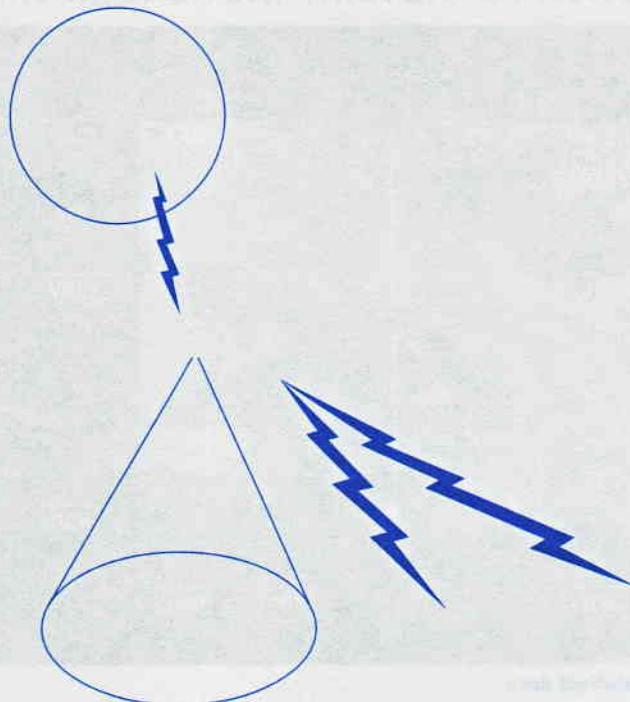
AWACS, or 'Magic' to pilots, provides an accurate air picture over a 300 mile radius, and directs aircraft to intercept bogeys. Originally designed to monitor the Warsaw Pact countries, AWACS proved invaluable in the Persian Gulf War, and in peace keeping operations over the Balkans.

JOINT STARS

The E-8 JSTARS (Joint Surveillance Target Attack Radar System) aircraft was rushed into service during the Gulf War, while still a prototype. It is the ground-watching equivalent of AWACS, able to detect second-echelon ground concentrations far behind enemy lines.

JTIDS

JTIDS replaces voice communications with high-volume pulses of coded digital information. These are fired in short bursts using fast frequency hopping techniques for outstanding resistance to jamming. JTIDS terminals are now installed in all major combat and surveillance vehicles, from AWACS itself to EF2000.



How the information flows with JTIDS

EF2000 AVIONICS

JTIDS IN USE

JTIDS VERSUS RADAR

Wherever possible, use JTIDS in preference to radar, because it does not give your position away to the enemy. It makes you 'stealthy'. It also provides you with an all round picture of the combat environment. JTIDS will display all hostile aircraft, ground mobiles and ships detected by AWACS and JSTARS. If either of these planes is shot down, the relevant aspects of the JTIDS picture will disappear, forcing you to rely on your radar once more. It is always worth double-checking your JTIDS data from time to time, by comparing it with the ECR-90 radar picture.

TACTICAL OVERLAYS

JTIDS lets you display your waypoint route on the tactical picture, helping you to determine where threats may occur during your flight. Double checking this information with the DASS will tell you where active EW and SAM radars are located. In addition, you can de-clutter the display by turning air and ground threats on and off. This is worthwhile in case air targets are obscuring an immediate ground-based threat. Range can also be adjusted, with the smaller scales providing the clearest display of the

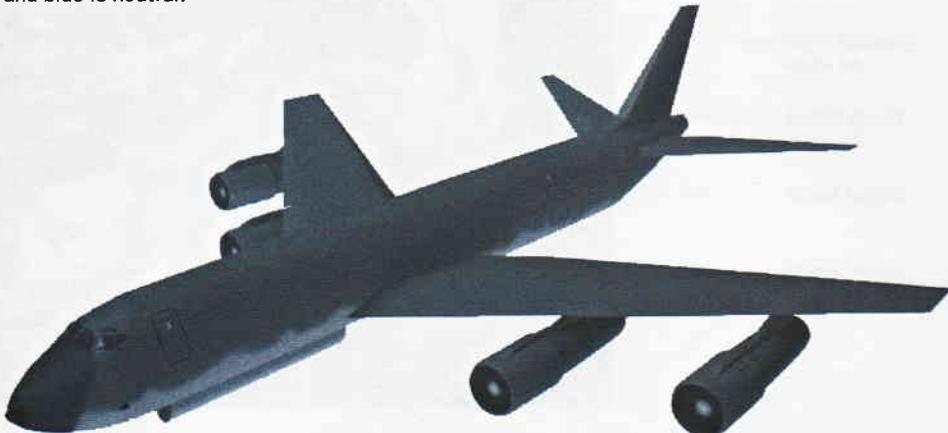
immediate battle zone. Crosses represent ground threats. Squares represent aircraft. Red is for the enemy.

JTIDS COLOR CODING

Green represents NATO, red indicates Russian and blue is neutral.

JTIDS AND THE MMD

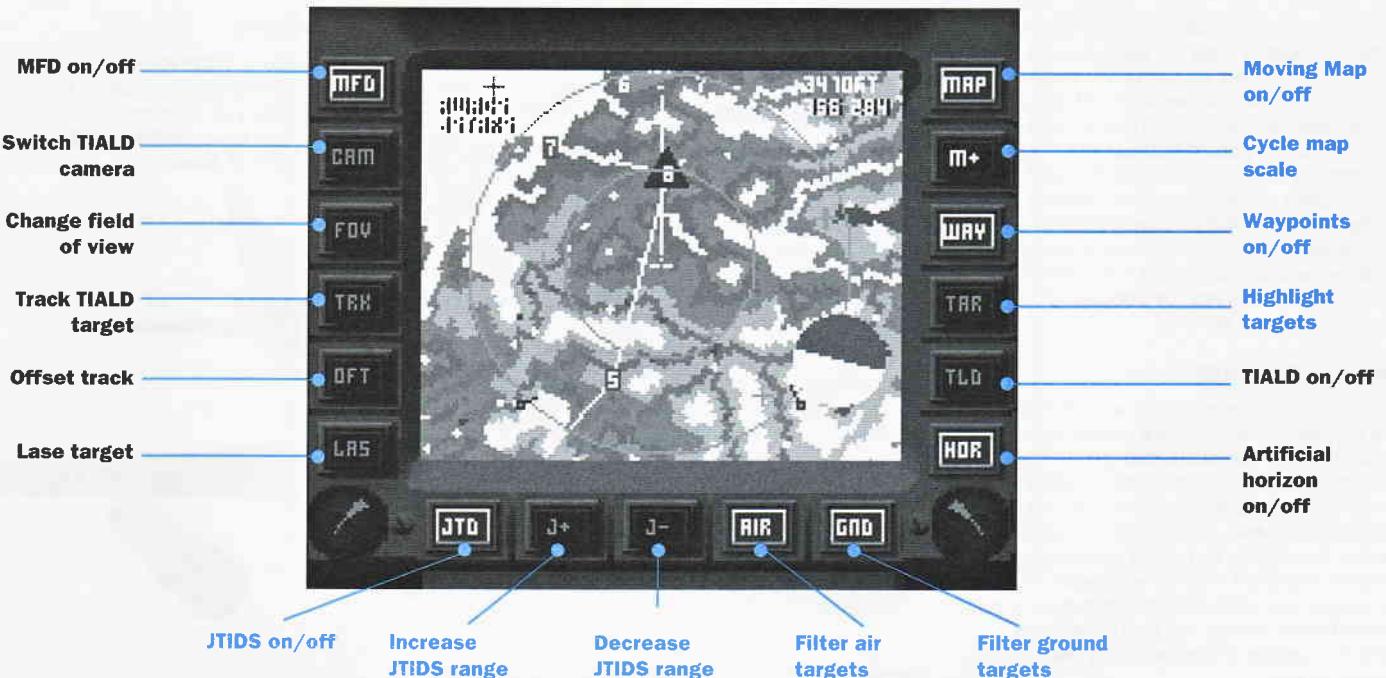
You can also overlay JTIDS data onto the moving map, enabling you to pinpoint the exact geographic locations of different threats. This is especially useful for engaging 'Targets of Opportunity' and SAM sites.



JSTARS

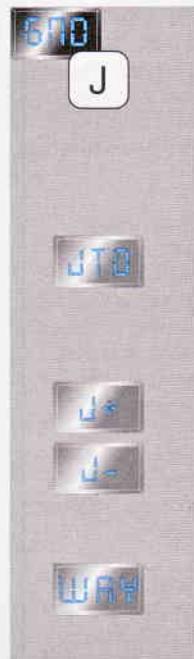
EF2000 AVIONICS

OPERATING JTIDS



EF2000 AVIONICS

OPERATING JTIDS



ACCESSING THE CORRECT MFD

PRESS 'J'

In EF2000, JTIDS is displayed on the centre Multi-Function Display. Press the appropriate key to access this MFD.

SWITCHING JTIDS ON/OFF

PRESS 'JTDS' ON THE MFD

The default is off, but JTIDS can be on at all times during missions. Selection of other displays other than the map will cancel JTIDS, which may be re-activated by pressing the appropriate key.

CHANGING RANGE MANUALLY

PRESS 'J+' or 'J-' ON THE MFD

This will allow you to zoom in on the threat picture. When nearby threats are overlaid, zooming-in should help to separate the signals.

WAYPOINTS OVERLAY

PRESS 'WAY' ON THE MFD

This lets you see your mission waypoint route.



TOGGLE AIR TARGETS ON/OFF

PRESS 'AIR' ON THE MFD

This lets you declutter the display, and search for ground targets obscured by the air targets.

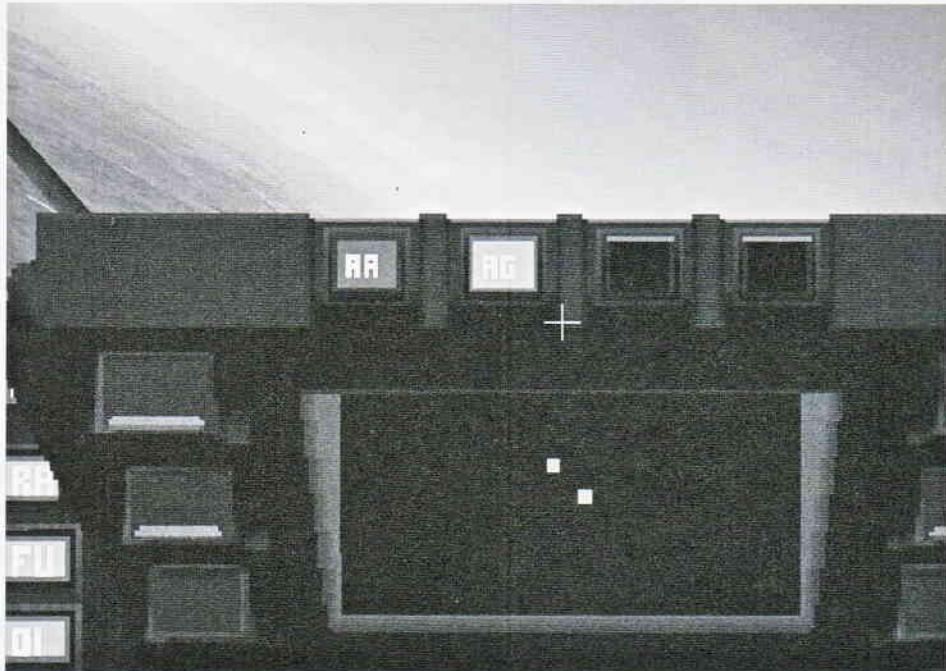
TOGGLE GROUND TARGETS ON/OFF

PRESS 'GND' ON THE MFD

This lets you declutter the display, and makes only ground targets visible

EF2000 AVIONICS

AN INTRODUCTION TO THE INFRA-RED SEARCH & TRACK EQUIPMENT



IRST allows stealthy detection of enemies

Years before Western powers considered it worthwhile, the Russians were busy integrating Infra-Red Search and Tracking equipment into their front line fighters. This enabled them to acquire and track targets without resorting to radar, which always gives the game away with its tell-tale emissions.

Planes like the MiG-29 are able to make 'covert' attacks on enemies, getting close enough to ensure a high Probability of Kill (PK) without their opponents ever knowing that they were there. IRST works by detecting differences in heat emitted by various objects, and that doesn't only mean hot jet pipes. Consider that at absolute zero, minus 273.15 degrees centigrade,

0 degrees Kelvin, the IR scanner would see nothing; an iceberg by contrast would have a difference in temperature of between 230K and 280K, so would be clearly visible.

IRST is therefore capable of showing detailed visual information over an estimated distance of 25 miles. This information can be filtered by software to provide a radar-like display of air targets, or enhanced to produce TV-like images

EF2000 AVIONICS

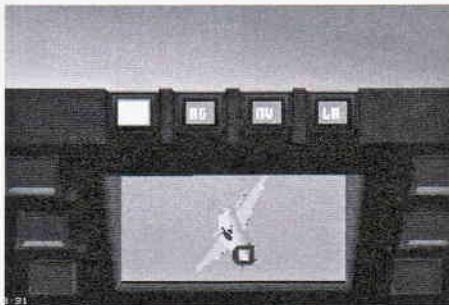
IRST IN USE

In EF2000, IRST serves two practical purposes. Firstly it is capable of detecting targets and tracking them in a similar fashion to radar, without giving the EF2000's position away. Secondly, it is capable of generating TV quality images, which can be used for target identification. For example, hot airborne targets within 25 miles will appear as small points of white light. If then acquired by an IR missile's seeker head, the target will be enlarged on the display to make target identification easier. The IRST head is gyroscopically stabilized, so the image will remain steady during manoeuvring, although the limit of its field of vision is 170 degrees.

In ground-attack modes, IRST also doubles as Forward Looking Infra Red (FLIR) guidance for Mavericks. On acquisition of 'hot' ground targets, the view is enlarged automatically in the small screen below the HUD, to show what has been targeted prior to release of the weapon. The seeker head is gimballed, to allow a very wide field of regard.

IDENTIFICATION OF TARGETS

The 'IRST' display works like a crude radar to a range of around 30 nautical miles. It also helps you identify targets visually. Phantom F4 pilots on air-Defense duty sometimes carried a small telescope to help confirm distant visual sightings. The IRST screen does virtually the same job. Simply let an IR missile lock-on to a target that's within visual range in the HUD, but is too small to be recognizable; a zoomed image of the tracked plane will appear in the



Target imaging on IRST

A BRIEF HISTORY OF PIRATE

In the real EuroFighter, IRST is part of the The Passive Infra-Red Airborne Track Equipment (PIRATE), which is designed to detect and track several targets simultaneously at estimated ranges of around 30 miles. Scanning is in the 3 – 8 and 8 – 11 micron wavelengths, using signal processing techniques from the latest anti-aircraft missile systems. Like many other major EF2000 systems, PIRATE is the responsibility of a consortium from the four member nations of the EF2000 project.

EF2000 AVIONICS

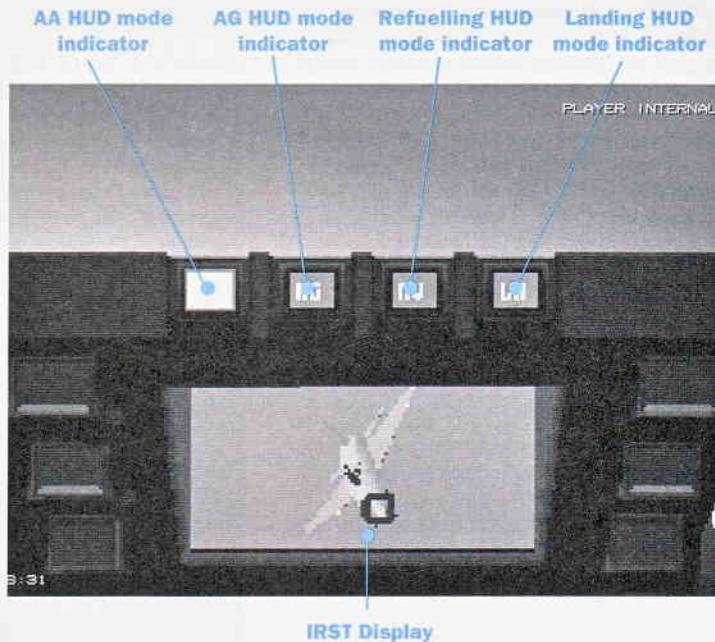
OPERATING THE IRST



ZOOMING ON THE HUD MONITOR

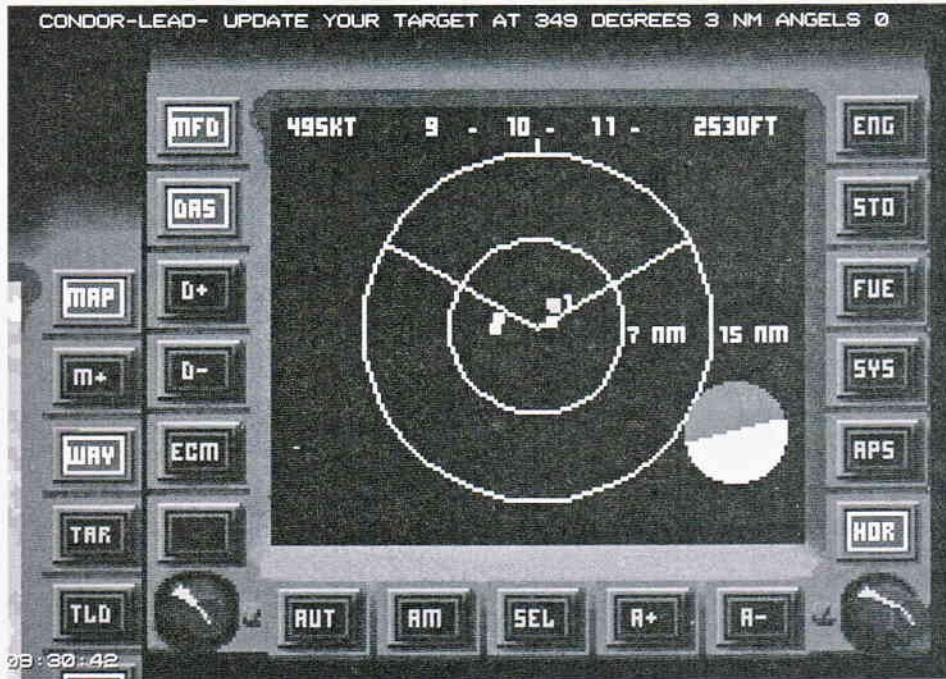
PRESS '5' ON THE NUMERIC KEYPAD

IRST is constantly active and displayed on the small screen under the HUD. For a close-up view of this screen, press the appropriate key or switch to an MFD view.



EF2000 AVIONICS

AN INTRODUCTION TO THE DEFENSIVE AIDS SUB-SYSTEM (DASS)



DASS helps automate the job of defending the aircraft

The time that pilot's most need to operate defensive systems is precisely the time of highest stress in the cockpit... the time when the plane is under attack. Because the task of orchestrating counter-measures and defensive systems has become so complex in single-seat fighters, the EF2000 designers realized the need for intelligent automation. The result of their efforts is known as the Defensive Aids Sub-system (DASS). It integrates an advanced radar warning receiver (RWR), an IR warning receiver (IRWR), a laser warner, a towed decoy, automatic IFF (identify friend or foe), the ability to select and jam threats, and an automatic release mechanism for chaff and flare. Most significantly, EF2000 is the first fighter in which a complete suite of defensive measure has been incorporated into the aircraft design.

No external pods are necessary, allowing a greater weapons payload.

EF2000 AVIONICS

AN INTRODUCTION TO THE DEFENSIVE AIDS SUB-SYSTEM (DASS)

RADAR COUNTERMEASURES

In the Second World War, the technique of jamming radar with 'Chaff' was developed (code named 'Window' by Britain, and Düppel by Germany). Chaff comprises strands of radar reflective material cut to the same wavelengths as those used by the target radar. This creates a false echo on the radar which is capable of fooling enemy pilots and radar guided missiles. Chaff has proved so effective that it's still in use today, fired in small canisters out of the rear of the aircraft. One hundred and fifty such canisters are kept on board the EF2000, and DASS takes care of releasing them automatically, at just the right moment.

Another technique for dealing with radar is jamming, in which the defender emits high energy signals at the same frequency as the attacking radar. On older radar screens, jamming appears as snow, making it impossible to see the real returns. A subtler technique is known as 'deception jamming', and attempts to confuse enemy radar by creating false returns. DASS offers both

techniques, and controls their use automatically. However, you should remember that using ECM makes your presence known to everyone in the area.

IR COUNTER MEASURES

Defenses against Infra-Red guided missiles are primarily based on flares. The drawback is that modern missiles are highly tuned to the IR frequencies emitted by the jet pipes of different aircraft, and can distinguish between exhaust and flare. Another problem is the flare's short burn-time, which is why flares are released in groups. DASS automatically releases flares at the right moment, changing the release sequence each time to prevent the enemy missile from recognizing the patterns.

THREAT WARNING INDICATORS

Radar Warning Receivers (RWR) are as old as radar itself, and were developed to tell a pilot when an enemy radar was 'painting' his plane. Signals are gathered from aerials positioned in various parts of the aircraft to give all-round coverage. Modern receivers, such as the type built into the DASS, are able to check 'spikes'

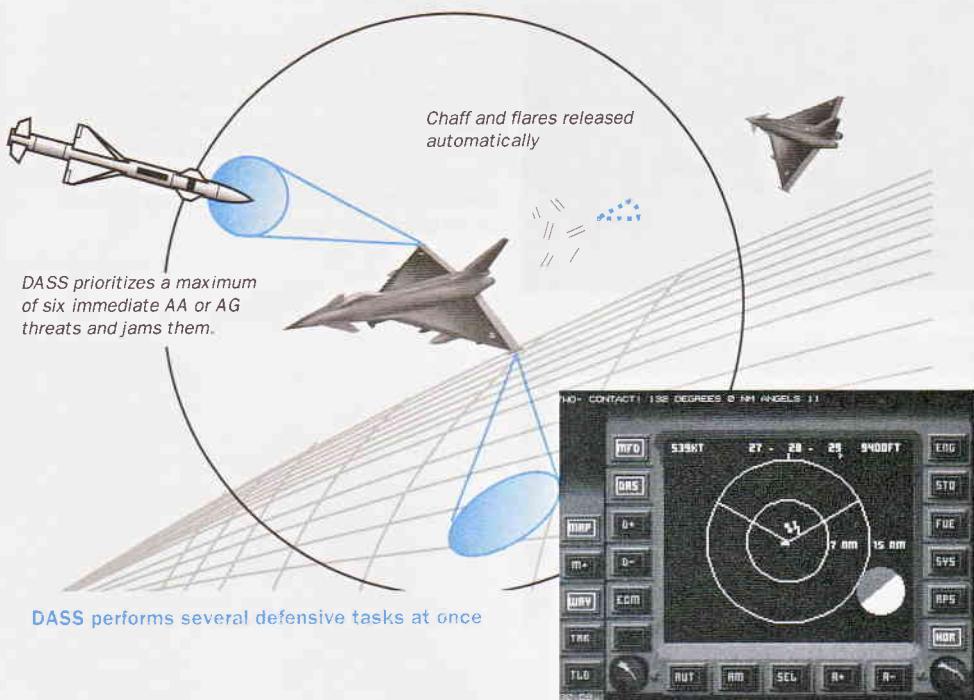
against a library of known signals, and decide what aircraft, SAM or EW radar is painting the plane. They can also detect incoming missiles, and trigger an appropriate warning.

In the EF2000, the RWR is supplemented by an IR Warning which uses data from the Infra Red Search and Track System. This is able to detect the hot gases of SAMs and AA missiles in the forward field of view and classify whether it is an IR or radar guided weapon.

EF2000 AVIONICS

THE DASS IN USE

The DASS display works like a 2D plan radar with your plane at the centre. However, unlike radar it receives signals passively and only displays ground-based mobiles, ground stations, ships or planes that are 'painting' your aircraft with radar. Aerials in the carbon-fibre skin of the EF2000 detect the direction of a signal and its strength. Because a contact (spike) could be a powerful radar at long-range, or a weak radar at short range, the RWR is inherently poor at giving accurate range data. For this reason, blips tend to move in large steps, rather than smoothly, giving only approximate range data. However, in EuroFighter, the systems engineers have overlaid data from radar andIRST in front of the plane, to provide a much more accurate assessment of objects moving ahead of the plane. This is marked on the MFD as a cone forward of the aircraft.



EF2000 AVIONICS

THE DASS IN USE



Radar missiles are tracked by DASS



DASS also jams the SAMS

DASS RANGES

Because DASS is fed by a new generation of RWR sensors,IRST, and the ECR-90 radar, it has a very good range for a single-seat aircraft system. Maximum useful range is 80 miles, which makes it effective in BVR combat against aircraft, and allows easier navigation of SAM saturated territory. The range can be stepped up or down using an MFD key.

A BRIEF HISTORY OF THE DEFENSIVE AIDS SUBSYSTEM (DASS)

EuroFighter's Defensive Aids SubSystem (DASS) represents the pinnacle of achievement in electronic warfare for single-seat fighter aircraft. It integrates key defensive components into an electronic warfare suite, including radar warning receiver, ECM, offboard decoy (towed), computer, chaff/flare dispenser, laser warner and missile approach warner. A consortium of companies from the United Kingdom and Italy are responsible for its development. The laser warning system was developed by

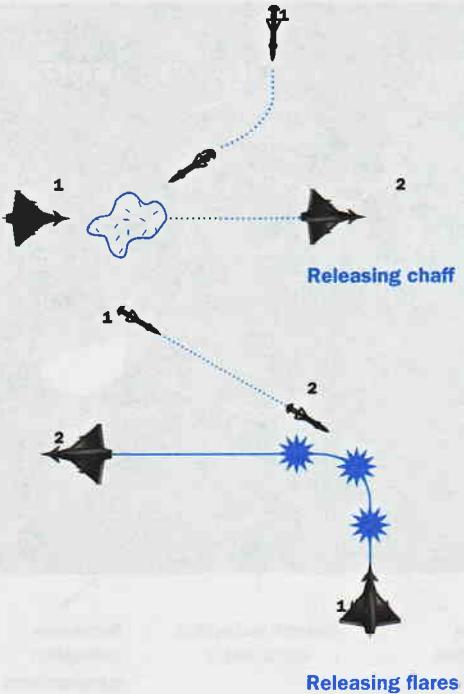
EF2000 AVIONICS

THE DASS IN USE

The DASS is displayed on a colour MFD, so it's much easier to distinguish threats. To avoid confusion, it uses the same type of symbology as the ECR-90 radar for air threats, but uses red crosses to portray ground based threats. Small yellow squares represent incoming radar guided missiles, and small red squares show IR missiles in the forward field of view only. Code numbers identify the type of aircraft or system that's tracking you. See the table for details. Threats which have been jammed will flash on and off.

CHAFF AND FLARE RELEASE

If DASS detects a missile launch, it will release chaff or flare when the missile is within five miles of the plane. However, study the DASS display or 'padlock' view the missile to determine where it is coming from. Study the diagrams for ideal evasive manoeuvres.

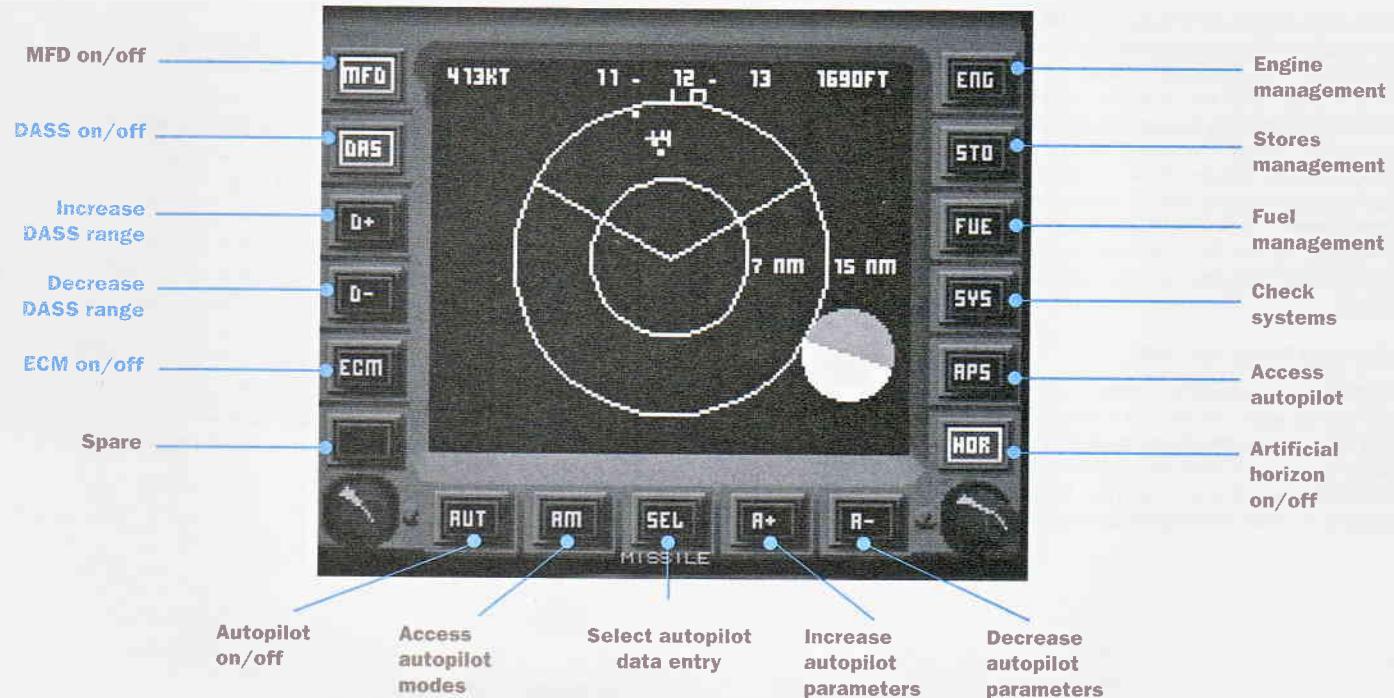


1	MIG-29, MIG-31, Su-27, Su-33, Su-35
2	Su-34, MIG-27, MIG-21
3	SAM site
4	Ship based radar
5	Early Warning ground-based long-range station
6	AWACS

DASS code numbers for threats

EF2000 AVIONICS

OPERATING THE DASS



EF2000 AVIONICS

THE DASS IN USE



ACCESS THE CORRECT MFD

PRESS '3' ON THE NUMERIC KEYPAD OR PRESS 'D'

In EF2000, the DASS is displayed on the right-hand Multi-Function Display. Press the appropriate key to access this MFD and press it again to return to the previously selected view.

SWITCH THE DASS ON/OFF

PRESS 'DAS' ON THE MFD

DASS should be on at all times during missions. Selection of other displays will cancel DASS, which may be activated by pressing the appropriate key.

CHANGE RANGE MANUALLY

PRESS 'D+' or 'D-' ON THE MFD

This will allow you to zoom in on the threat picture from the maximum range of 80 miles; remember, the most dangerous radius of threat is 30 miles. When nearby threats are overlaid, zooming-in should help to separate the signals.



ACTIVATE AND DE-ACTIVATE ECM

PRESS 'ECM' ON THE MFD

Automatic systems are wonderful, but they can always let you down. For example, imagine you are making a sneaky, attack run, and the radar of your wingman causes the system to start dumping flares and chaff. Use the ECM key to disable the automatic Electronic Counter Measures when making sneak attacks.

RELEASE CHAFF AND FLARE MANUALLY

PRESS 'INSERT' OR 'DELETE' KEYS

You may feel the need to dump chaff and flare manually, in which case press the appropriate keys.

EF2000 AVIONICS

AN INTRODUCTION TO THERMAL IMAGING AND LASER DESIGNATION (TIALD)



The TIALD system

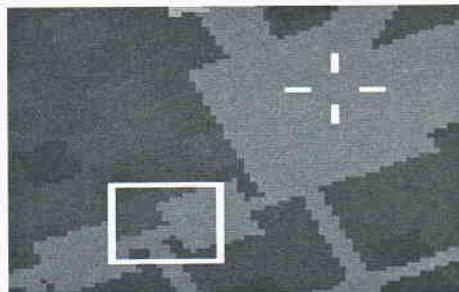
In order to guide an LGB, the target must be designated by a laser for the duration of the attack. In the early days the RAF used the Buccaneer aircraft fitted with a Pavespike laser designation pod to designate targets. The Pavespike pod was one of the first laser designation systems; it was not automatic and consequently required considerable skill from the navigator to ensure a successful attack. The latest version of designation pods is the TIALD which was rushed into service on the Tornado for the Gulf war. TIALD combines the laser with a thermal imaging system which enables the pod to operate at night. In addition, the TIALD pod is fitted with a low light TV sensor which can be used when the thermal contrast is poor (after heavy rain showers). Once the target has been identified, TIALD can automatically track the target using a video correlation tracker. Laser energy is attenuated by cloud and therefore the system requires a clear line of sight to the target to be effective.

EF2000 AVIONICS

TIALD IN USE

An airborne designator can either designate for its own weapons or can designate for a succession of 'bomb trucks' thus being able to attack many targets on one sortie. The designator on the attacking aircraft can fly either at high or low levels depending on the defensive threat.

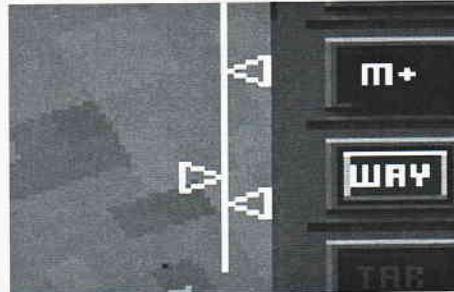
In some cases targets can be designated by ground lasers fired by specially trained ground forces. Whilst very effective, ground based lasers require close coordination and cannot be simply switched to a new target.



Offset aiming

TIALD was developed for use in 2 seat aircraft where the pilot flew and the navigator designated the target. As a result of an urgent operational requirement in 1994 the TIALD pod has been integrated with advanced avionics in the RAF single seat Jaguar to allow effective single pilot operation.

The TIALD system in EF2000 is a derivative of the TIALD training system developed for the RAF by DID. The system gives an excellent insight into some of the difficulties of designating for an LGB attack.



The countdown indicator (left triangle)

BASIC TARGETING

Run in towards the target at around 15,000 ft. When you select LGBs, the TIALD display is set up on MFD 2. The TIALD pod automatically looks at the Target area. At the centre of the screen are the cross hairs and the tracking box which can be steered with the SHIFT CURSOR ARROW keys to refine the aim position. It is possible to double the magnification, or field of view with the FOV MFD button.

The vertical scale on the right of the display is a countdown scale and indicator for weapon release. You should begin your run two to three minutes from the target, or approximately 15 miles away. Check your moving map display for this information, or read the range data waypoint information. The dotted line extending from the track box indicates the relative bearing of the target, and you should aim to get this at twelve o'clock by flying towards the waypoint. As you get closer, this line will shorten, and it will flash until the target is tracked.

EF2000 AVIONICS

TIALD IN USE

To 'designate' a target, slew the track box over the target and press the 'TRK' button on the TIALD MFD. Be aware that the image will not necessarily remain stable until you decide to track the target. If you have problems losing your position, turn TIALD on and off again to look at the waypoint once more. If you are happy with the aiming, lase the target by pressing the 'LAS' button on the MFD. When close to the target, TIALD will automatically show the waypoint to look at. You must release the bomb when the countdown indicator is between the triangular markers on the right of the scale. Release after the second triangular marker, also called the 'cliff-edge', will result in a miss. You must now continue to lase the target until you see the bomb impact.

ADVANCED TARGETING

Occasionally, there will be targets on which it is difficult to make the track box lock, such as a road. The solution is to offset the track box with the 'TIALD OFFSET TRACK' MFD button, and lock it onto any suitable object nearby. You are now free to slew the cross-hairs onto the target, which may be located on the road, and lase it.



TIALD in action

MASKING PROBLEMS

In certain situations, banking your aircraft may 'mask' the laser beam, causing the bomb to break lock and go freefall. You will notice this happening when the sight line begins to flash once more. To avoid the problem, level the plane. If the problem persists, you may have to abort the mission.

EF2000 AVIONICS

TIALD IN USE



EF2000 AVIONICS

OPERATING TIALD



ACCESSING THE CORRECT MFD

PRESS KEY 'T'

In EF2000, TIALD is displayed on the centre MFD. Press the appropriate key to access this MFD.

SWITCHING TIALD ON/OFF

PRESS 'TLD' ON THE MFD

The default is off, but TIALD is automatically selected when laser guided weapons are chosen.

TOGGLE THE FIELD-OF-VIEW

PRESS KEY 'FOV' KEY ON THE MFD

TIALD features a one step zoom focus. When in wide angle field-of-view, the area that corresponds to the zoomed field-of-view is marked

CYCLE BETWEEN TV OR INFRA RED CAMERA

PRESS KEY 'CAM' ON THE MFD

Select the image which gives the best contrast for your target.

SLEW IR OR TV IMAGE.

PRESS 'SHIFT' CURSOR ARROW

Use this to move both the tracker box and the cross hairs.



TRACK DESIGNATED AREA.

PRESS KEY 'TRK' ON THE MFD

Press this to lock the track box onto a ground object.

LASE DESIGNATED AREA.

PRESS KEY 'LAS' ON THE MFD

This fires the laser, and triggers the timer countdown.

OFFSET TRACK BOX.

PRESS KEY 'OFT' ON THE MFD

Disconnects the track box from the cross hairs, allowing you to offset track for easier and more stable aiming.

SLAVE TO WAYPOINT.

TURN TIALD ON AND OFF AGAIN

Reslaves the TIALD pod to your waypoint view.

RELEASE WEAPON.

SPACEBAR OR JOYSTICK BUTTON 1

Drops the bomb. Remember that you must lase the target until the bomb hits.

EF2000 AVIONICS

AN INTRODUCTION TO THE MAVERICK AIMING SYSTEM



The Maverick aiming system

The Maverick AGM-65D Imaging Infra Red missile is an ideal weapon for destroying armor, vehicles and aircraft on the ground. Its range of around 12 nautical miles allows the aircraft a limited stand-off margin, enabling it to avoid flying close to the target and possible AAA or SAM fire. To use this weapon to its best effect, practice firing it at long range.

It was not until 1980 that IR detectors were smart enough to detect point targets. The problem is that at great distances, targets subtend an angle that is smaller than the picture element (pixel) of the detector. In EF2000, the IIR detectors are able to detect and lock on the smallest point targets at ranges of around 25 miles. Furthermore, the detector has the ability to analyze two different wavelengths, making it extremely difficult for enemies to use IR camouflage.

In EF2000, the Maverick aiming system uses both the MFD and IRST screens. The MFD is used for aiming the weapon, and the IRST screen is used for target imaging.

EF2000 AVIONICS

THE MAVERICK AIMING SYSTEM IN USE

After selection, the weapon is aimed via the left-hand MFD. The image projected on the MFD originates in the missile seeker head, and is slaved to the EF2000 optical systems. Aiming is a straightforward business. Simply fly the plane towards a target, or slew the seeker head with the SHIFT CURSOR keys, and the missile will track the point of greatest temperature differential on the vehicle. Next, the digital centroid seeker adjusts the aim so that the missile is heading directly for the centre of the object. To break the lock, simply slew the

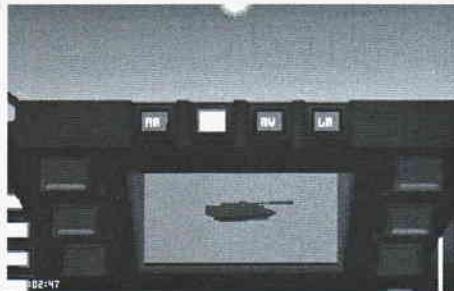
seeker head away from the currently selected target, or fly the plane away from the target.

Once a target has been locked, you will receive information on target range in the corner of the MFD. At the same time, an enlarged and enhanced image of the target will be relayed to the IRST screen under the HUD (access with numeric key 5). This will help you to assess the target type, and whether it is worthwhile destroying with a valuable Maverick missile.

If desired, the image may be zoomed to assist target recognition, and help pick the right target from closely bunched vehicles.



Basic targeting



IRST screen under the HUD

EF2000 AVIONICS

THE MAVERICK AIMING SYSTEM IN USE

WHEN TO SLEW

Maverick is an ideal weapon for a fast moving jet, which has little time near the target and is vulnerable to ground fire. When terrain hugging and flying directly towards a reported target position, it is best to aim simply by pointing the aircraft at the target, because this is the quickest method. However, when approaching the target on a parallel heading, maintaining a safe distance and slewing the seeker head is your best option. This will allow you to remain at maximum range. Remember, there is a zoom function to help you select the right target.

AWACS AND FORWARD AIR CONTROL

On a real battlefield, little remains the same for very long. The constant movements and redeployment of ground troops and vehicles demands careful and constant monitoring.

There are three principle methods of intelligence gathering : special units on the ground, inserted under cover of darkness behind enemy lines by stealthy helicopters; small spotter planes, which act as Forward Air Controllers, relaying tactical information to pilots on the whereabouts and danger of enemy units; and JSTARS, which

is able to detect second echelon ground movements deep behind enemy lines.

On missions such as Close Air Support and Battlefield Interdiction, you will receive information from both FAC and JSTARS, detailing where your next targets are to be found. Messages will be displayed on your screen, so watch out for updates.

Remember to watch out for missile launches during low-level operations. Cockpit alarms and messages will tell you when to start worrying, while the DASS will help you determine where the threat is coming from.

EF2000 AVIONICS

THE MAVERICK AIMING SYSTEM



EF2000 AVIONICS

AIMING THE MAVERICK



ACCESSING THE CORRECT MFD

PRESS NUM 1

In EF2000, the Maverick sight is displayed on the left-hand Multi-Function Display. NOTE: Make sure that you have selected the weapons first, otherwise the MFD will display only the radar.

TOGGLE THE FIELD-OF-VIEW

PRESS KEY 'Z' ON THE MFD

Maverick aiming features a one step zoom focus. Press this key once to obtain a close-up imaging, and again to zoom out.

SLEW MAVERICK IR IMAGE

PRESS 'SHIFT' CURSOR ARROW

Use this to slew the iR image.

RELEASE WEAPON

SPACEBAR OR JOYSTICK BUTTON 1

Fires the Maverick. Once the Maverick has been fired, look out of the cockpit to check its progress.

EF2000 AVIONICS

AN INTRODUCTION TO THE MOVING MAP DISPLAY (MMD)



The electronic version of survey maps

In recent years, digital map technology has played an increasingly important role in navigation and attack planning. Gone are the days when pilots relied on folded ordnance survey maps on their knees. And gone are the days of MMD based on expensive film. Today's MMD is based on data supplied from military-specification data retrieval systems. The advantage of digital data is that they are easy to update, allowing the overlay of tactical information on the display. They also provide the means to replace radar-guided terrain following systems, which are easier for EW operators to detect, and they allow integration of data from other sources, such as JTIDS.

The MMD in EF2000 uses a synthetic map display, and is the principle navigation tool. It will help you follow your waypoints, locate the target and establish your approach, then help you get back to base.

EF2000 AVIONICS

THE MOVING MAP DISPLAY IN USE

NAVIGATION WITH THE MMD

The Moving Map Display is located on the centre MFD. The symbol representing your plane is located two-thirds of the way down the display, in order to give you a good forward view. The real EuroFighter offers three different map scales: 1:500,000 map for general navigation and situational awareness; 1:1,000,000 for airways flying; and 1:50,000 for target identification and accurate navigation. In SUPER EF2000, two maps are available, a larger scale for general navigation; and a smaller scale map for ground attack and precision navigation.

ESTIMATING TIME TO GO (TTG)

The direction line extending from the top of the MMD is calibrated to show minute intervals. This scale will vary according to your ground speed. So if you want to know how long it will take to reach a point directly in front of you, simply count the number of marks and you have the time! A useful feature of the MMD is the ability to overlay waypoint routes, turning the display into an essential mission tool. It's also possible to overlay JTIDS data, which will indicate the position of hostile aircraft and ground targets.



A zoomed map



Overlay of JTIDS information



Each mark on the white line is 1 minute

EF2000 AVIONICS

OPERATING THE MOVING MAP DISPLAY



EF2000 AVIONICS

OPERATING THE MOVING MAP



ACCESSING THE CORRECT MFD

PRESS '2' ON THE NUMERIC KEYS

In EF2000, the MMD is displayed on the centre Multi-Function Display. Press the appropriate key to access this MFD.

SWITCHING THE MMD ON/OFF

PRESS 'MAP' ON THE MFD OR THE 'M' KEY

The default status for this MFD is on, but selection of other displays will cancel the MMD, which may be re-activated by pressing the appropriate key.

CHANGING MAP SCALES

PRESS 'M+' ON THE MFD

Selects the large scale or small scale maps.

OVERLAYING WAYPOINTS

PRESS 'WAY' ON THE MFD

Overlays your current mission's waypoint route.

EF2000 AVIONICS

AN INTRODUCTION TO THE FLIGHT ASSISTANCE SYSTEMS



When the going gets tough, switch on the autopilot

To say that flying is hard is a myth perpetrated by pilots themselves. To say that flying in the combat environment is easy would be a lie. When battle begins, pilots not only have to monitor the air-situation using a wide variety of sensors, they must command wingmen, monitor and evade missiles, select the appropriate weapons, manoeuvre into the best position, and generally ensure that the aircraft is in a fit state to fight. All of these demands frequently occur in a very short space of time. So it's little wonder that a great deal of research has been invested in helping the pilot fly the plane in high-stress conditions. We have recreated some of these features, which both new and experienced PC pilots will find to their advantage.

Don't feel like it's cheating to use a feature like the Autotracking Autopilot - even the real EF2000 has a very similar system.

EF2000 AVIONICS

FLIGHT ASSISTANCE SYSTEMS IN USE

RECOVERY BUTTON

Key 'L' puts the plane into safe, level flight. It can be pressed just as a pilot begins to black-out due to G-loc, or it can be used to achieve a safe attitude while studying an MFD. The real EuroFighter has a similar button.

AUTOMATIC LANDING & REFUELING

If you don't want to land or refuel yourself, let the plane do it for you. Simply press 'SHIFT S' until you are past the refueller or on the ground again.

AUTOPILOT

An autopilot system is available on MFD 3, which is able to control the aircraft by adjusting joystick and throttle inputs. There are four main modes, and the pilot simply enters the correct data into the MFD before activating Autopilot.

AUTOPILOT MODE 1: WAYPOINT

Directs your aircraft at the chosen speed to the next waypoint. This is particularly useful if you want to spend some time studying MFDs while on the way to a target.



AUTOPILOT MODE 2: HEADING

Maintains the required heading, altitude and speed.



AUTOPILOT MODE 3: TRACKING

Directs your aircraft towards the aircraft you are tracking on radar. The default speed is the aircraft's own, but adjustments can be made. When it's difficult to get a good angle on a target aircraft, switch to this mode.

In the real EF2000, there is a similar feature which flies the plane into optimum position for weapons firing. With the autofiring cannon, you are using what is known as the Manoeuvring Attack System. To change targets, simply use the target cycle controls on the radar.



EF2000 AVIONICS

FLIGHT ASSISTANCE SYSTEMS IN USE



AUTOPILOT MODE 4: AUTO-THROTTLE

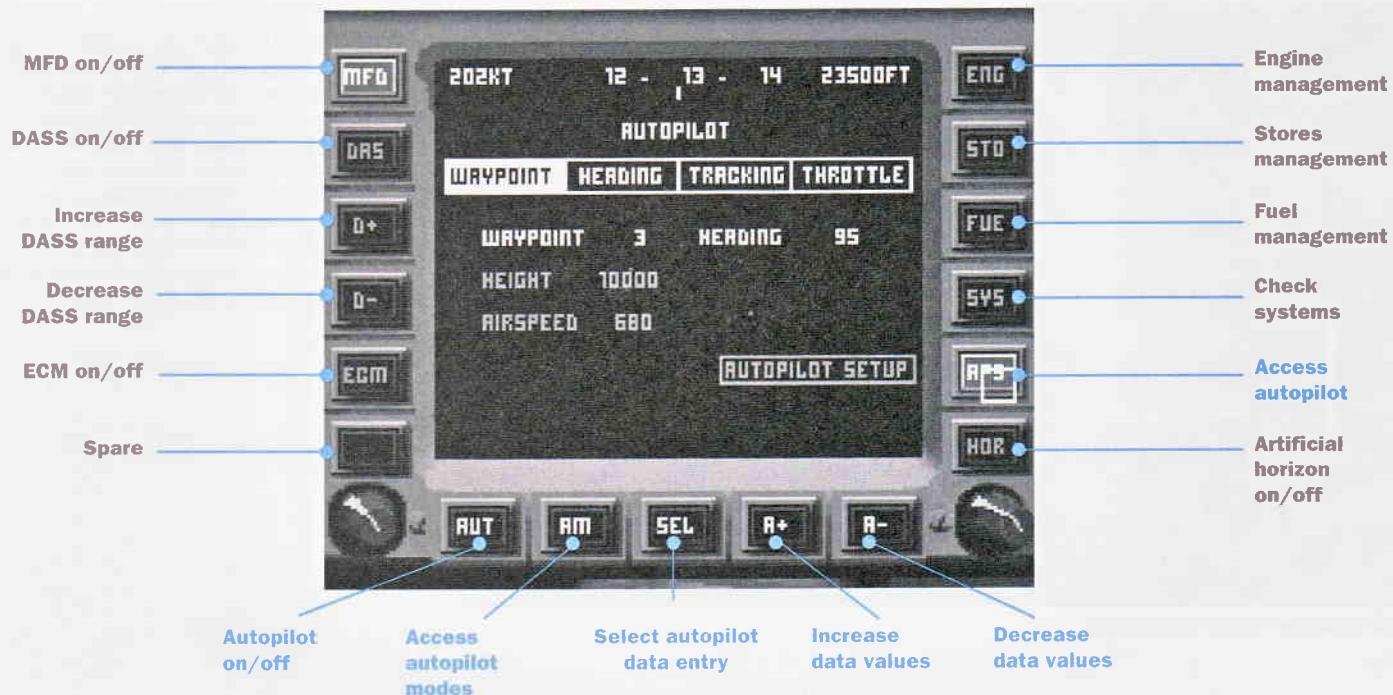
Leaves the joystick (or key) control in the hands of the pilot, but maintains the chosen speed.

This is an excellent mode for maintaining a constant velocity in supersonic BVR manoeuvres. It can also be used to fix a maximum or minimum throttle setting, which may help in dogfighting or landing where constant speed is necessary. For example, with speed set to 250 knots, simply pressing 'A' while travelling at Mach 1 using afterburner will cause a sudden bleed-off in speed down to 250 knots.

NOTE: Your aircraft's speed will not remain constant in all situations, for example, no great speed can be sustained in an 80 degree climb, even on autothrottle.

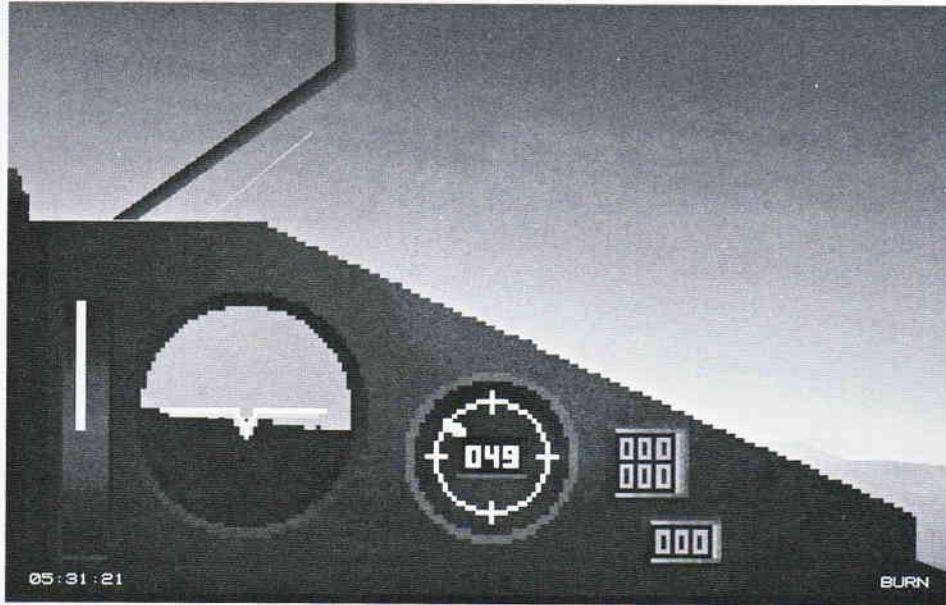
EF2000 AVIONICS

OPERATING THE AUTOPILOT



EF2000 AVIONICS

ANALOGUE NAVIGATION INSTRUMENTS



The analogue horizon ball and compass

In the worst circumstances, you may lose all your MFD and HUD functions, in which case you will lose all digital navigation data. However, your analogue back-up instruments should still function and will tell you enough for basic navigation. The compass also functions as a basic Horizontal Situation Indicator (HSI), with the red marker showing the heading to the next waypoint, and the green marker indicating your current heading. When both markers are overlaid, you are on course. The read-out in the centre is your current heading in degrees.

EF2000 AVIONICS

OPERATING THE FLIGHT ASSISTANCE SYSTEMS



RECOVERY BUTTON

PRESS THE 'L' KEY

Puts you in straight and level flight when you lose control.

AUTOMATIC LANDING AND REFUELING

PRESS THE 'SHIFT S' KEYS

To bypass both events, just use the skip-event feature.

ACCESS AUTOPILOT SETUP SCREEN

PRESS 'APS' ON THE MFD

This key lets you activate the autopilot menu screen.

SWITCH AUTOPILOT ON/OFF

PRESS 'AU' ON THE MFD OR PRESS THE 'A' KEY

Adjust your autopilot parameters, then activate the autopilot from the MFD or the keyboard.

SELECT AUTOPILOT MODE

PRESS 'AM' ON THE MFD

Allows you to select one of four autopilot modes. The mode selected is highlighted in the description bar at the top of the MFD.



EDIT AUTOPILOT PARAMETERS

PRESS 'SEL' ON THE MFD

Allows you to select a field for editing in any mode. When selected, the field changes colour to green.

INCREASE AUTOPILOT PARAMETER VALUES

PRESS 'A+' ON THE MFD

A single click will increase the value by one unit. Holding the key down will increment the values continuously.

DECREASE AUTOPILOT PARAMETER VALUES

PRESS 'A-' ON THE MFD

A single click will reduce the value by one unit. Holding the key down will decrement the values continuously.

EF2000 AVIONICS

AN INTRODUCTION TO THE INFORMATION AND STATUS DISPLAYS



The fuel management display

It is in the area of displaying conventional flight and aircraft status information that some of the greatest progress has been made. Of course, there are considerable demands from the civilian sector as well as the military, and this has lead to the development of the 'glass' cockpit. In these modern designs, conventional analogue instruments are replaced by large colour displays, which portray virtual equivalents of the analogue dials and displays. The advantages are not only visual, but ergonomic, because the new systems allow push-button access to more concise information, or data which has been processed for the pilot rather than by the pilot.

In our simulation we have portrayed some of the more critical displays. These include engine management, fuel management, stores management, warning message and briefing displays. These will enable you to assess the airworthiness of your EF2000, or its suitability for action in different scenarios.

EF2000 AVIONICS

USING THE INFORMATION AND STATUS DISPLAYS

ENGINE MANAGEMENT

Accessible on the right-hand MFD, this display tells you the status of your engines, your fuel load and the fuel flow for a given throttle setting. Take a look at this display just prior to take-off, to check that all systems are go. It's also useful to check how the afterburner is affecting your fuel load. It will certainly serve to remind you that afterburners should only be used in the following cases:

- * To gain altitude rapidly on a ground-launched intercept mission.
- * To accelerate rapidly into or away from a dogfight.
- * To maximize the range of your long-range missiles prior to launch.
- * To assist take-off when fully laden for an Air-to-Ground mission.



Altitude affects your fuel consumption, so you will be able to use this display to judge the optimum cruising altitude. Use it in conjunction with the fuel management display for proper management of your fuel reserves.

WARNING: USING AFTERBURNER INCREASES YOUR IR SIGNATURE, WHICH MEANS IR GUIDED SAMS ANDIRST EQUIPPED AIRCRAFT WILL SEE YOU FOR MILES!

EF2000 AVIONICS

USING THE INFORMATION AND STATUS DISPLAYS

FUEL MANAGEMENT

Next to running out of weapons, running out of fuel is a major problem, especially in a dogfight. And dogfighting is certainly sure to burn up fuel at an alarming rate, as you turn, twist, and apply afterburner. The fuel management display is designed to help prevent you falling victim to lack of fuel.



On its top line, the display shows how much fuel the aircraft is carrying. The bar below shows how much fuel is required to reach the next waypoint. The bottom bar shows how much fuel is required to reach base. If the length of the bottom bars exceeds the length of the bars on

top, you are in trouble. Start looking for a tanker or friendly airbase.

The relationship between throttle setting, duration of reheat or full throttle, and load being carried is critical. It's just the same as a car or motorbike. Don't try high-speed stunts when you're heavy. If you must manoeuvre or depart at high speed, your only choice may be to drop your air to ground stores (Alt J, for Jettison). Although they take valuable pylons, drop-tanks could save you the embarrassment of a dry gas tank. Alternatively, make sure a tanker is on-track at critical phases of your flight, or plan for a refuel stop at a friendly airbase.

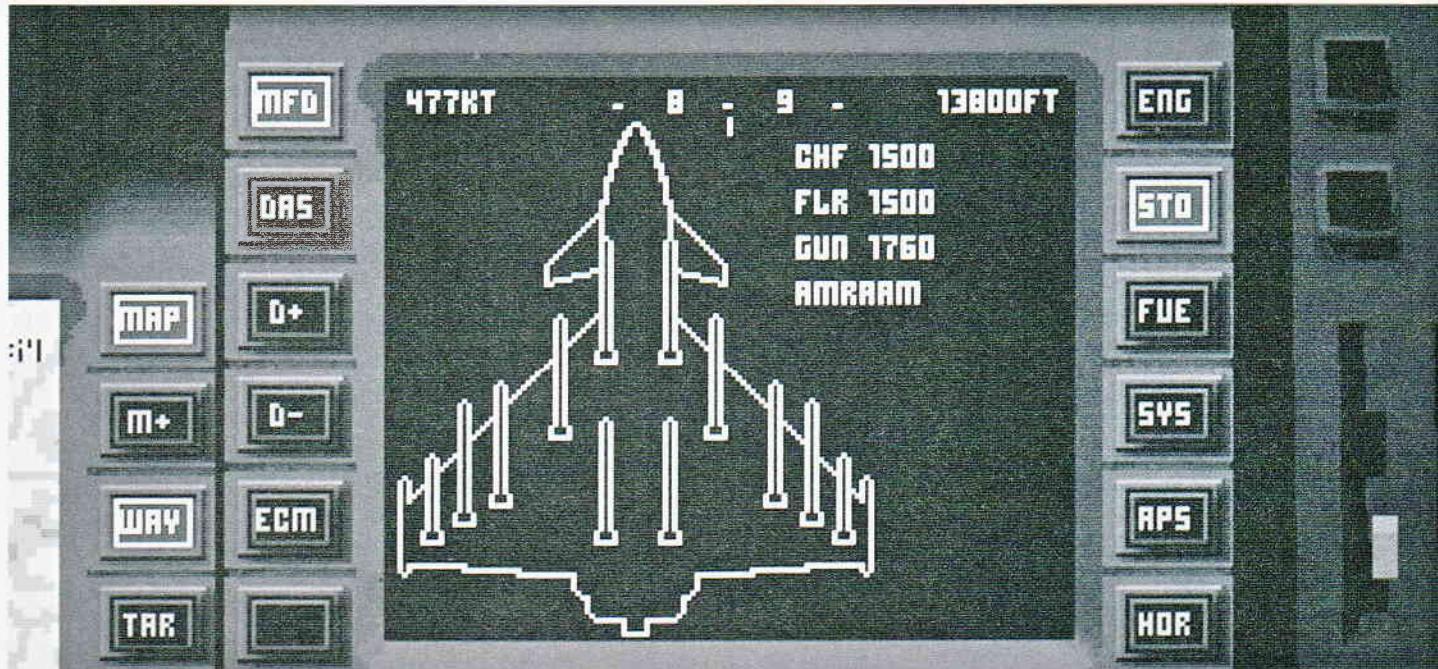
Remember, lower the throttle when you're in a dive, as the plane will build momentum. Just remember to open the throttle again before you need to climb. Watch the range indicator on the MFD, and compare this with your distance to target.

On ground attack missions, try to avoid conflicts with fighters altogether. Use stealth. On the run-in, you'll be heavy with weapons and less agile.

On the way out, you may be lighter on weapons, but you'll have less gas too, so don't start anything you can't finish. Remember, if you have to dump your AG stores to enter a dogfight, this counts as a 'mission kill' to the enemy (he may not destroy you, but he has eliminated your strike capability).

EF2000 AVIONICS

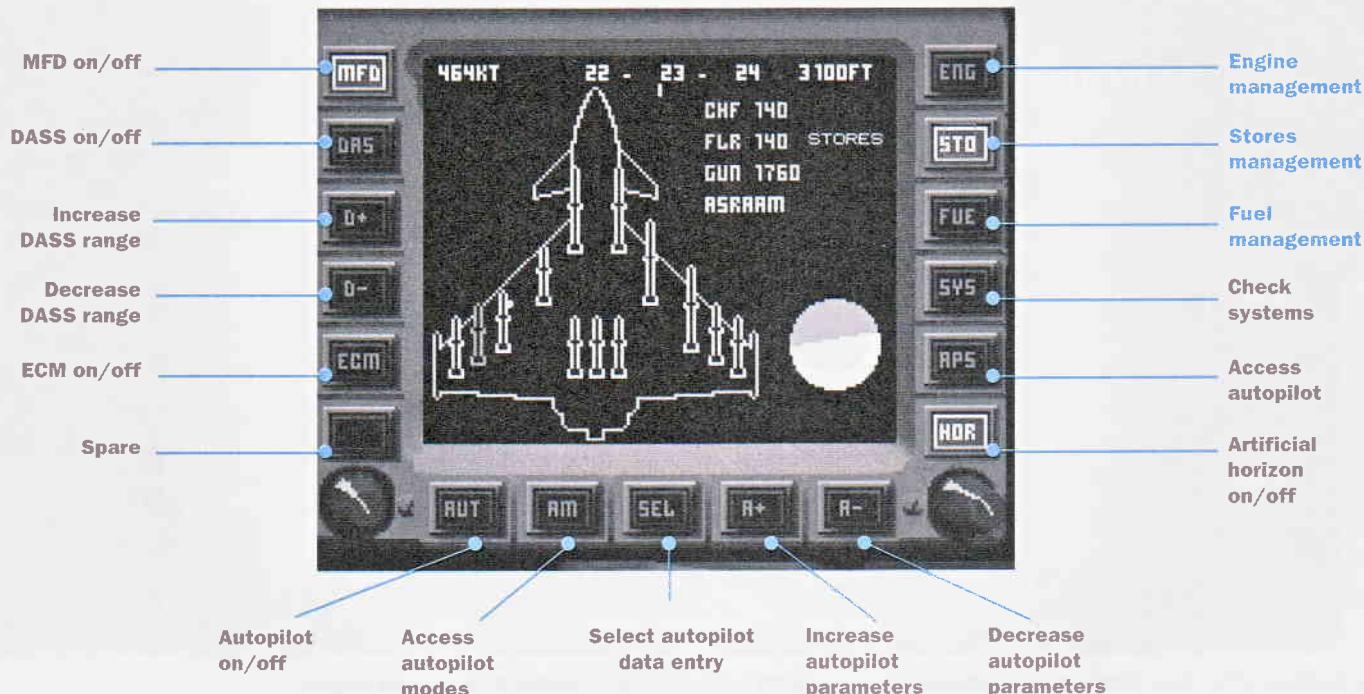
STORES DISPLAY



This handy graphic shows what's hanging off your pylons and what's not. It's worth keeping an eye on this display.

EF2000 AVIONICS

OPERATING THE FLIGHT INFORMATION SYSTEMS



EF2000 AVIONICS

OPERATING THE INFORMATION STATUS DISPLAYS



ACCESSING THE CORRECT MFD

PRESS NUM 3

All information status displays appear on the right-hand MFD.

ACCESS THE FUEL MANAGEMENT DISPLAY

PRESS 'FUE' ON THE MFD

This gives you access to all fuel management data.

ACCESS THE ENGINE MANAGEMENT DISPLAY

PRESS 'ENG' ON THE MFD

To see the status of the engines and the fuel flow rate, press this key.

ACCESS THE STORES DISPLAY

PRESS 'STO' ON THE MFD

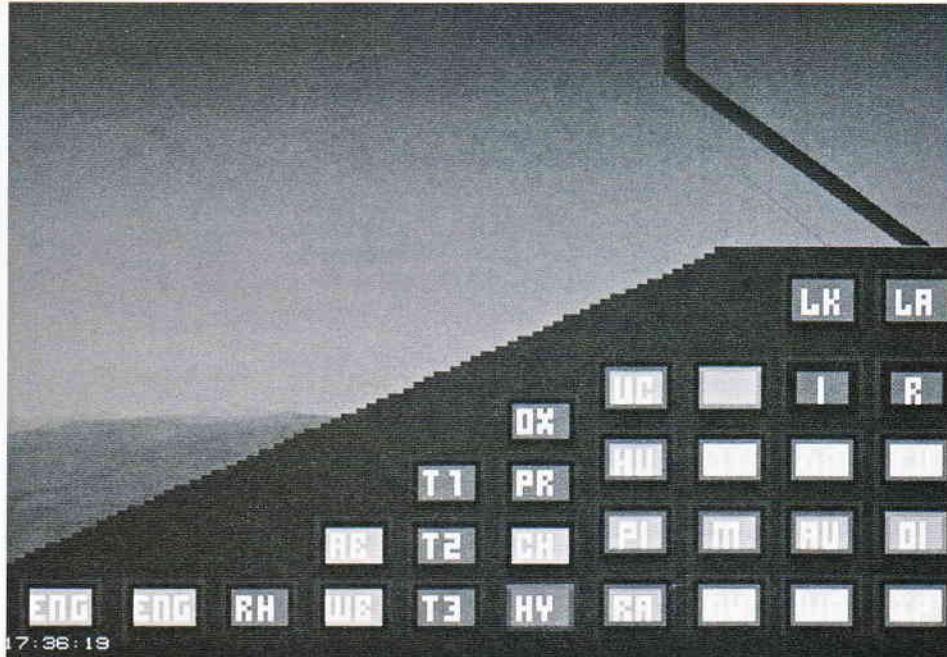
To see what weapons you have and how many, press this key.

EF2000 AVIONICS

AN INTRODUCTION TO THE AIRCRAFT WARNING SYSTEMS

In an aeroplane as advanced as EuroFighter, there are many complex systems and a million and one things that could go wrong. Managing the sophistication must never be a challenge for the pilot, who will be busy enough trying to stay alive in the enemy saturated combat environment. This is why EuroFighter incorporates a range of advanced warning and damage control systems.

It is in the cockpit where you notice the biggest difference to previous generations of fighter. To begin with, there are hardly any conventional analog dials or instruments. Instead, there are just three big colour display panels, known as Multi-Function Displays (MFDs), which are capable of displaying a crisp and clear image of all the major avionics systems, even in bright sunlight. There are also a variety of warning lights, in what has now become known as the 'Glass Cockpit'. These lights are arranged into functional groups



The EF2000 warning panel, accessed by the numeric pad '4' key

EF2000 AVIONICS

AIRCRAFT WARNING SYSTEMS IN USE

WARNING LIGHT COLORS

The cockpit has a simple colour coding system for the information displayed.

GREEN The system is functional.

BLUE The system is active; i.e. in use.

YELLOW Caution! The system has sustained slight damage.

RED The system is damaged beyond repair.

WARNING LIGHT TEXT

ENG Engines.

RH Reheat or afterburner. This should not be left on for periods longer than two minutes, otherwise the jet-pipe temperature (TP) will become excessive leading to possible engine damage.

AB Air brake. When the air brake is extended or retracted, this light will turn blue. Remember to watch your air speed does not become too low with the brake extended.

WB Wheel brake. When the wheel brake is activated on the ground, this light will be blue. Use the brakes in bursts, because they may overheat and fail.

T1 Wing tank 1. Jettison tanks prior to aerial combat or a ground strike.

T2 Wing tank 2.

T3 Center line tank.

OX Oxygen. If your oxygen system fails, you must descend to below 10,000 ft.

PR Pressure. If your cabin pressure drops, descend to less than 10,000 ft. If both your oxygen and cabin pressure fail at high altitude, land as soon as possible.

CH Chute for braking. On activating the chute, the light will turn blue, but the chute should be released (disconnected from the aircraft) at a speed of not less than 50 kts, to prevent excessive damage. Releasing the brake will cause the warning lamp to glow red.

HY Hydraulics control many vital systems in the aircraft. Damage to the hydraulic system may cause an explosion, because the fluid is flammable

HU Head-Up Display. If the HUD is switched off using the declutter button, the lamp will glow green.

I Infra-Red missile launch light.

R Radar missile launch light.

UC Undercarriage. When the undercarriage is extended or retracted, this light will turn blue.

JT JTIDS. Information on the JTIDS display is only available if the relevant AWACS and JSTARS aircraft are flying (AWACS detects AA targets, JSTARS detects ground targets). If the information is not available, the lamp will glow red.

EF2000 AVIONICS

AIRCRAFT WARNING SYSTEMS IN USE

- M** Moving Map. Should the MMD fail, you will have to use the paper map included with this manual, and navigate by compass and visual sighting.
- NV** Navigation. Should your HUD fail, you will still have access to the same information on the right-hand glare shield.
- DA** DASS. Failure of the DASS will leave your aircraft vulnerable to attack. You will be forced to drop chaff and flares manually, and the advice is to abort the mission and return to base as quickly as possible.
- AU** Autopilot. Loss of autopilot is an inconvenience, but not critical for a trained pilot.
- WE** Weapons. If weapons become damaged or unusable, jettison them to save weight and return to base as quickly as possible.
- FU** Fuel. If your plane takes damage during combat, check these light quickly to ascertain whether the fuel level has become critical or the supply damaged.
- OI** Oil. Damage to the lubricating systems will eventually lead to damage in the engines, leading to overheating and finally engine failure. If this light is on, try shutting down the damaged engine, prepare for emergency landing or get ready to eject.
- TP** Jet pipe temperature. A warning that your engines are getting too hot, either through excessive use of reheat or through combat damage.
- LK** Missile Lock. If a radar obtains a lock on your plane, this lamp will glow red.
- LA** Missile Launch. If a missile is launched at your plane, this lamp will glow red.
- RA** Radar warning light.
- PI** IRST warning light.

EF2000 AVIONICS

AIRCRAFT WARNING SYSTEMS ERROR MESSAGES

When a warning lamp turns red, these messages will be displayed automatically on the Warning MFD.

ENG 001 WARNING!

RIGHT ENGINE	FIRE
THROTTLE	TO ZERO
FIRE EXTINGUISHER	ACTIVATED
TRANSMIT	MAYDAY CALL
LAND	ASAP
IF FIRE CONTINUES SECONDS	EJECT AFTER 30

IF WARN CONTINUES
IF FIRE CONTINUES

RH 002 WARNING!	
REHEAT	FIRE
THROTTLE	IDLE
FIRE EXTINGUISHER	ACTIVATED
TRANSMIT	MAYDAY CALL
LAND	ASAP
IF WARN CONTINUES	STOP ENGINE
IF FIRE CONTINUES	EJECT

JETTISON
IMMEDIATELY

T 767 - WARNING!	
WING TANK	FUEL LOSS
REHEAT	CANCEL
JETTISON	IMMEDIATELY

T 768 - WARNING!	
CENTRE TANK	FUEL LOSS
REHEAT	CANCEL
JETTISON	IMMEDIATELY

ENG 002 WARNING!

LEFT ENGINE	FIRE
THROTTLE	TO ZERO
FIRE EXTINGUISHER	ACTIVATED
TRANSMIT	MAYDAY CALL
LAND	ASAP
IF FIRE CONTINUES SECONDS	EJECT AFTER 30

AB 078 - WARNING!	
AIR BRAKE	JAMMED
TRANSMIT	NOTIFY ATC
LAND	SCHEDULED TIME
DANGER	FIRE HAZARD DUE TO HYDRAULIC LEAK

OX 221 - WARNING!	
OXYGEN SYSTEM	FAILED
EMERGENCY OXYGEN	ACTIVATED
ALTITUDE	TO BELOW 10,000 FT
LAND	ASAP

RH 001 WARNING!

REHEAT	FIRE
THROTTLE	IDLE
FIRE EXTINGUISHER	ACTIVATED
TRANSMIT	MAYDAY CALL
LAND	ASAP

WB 061 - WARNING!	
WHEEL BRAKE	DAMAGED
TRANSMIT	NOTIFY ATC
LAND	SCHEDULED TIME

PR 141 - WARNING!	
CABIN PRESSURE	LOW
EMERGENCY OXYGEN	ACTIVATED
SPEED	BELOW 300 KTS
ALTITUDE	TO BELOW 10,000 FT
LAND	ASAP

CH 190 - WARNING	
BRAKE CHUTE	DAMAGED
LAND	SCHEDULED TIME

EF2000 AVIONICS

AIRCRAFT WARNING SYSTEMS ERROR MESSAGES

HY 002 - WARNING!		JT 089 - WARNING!		FU 120 - WARNING!	
HYDRAULIC SYSTEM	FAILED	JTIDS	FAIL	FUEL SYSTEM	FUEL LOSS
CHECK	REFUELLING PROBE	ACTION	USE RADAR	REHEAT	CANCEL
CHECK	GEAR			LANDING	ASAP OR PREPARE TO EJECT
CHECK	AIRBRAKE	MM 090 - WARNING!		TP 002 - WARNING!	
LAND	ASAP DUE TO FIRE RISK	MOVING MAP	FAIL	ENGINE	OVERHEAT
		ACTION	USE PAPER MAP	REHEAT	CANCEL
HU 230 - WARNING!		NV 004 - WARNING!		THROTTLE	TO 70% POWER
HUD	DAMAGED	NAV HUD	FAIL		
ACTION	USE ANALOGUE INSTRUMENTS	ACTION	USE ANALOGUE INSTRUMENTS		
PI 121 - WARNING!		DA 331 - WARNING			
PIRATE IRST	DAMAGED	DASS	FAIL		
ACTION	USE RADAR	ACTION	RETURN TO BASE		
RA 124 - WARNING!		AU 441 - WARNING!			
RADAR	DAMAGED	AUTOPILOT	FAIL		
ACTION	SWITCH TO IRST OR JTIDS	ACTION	DO NOT ENGAGE		
UC 036 - WARNING!		WE 342 - WARNING!			
UNDERCARRIAGE	DAMAGED	WEAPONS	FAIL		
JETTISON	ALL WEAPONS EXCESS FUEL	ACTION	RETURN TO BASE		
LANDING	ATTEMPT SLOW LANDING OR EJECT AFTER MISSION				

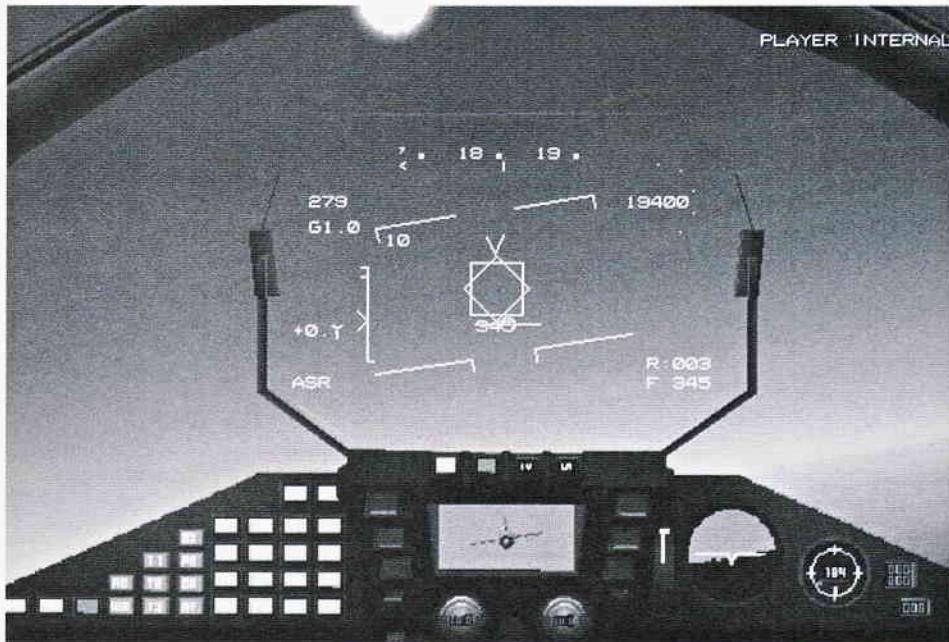
EF2000 AVIONICS

OPERATING THE MFD WARNING SYSTEM



EF2000 AVIONICS

AN INTRODUCTION TO THE HUD AND HMD



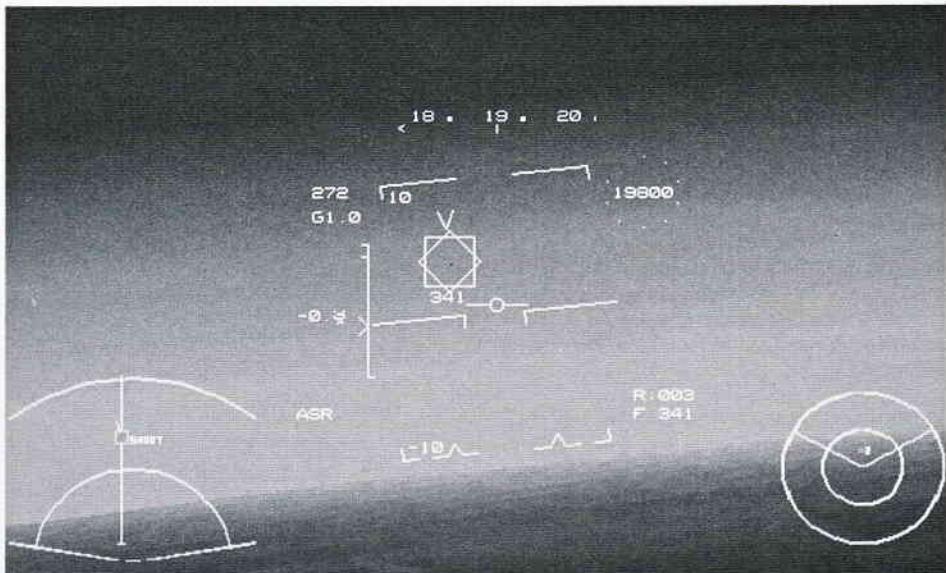
The EF2000 HUD and cockpit

World War II saw the development of the predictor gunsight, which projected a computing gunsight onto a plate of glass between the pilot and the canopy. With the advent of digital computers in post-war avionics, this relatively simple device was to evolve into the Head Up Display (HUD) that is now a standard feature of modern jet fighters. The major difference between the early reflecting gunsights and today's HUD is the amount and type of information displayed.

In EuroFighter, you'll find data on pitch, heading, speed, altitude, gear status, weapons selection and much more. In fact, virtually all you need to know for 90% of the time you are flying is projected onto the HUD. Naturally, HUD design has its own peculiar problems - not least how much information to display without confusing the pilot or causing images to overlap and lose their meaning. For this reason, HUD symbology varies according to the flight mode currently in use; for example, air-to-air combat, refuelling, air-to-ground missions and landing all have their own special modes.

EF2000 AVIONICS

AN INTRODUCTION TO THE HUD AND HMD



Helmet mounted sights or displays are a more recent innovation, and show the trend towards integrating information systems into the pilot's helmet. Such displays allow weapons to be launched 'off-boresight', or when the direction of plane travel does not correspond with where the pilot wants to aim. The advantage is obvious: the pilot can now engage targets much more easily with less manoeuvring. In a knife-edge fight, this will make the difference between life and death.

INFORMATION COMMON TO ALL HUD MODES

The HUD has four modes: AIR-TO-AIR MODE; AIR-TO-GROUND/NAVIGATION MODE; REFUELING MODE; and INSTRUMENT LANDING MODE. Although each mode has its own special features, much of the information is common to all. These commonalities are described here.

AIRSPEED: From standstill to Mach one, the speed is shown in knots. At the speed of sound, your velocity is automatically shown as a Mach number. You will notice that the speed of sound is achieved at seemingly lower speeds the higher you fly, simply because there is less air resistance at altitudes.

ALTIMETER: Up to altitudes of 5,000 ft above the nearest terrain, the altimeter displays what is known as RADALT. This simply means that a small downward looking radar calculates your real altitude above the terrain below, as opposed to your altitude above sea level, otherwise known as BAROMETRIC ALTITUDE. Above 5,000 ft, barometric altitude is displayed automatically. The small clock surrounding the altitude data displays your change in altitude in hundreds of feet.

EF2000 AVIONICS

AN INTRODUCTION TO THE HUD AND HMD

VERTICAL SPEED INDICATOR (VSI): This instrument appears on the AG, landing and refueling HUD, but a back-up is located on the right of the IRST. It shows the vertical speed of the aircraft in units of feet per second. The VSI is mainly used to perform good landings and steady descents on bomb runs. A healthy VSI for landing is halfway between the middle marker and the bottom marker.

ENGINE THRUST: Tells you the percentage of power currently being delivered by the engines. At 60%, the engines are idling. At 100% you are using full dry thrust. Activate the afterburner, and the engine power is boosted dramatically, along with your fuel consumption. To check this, watch the engine management or fuel management displays while turning the afterburner on and off.

G-FORCE: The G-Force indicator not only warns you when G-LOC is likely to occur, it gives you a way to time the rate of your turns. See the section devoted to gravity.

COMPASS TAPE: Located at the top of the HUD, and giving your heading in units of 10 degrees. North is at 0 degrees, East is at 90 degrees,

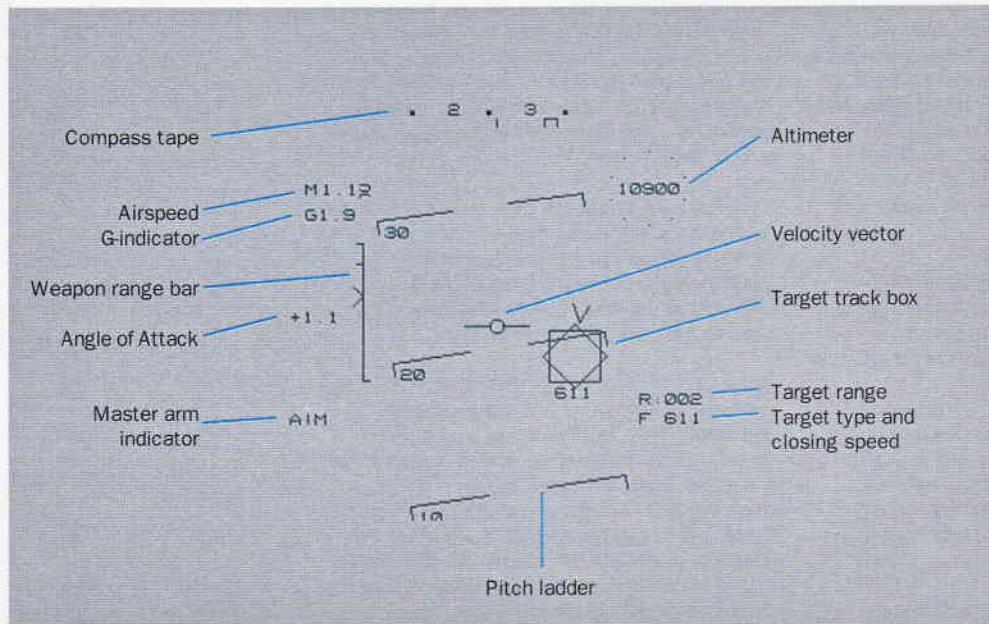
South is at 180 degrees and West is at 270 degrees. To read your heading, check the number above the pipper, which is located just below the tape in the centre. A small inverted 'U' shaped mark indicates the correct heading for your currently selected waypoint. The small arrow which appears on the left of the compass tape indicates which way you must turn to find the waypoint.

WEAPON RANGE BAR: On the left of the HUD, a small vertical bar and arrowhead symbol indicate whether a weapon is within range. If no arrowhead is displayed, don't waste your ordnance!

MASTER ARM INDICATOR: Informs you that the currently selected weapon is armed and ready to fire. In air-to-air mode, pressing ENTER will cycle the weapons. In air-to-ground mode, press BACKSPACE to cycle the weapons.

EF2000 AVIONICS

AN INTRODUCTION TO THE HUD AND HMD



EF2000 AVIONICS

AN INTRODUCTION TO THE HUD AND HMD

PITCH LADDER: This is very handy for checking the orientation of the plane. Note that the widest bar corresponds to the horizon. The bars below the horizon are broken, and the ends of the bars indicate the direction to the ground. In air-to-air mode, the number of pitch bars is halved to help declutter the HUD. NOTE: when using the Helmet Mounted Display to look around the aircraft, both the Pitch Ladder and Velocity Vector disappear.

AFTERBURNER: Afterburner involves dumping large quantities of fuel into the final stages of a jet engine. It boosts power and speed considerably, but at a price: fuel consumption is enormous.

AIRBRAKE: Whenever your airbrake is activated, a small flashing symbol will appear above the velocity vector. Remember not to leave the airbrake on for too long, or you may lose so much airspeed that you place yourself at a tactical disadvantage.

VELOCITY VECTOR: This small aeroplane shaped symbol predicts your flight path, and therefore provides an invaluable aid to positioning yourself for critical manoeuvres; for

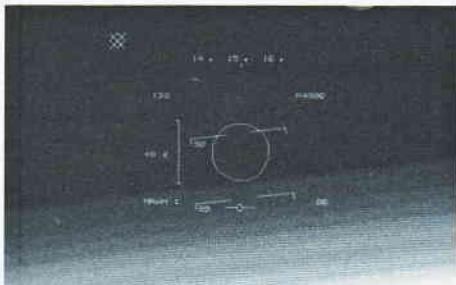
example, in dogfights or on landing approaches. Suppose you are in a turning fight behind a bandit, flying your velocity vector directly over the target puts you on a collision course; placing it slightly behind puts you in what is called 'lag' pursuit; and placing in front of the target places you in 'lead' pursuit.

On landing, try to get the velocity vector to settle on the place where you wish to touch down. When terrain hugging over hills, keeping the velocity vector above the crest of the hill will ensure that you don't collide with the ground (see also the Digital Terrain System).

ANGLE OF ATTACK INDICATOR (AOA): AOA is the angle between your velocity vector (current estimated flight path) and your aircraft datum, or centre-line. A high angle of attack means that your nose is up, although the aeroplane is travelling in a different direction to where your nose is pointing. The 'Cobra' is a typical example of a high AOA manoeuvre, and may be useful in combat for quickly bringing weapons to bear in difficult dogfight situations.

EF2000 AVIONICS

AIR-TO-AIR HUD AND HMD MODES

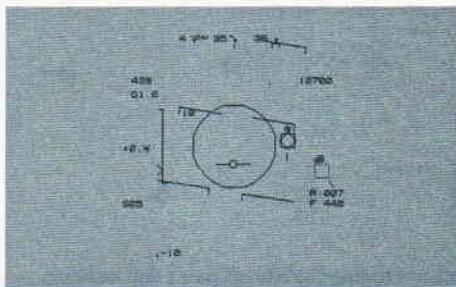


The AA hud mode

When this mode is chosen, the air-to-air radar, JTIDS and DASS are activated, the flight model is adjusted to a more appropriate air-to-air combat profile, and air-to-air missiles can be launched. The HUD symbology becomes combat-specific. Most noticeable is the fact that there are half the number of pitch lines, in order to keep the HUD as decluttered as possible.

- 1 Press the ENTER key to select the air-to-air HUD mode.
- 2 Press the ENTER key again to cycle through any air-to-air missiles on board and activate the relevant air-to-air systems.

S-225 & AIM-120 TARGET TRACK BOXES: These appear around the targets when they are within range. When S-225 and AIM-120 are selected, you may see up to six targets locked in track boxes. You will notice that they are prioritized, with the letters A to F, depending upon their threat value. With ASRAAM, AIM 9M and cannon, only one track box will appear. You may override the computer's choice of target by pressing 'C', which will then select the next target in the sequence A to F. Notice that the currently selected target box has a solid outline, while the others have a broken outline.



Multiple target tracking

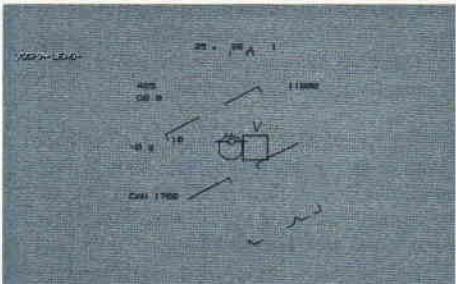
ASRAAM AND AIM-9M TARGET TRACK BOX: A single track box appears for these targets, and with ASRAAM this is visible in the HMD, even when looking over your shoulder.

MISSILE ALLOCATION: When a target has been picked up by the designator box and is in range, the Missile Seeker Head diamond will lock on it. The currently selected missile is now locked on to the target and ready to launch.

PREDICTOR GUNSMITH: When the Mauser 27 mm cannon is selected, a circular predictor sight appears, which shows where your shells will strike if fired at that moment. The outer ring of the circle is also a range indicator. A complete circle shows that the target is at three miles or more, which represents a difficult shot. As you get closer, the line moves around and at the half-way mark you are with one-and-a-half miles, which is a good range to go for a kill.

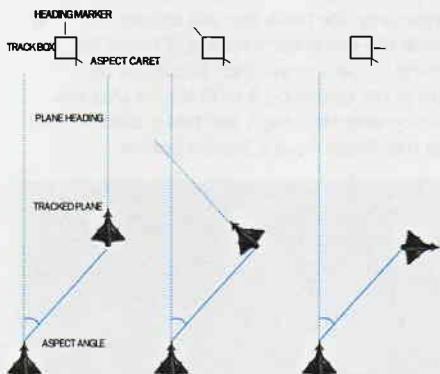
EF2000 AVIONICS

AIR-TO-AIR HUD AND HMD MODES



The predictor gunsight with range clock

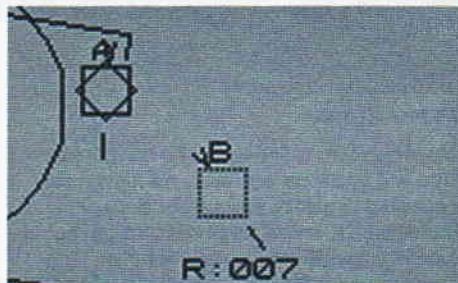
AIMING RETICLE: This 'kill circle' appears on the HUD when an air-to-air missile is selected. The size of the Aiming Reticle depends on the chosen missile: a small circle is used for long-range stand-off weapons such as the S-225, and a large circle is for short-range missiles. Because missile flight envelopes are accurately modeled, you should ensure that your target is within the reticle in order to ensure the best possible shot.



Understanding the aspect caret and heading marker. A constant aspect angle but with changes of heading

TARGET HEADING LINE: On each track box, a solid line moving around the box shows the target aircraft's heading relative to yours.

TRACKING INFORMATION: On any aircraft being tracked by your radar. F=Fighter, B=Bomber, R=Refueller, A=AWACS.



The aspect caret and target heading line

AIRCRAFT CLOSING SPEED (KNOTS) In short range missile and cannon mode, the closing speed between you and the target is displayed in the bottom right of the HUD; e.g. + 80 means that you are travelling 80 knots faster than the enemy.

EF2000 AVIONICS

AIR-TO-AIR HUD AND HMD MODES

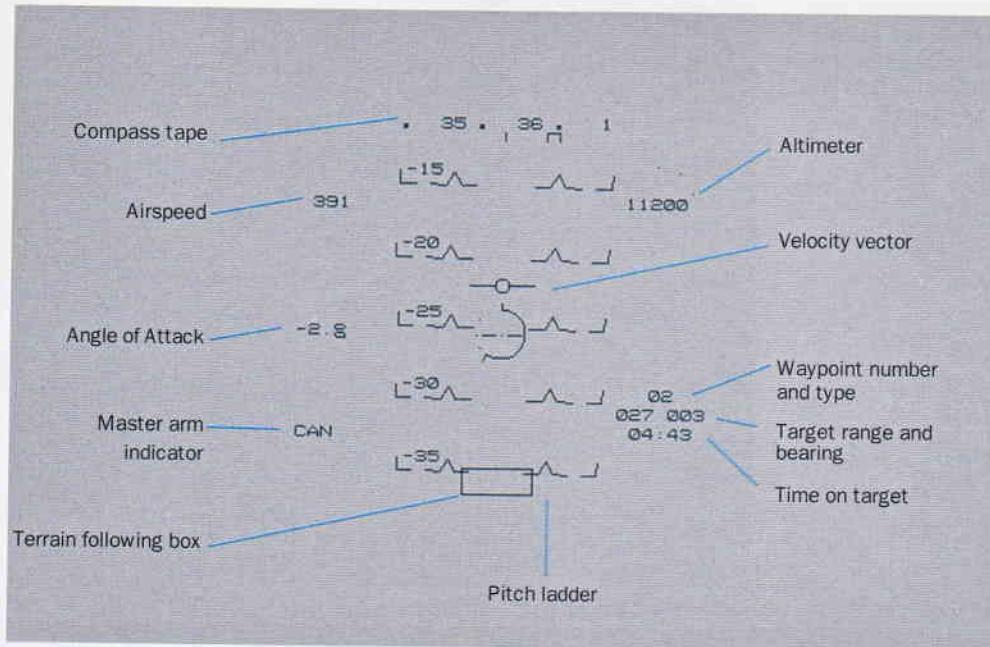
DIAMOND X: When you see this diamond with an 'X' at its centre, you will know that a target is outside the HUD view. Fly in the direction of the Diamond X until the target enters the HUD view. The Diamond X will change to a Target Designator Box.



Follow the diamond X

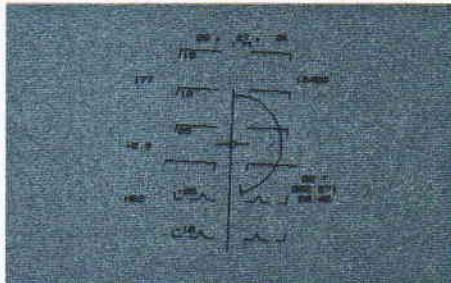
EF2000 AVIONICS

AIR-TO-GROUND HUD AND HMD MODES



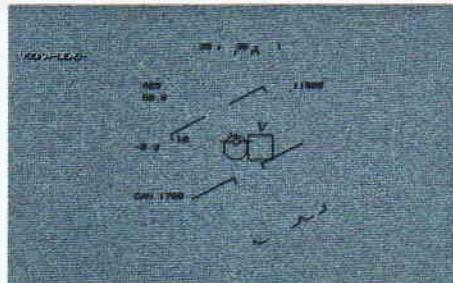
EF2000 AVIONICS

AIR-TO-GROUND HUD AND HMD MODES



Freefall bombing mode

DROPPING A FREEFALL BOMB: When you select this weapon, a bomb fall line appears in the centre of the HUD, together with a count-down clock that starts when you are 65 seconds from the target. If the target is predefined there will be a small triangle on the HUD indicating the nearest waypoint. The target is marked by an 'X'. The small horizontal line is the Continuously Computed Impact Point and shows where the weapon will fall if it is launched at that moment. Approach the target at an angle (up to 40 degrees) and as soon as the CCIP line crosses the target, release the bomb.

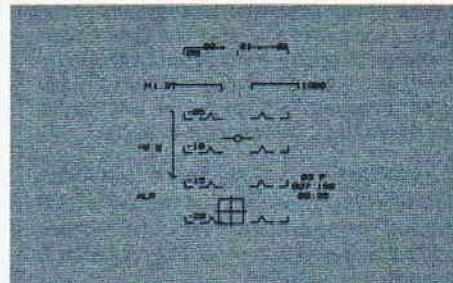


The cannon and CRV-7 sight

CANNON: When the air-to-ground cannon is selected, an AG predictor sight with range circle appears on the HUD.

CRV-7 SIGHT: This is a very similar sight to the one used for AG cannon, and shows where the rockets will impact.

ALARM SIGHT: This auto-tracking sight will only lock on to radar sources. ALARM may be fired in indirect mode, without any target, in which case it will travel for 15 miles and zoom climb to 40,000 ft, where it will wait for a target to switch on its radar. Alternatively, if there are



The ALARM sight

targets in direct view of the missile, it will designate them with a small square in the HUD. The missile may then be launched when a small cross appears in the square.

EF2000 AVIONICS

AIR-TO-GROUND HUD AND HMD MODES

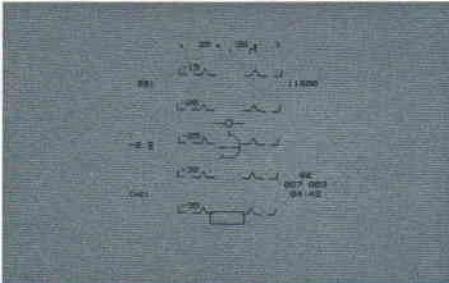
When this mode is chosen, air-to-ground targeting radars are activated, the flight model will change to air-to-ground attack profile and air-to-ground weapons can be selected. If your aircraft is carrying GBU bombs, the laser target designator (TIALD) will become available.

WAYPOINT NUMBER/TASK: Shows the currently selected waypoint number, and the task at that waypoint. Task codes are: R-refuelling; T-target; P-combat air patrol loop point; I-ingress point for ground strikes; L-landing.

TIME ON TARGET (TOT): Shows how far you are from your currently selected target in minutes and seconds.

RANGE TO TARGET: Shows how far you must travel to your target in nautical miles.

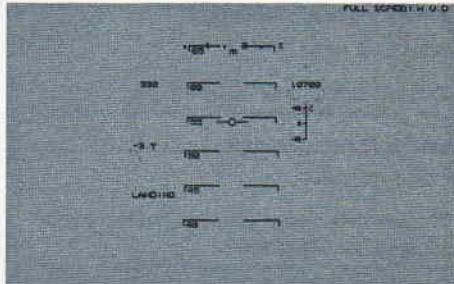
TIME EARLY/LATE: Shows you whether you are on time for your target run. The scale is 100 seconds early or late; you should aim to get the caret over the dot in the middle, in order to be on time for your attack.



The AG HUD mode

EF2000 AVIONICS

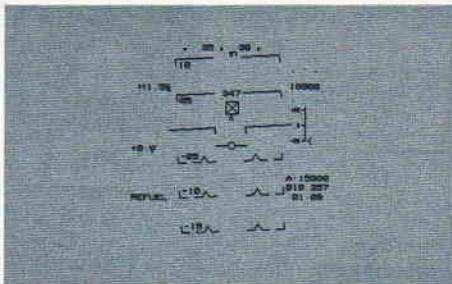
LANDING AND REFUELLED HUD MODES



Instrument landing system HUD mode

A variation of the navigation mode HUD comes into effect when the Instrument Landing System is activated. If ILS is available or in range, a small box will appear in your HUD.

ACTIVATE ILS: Choosing ILS within thirty miles of an airfield will activate the Command Flight Path Display (CFPD), which is a corridor in the sky that helps you make perfect landings. Simply fly through the boxes, steering with the aid of your Velocity Vector (VV). To make landing easier still, select autothrottle in the autopilot screen, and program it with a speed of 150 knots. When you have touched down, remember



Refuel HUD mode

to switch off the autopilot, prior to applying the brakes.

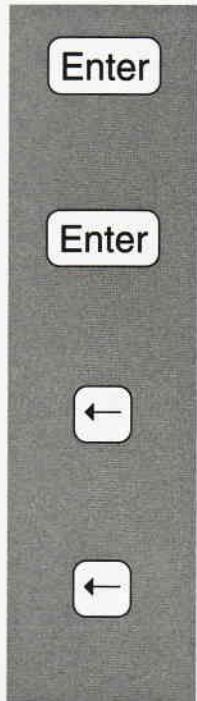
UNDERCARRIAGE DISPLAY: When ILS is activated, so is the undercarriage indicator in the bottom centre of the HUD. Three U's mean that your undercarriage is up. Three D's indicate that the under carriage is down.

A variation of the air-to-air HUD comes into effect when you are set to refuel.

Instead of an enemy target, the HUD tracks the refuel aircraft. Note that all weapons systems are shut down for refuelling. The closing speed is displayed above the tracking box.

EF2000 AVIONICS

OPERATING THE HUD MODES



SELECT AA MODE

PRESS ENTER

This will switch the HUD to AA mode, with half the number of pitch bars.

CYCLE AA WEAPONS

PRESS ENTER

This will allow you to cycle between the available weapons. Targeting symbology will vary automatically, according to the weapon selected.

SELECT AG MODE

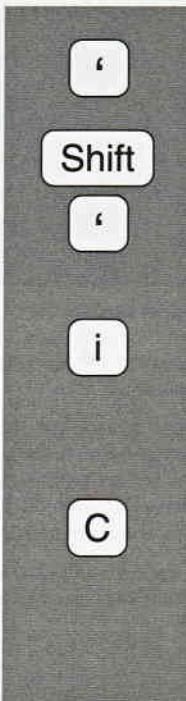
PRESS BACKSPACE

This will switch the HUD to AG mode, giving you access to important waypoint information.

CYCLE AG WEAPONS

PRESS BACKSPACE

This will allow you to cycle between the available weapons. Targeting symbology will vary automatically, according to the weapon selected.



ACTIVATE REFUELLER NOZZLE

PRESS THE ' KEY

This will extend your refuelling probe.

SELECT REFUELLER MODE

PRESS THE SHIFT ' KEY

This will de-activate weapons and allow your radar to track the tanker.

SELECT ILS MODE

PRESS THE i KEY

The CFPD system displays boxes which you should try to follow with the velocity vector.

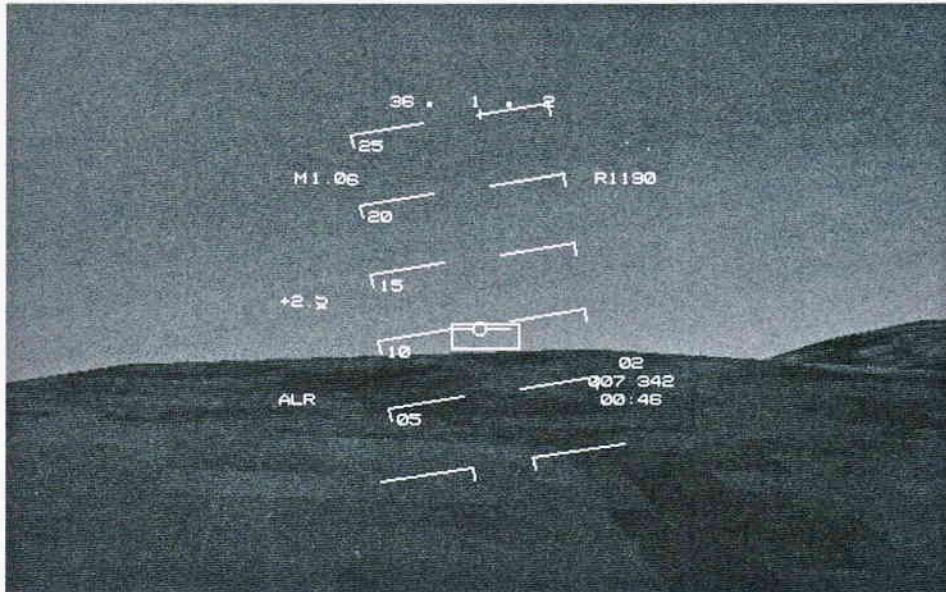
CYCLE THROUGH MULTIPLE TARGETS

PRESS THE C KEY

When several track boxes are visible in the HUD, and you wish to override the ECR-90 prioritization, press this key to cycle through the targets.

EF2000 AVIONICS

DIGITAL TERRAIN SYSTEM



Simply fly the flight pipper into the letter box

By eliminating the need for ground radar, a Digital Terrain System provides a stealthy and affordable way to help pilots fly ground-hugging profiles through hostile territory. The system projects flight cues into the HUD based on reference to digital terrain data. These data are cross-referenced with inputs from the aircraft's various navigation aids, such as the radar altimeter. Differences between the real and anticipated readings are resolved and relayed to the display system.

In EF2000, a Digital Terrain System predicts the flight path that should be taken, and projects a small rectangle into the HUD, showing the pilot when to pull back or push down on the stick. All the pilot has to do is keep the velocity vector centered in the small square. The system should keep the aircraft at least 200 ft clear of terrain and obstructions.

Real Digital Terrain systems have other uses, including assistance in weapons cuing. In EF2000, use the system for stealthy low-level attack approaches in well-defended territory.

FEATURES AND TIPS

USING THE “RUNNING IN” COMMAND

Accessed via the TAB key, the “running-in” command is used on Strike, Wild Weasel and Anti-Ship missions to order your wingmen to attack their target.

ANTI-SHIP MISSIONS

Order your wingmen to “run-in” just before the flight reaches the IP. This will cause them to start their attack pattern.

WILD WEASEL MISSIONS

The “running-in” order will only appear in your command options when you are in the proximity of a SAM site or when a wingman reports “mud spike”. Tell your wingmen to “run-in” and they’ll launch an Alarm missile at the target.

STRIKE MISSIONS

The strike missions are similar to the anti-ship missions with the exception that the “running-in” command is automatically issued when the IP is reached.

NOTE: Should one of your wingmen be fired upon while “running-in” the flight will break-off the strike and engage the attackers. Another “running-in” command must be issued in order to tell your wingmen to recommence the strike. This will cause the wingman to restart his attack pattern.

FEATURES AND TIPS

SURVIVAL

You may sometimes wonder how the enemy manage to find you as you make your way to target. Even with your DASS set to 80 nm you may never see a spike, but the enemy still cross your flight path. The reason is that an enemy AWACS is vectoring fighters onto you. Enemy AWACS has a range in excess of 300 nm so you will not see an AWACS '6' spike if they are beyond the 80 nm DASS range.

When you're loaded with bombs, engaging incoming fighters is asking for trouble. To get to target you have to use JTIDS (if available) and work out the 'holes' in the enemy defenses. Fly low to avoid radar. With the new waypoint setting capabilities of the mission planner, you'll be able to set-up the optimum ingress point to give yourself a clear run at target, and squeeze stealthily between enemy SAM radar sites (also known as 'threading-the-needle').



FEATURES AND TIPS

AIR TO AIR COMBAT

With the Campaign AI, you will often find that aerial combat is balanced in the enemies favor, so good tactics are needed to win, or even survive.

Let's take a two on four scenario: two EuroFighters versus four SU-27 Flankers.

Set yourself up: When the engagement starts at long range get set up. Go to the right-hand MFD and toggle autopilot to 'throttle-only', and set for 550 kts. Next, re-activate the DASS and set to 80 nm or lower if enemy is closer. Go to the middle MFD and turn off the map, waypoints, ground items; i.e. leave only air targets visible to get a clearer picture of the action. Set range accordingly for best target resolution.

Make sure radar is set to Autorange, and turn to the bandits. Once you acquire them on radar, note their altitude. If they are at low level get to 10,000 feet and stay there. If they are at 30,000 feet get up there with them. Your missiles need all the power they have, and you don't want them climbing upwards to reach target.

If the enemy is lower than you, they will usually climb to greet you, you can use up/down radar toggle to keep them locked up.

Once you have a long range lock with S-225, order your wingman to engage; ignore his requests to engage before this time, otherwise missiles may be wasted. Give him a target to 'Fox One' and then select another target to fire at yourself. Once these two missiles are on their way have him bracket right or left, and you bracket the other way. This will split the enemy up, and reduce their missile capability per target as a group.

If the enemy uses ECM (Music) you can burn through it, by flying at the target. Your radar will achieve intermittent locks, and at this point you can fire more long/medium range missiles at each target. The X that appears in target tracking boxes informs you that a missile has been allocated to that target. You can still send more missiles to that target to increase your probability of kill (PK).

AVOIDING INCOMING MISSILES

If you get an incoming radar missiles, turn on ECM and switch to F12, drop some chaff, change course slightly and then get back on track. Check DASS to ensure missile is spoofed (yellow flashing dot means the missile is spoofed; a solid dot means it's active and tracking you.)

MEDIUM RANGE DOGFIGHTS

Depending on how well or how badly your missiles did at long range, get set up for the medium and close range combat. There is little point in keeping the AIM-120's. Once the enemy are too close, they are less than useful. Fire off as many as possible on every target you can get locked up. Once all your radar missiles have gone, switch to ASRAAM, leave ECM on (they know you're there!) and get ready to fight the enemy with infra-red missiles!

FEATURES AND TIPS

AIR TO AIR COMBAT

BEATING THE IR MISSILES

Russian IR missiles may re-acquire you several times, just when you thought you had them spoofed! Use F12 and learn to use simple cues like the reflections in the canopy to get orientation fixes on incoming weapons. You need to fly text book spoof techniques to fool these IR missiles. When padlock shows the smoke trail of the missile, turn into it, until it's in the HUD; start dropping flares and break high and to the left or right. No after burners please! Next roll inverted, enter a positive G dive and hope. Repeat exercise until the enemy have exhausted their missile supply. Don't lose too much airspeed, as you will be unable to manoeuvre sufficiently and so become an easy target.

Tip: If you leave radar on, your ASRAAMs will give a 'shoot now' tone if you lock a bandit up during these spoof moves. If you get a good tone SHOOT! If your radar is off, the only launch signal you get is in the target tracking box, as a diamond. So even while you are in a compromised position, you can still squeeze one off to get your own back!

CLOSE COMBAT

When it's down to IR missiles and guns, set the autopilot throttle to sustain speeds of 550 kts. When not using the autothrottle to maintain velocity, the EuroFighter can execute very high G, high AoA turns but with dramatic speed loss. Such manoeuvrability enables you to get your nose on a tight turning bandit and bring weapons to bear much quicker than your opponent. However, it can leave you hanging in a vulnerable position, at which point you should flick the autothrottle back in.

TRACKING TARGETS IN DOGFIGHTS

Use F2 padlock to get enemy fighters in the HUD region, then go to full view F1 to get the kill. The new auto cannon is lethal from the 6 o'clock position. If the enemy is cornering better than you, a simple hi-G yo-yo will put you firmly on his six again.

Warning: If you are on autopilot throttle and get an IR launch warning, turn autopilot off immediately. Chances are the afterburner will kick in when you try to avoid the IR missile! The last thing you want is something hotter than your flares at this point in time.

FEATURES AND TIPS

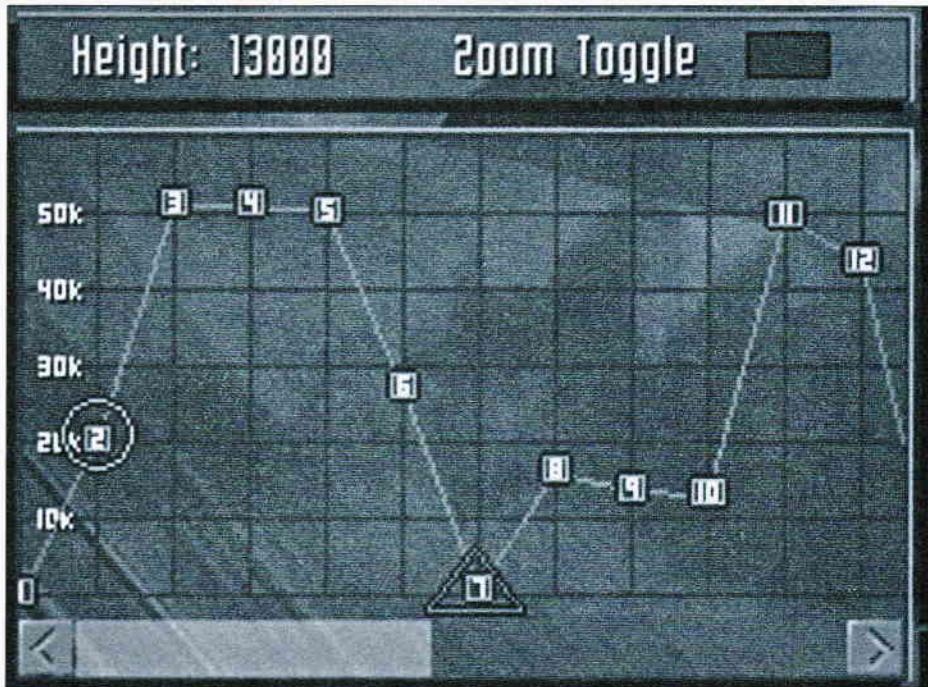
MISSION ALTITUDE PROFILES

Flying low level - 200 feet or less - at 450 kts or more burns fuel at an enormous rate. Unless you are very skilful with terrain-masking the enemy fighters may still find you close to targets, because ground observers quickly alert the defenders. However, if your JTIDS shows only ground threats, low-level flying can help keep you out of trouble with SAM sites.

Alternatively, consider a high altitude approach for the first 75% of your flight to target. At 30,000 feet fuel consumption is low, speed is high, giving the enemy less time to vector to your location. It will also keep you well above the Man Portable Air defenses (MANPAD) and AAA.

Over target is the usual five minutes of terror. ECM is near 100% effective against radar SAMS, but use the F12 missile padlock from time-to-time to make sure that you are not about to be toasted.

Once the bombs are off, egress at low level to avoid SAM radar, then climb back to thirty thousand feet for run home. This will conserve fuel, and you are now configured for dogfights, should the need arise.



Drag-and-drop way points and altitudes

FEATURES AND TIPS

CHOOSING TARGETS

In planning campaigns, considerable effort is spent choosing targets that will bring the enemy's war efforts to a halt in the shortest time possible. This is why targets such as AWACS aircraft are such high priority. After the Cold War, E3 Sentry squadrons were horrified to learn that as many as forty front-line Russian fighters would be tasked with their destruction in a single mission!

Alternatively, you may just have a particular type of mission that is a favorite. How you choose is up to you, but some mission types will be harder than others. That is for you to discover!



AWACS selected as a target

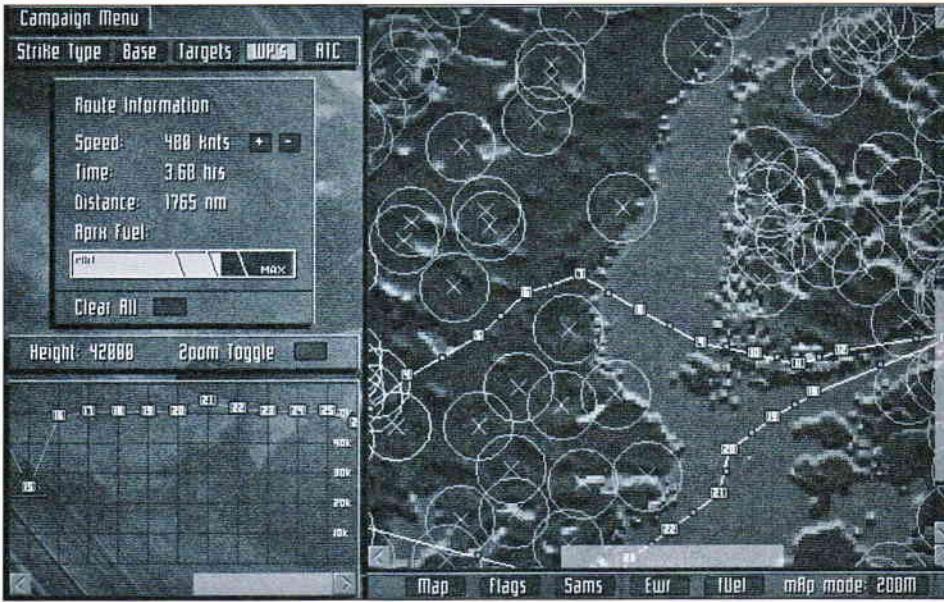
FEATURES AND TIPS

WAYPOINT POSITIONING

Positioning ingress and egress points with care. In low-level attacks, try to minimize exposure to enemy air defenses by popping up from behind hills or mountains, then diving back behind cover as quickly as possible. Autopilot can be a handy feature when you feel that you are becoming overloaded, or you have lost your bearings. Knowing that autopilot will take you to a safe waypoint is a comfort.

Although it is rarely wise to re-attack targets, the braver and more skilled amongst you may wish to do just that. In this case, set your waypoints to allow several passes over the target. Once again, autopilot can be a useful aid should you become disoriented.

In campaign, use the SAM and EWR switches on the map toolbar to plot a course around enemy radar coverage. You may have to fly a little further, but it will be safer. Conversely, plot courses that cross your own air defense network, as this will provide added protection should you be chased or attacked by enemy aircraft.

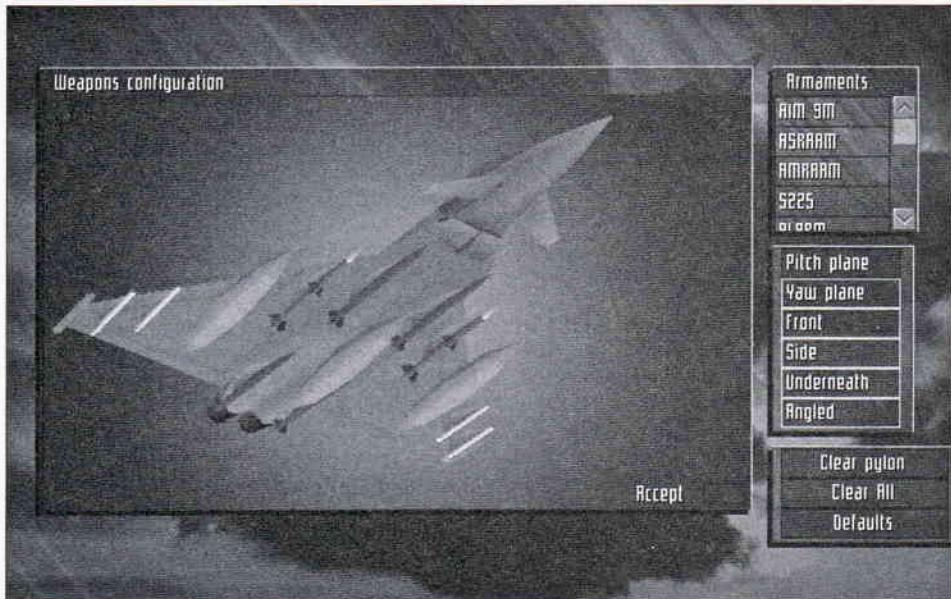


FEATURES AND TIPS

ARMING YOUR AIRCRAFT

In campaign, you now have the possibility to change your weapons load (your wingmen's loads will be changed to match yours). Because many of the missions are relatively long, think twice before removing the drop tanks. Instead you will have to find refuellers to compensate. If you are on a strike mission, try to avoid dogfighting at all costs, in order to conserve fuel and reach the objective. If you must fight, first jettison your fuel tanks. If the situation becomes desperate, only then should you jettison your Air-to-Ground stores. After this, you might as well fly home. Even if you survive, this counts as a mission kill to the enemy.

For Air-to-Air missions, try choosing Sidewinders for more challenging dogfights. These older AA missiles are best fired from the rear aspect, which means you'll have to fly harder in order to get a good shot.



In network campaign, you select armaments for your whole flight.

FEATURES AND TIPS

PLAYING YOUR OWN CD MUSIC

Once a mission has loaded, call the in-game configuration menu (key ') and load your own audio CD in the CD-ROM drive. Now use the CD audio options to select which track you would like to hear and return to the game.

SPEED AND EFFICIENCY

On minimum specification machines, there are a number of functions which can be adjusted to help improve the speed and fluidity of the graphics. Firstly, ensure the program is running in 320 x 200 resolution. If you are unsure, fly a mission and press ALT R to change resolutions. Then try adjusting the detail level with ALT D.

SVGA mode is best on faster Pentium machines (90 Mhz or more). In this mode, the quality of the graphics is actually better than some military simulators. For best results, purchase a 3Dfx or Rendition based accelerator card.

Switching off the virtual cockpit by pressing F1 will also increase the speed and fluidity of the graphics. Joystick response can be improved by entering the in-game configuration menu (KEY `) and setting the joystick sensitivity to maximum (the far right of the scale). There are also three detail settings, low, medium and high. Try lowering the setting to improve speed.

EF2000 is packed with high quality sound samples and texture maps, and on 16 MB machines will access the swap file from time to time to load data. Switching off the sound effects will reduce this disk access time.

Alternatively, fit more memory into your machine: 32 MB is ideal.

Double speed CD-ROM drives mean longer loading times. This problem can be solved by making a full installation or upgrading to a faster CD-ROM drive. N.B. Loading from the hard drive is almost always faster than loading from a CD-ROM drive.

FAST MENU ACCESS

In the Main Menu, you need only type the initial letter of each menu title to access the relevant simulation module; e.g. S for simulator. Quick Combat is accessed by pressing ENTER.

FAST MFD ACCESS

To gain immediate access to the MFD screens, rather than have them scrolling, first press ALT Z. The same key combination reverses the effect.

REMOTE AUTOPILOT KEYS

You may adjust the autopilot speed with the + and - keys without looking at the MFD. In addition, cursor left/right affects heading, and cursor up/down adjusts altitude.

SWITCHING THE AUTO-LEVELLER OFF

To do this press the L key again. Note, when you look at the Autopilot screen, you must press the AM Autopilot Mode key on the MFD to recall functionality.

FEATURES AND TIPS

LANDING GEAR PROTECTION

The aircraft will not let you drop your landing gear above 300 knots. Conversely, if you exceed 300 knots with your gear down, the aircraft will retract it automatically.

CONTROLLERS

Suncom's F-15 stick was released to us a little too late for inclusion in the manual, but has been tested and approved by DID for use with EF2000.

RUDDER PEDALS

In the EuroFighter itself, the rudders are almost redundant except in the very low speed regime; i.e. for landing. The effectiveness of the rudder cannot be compared with that of conventional aircraft with a mechanical flight control system. However, rudder calibration is included in the joystick calibration routine.

RECALIBRATING JOYSTICKS IN GAME

To restore your controllers to a central position during game play, press ALT C.

REFUELLING

When attempting to refuel, please be aware of the following points...

No response to a refuelling request means that the tanker is out of range, or is not within the required 30 mile radius. Simply fly towards the compass marker, or use Autotracking Autopilot while using the refueller HUD mode.

If you are told 'Negative, hold off', there is a refueller in range but all its available slots have been taken. In this case, simply keep trying until a slot is free.

'Clear to Join' means that you have been allocated a slot in the queue, but not necessarily a hose. You must wait for permission to connect with a hose, otherwise refuelling will not commence.

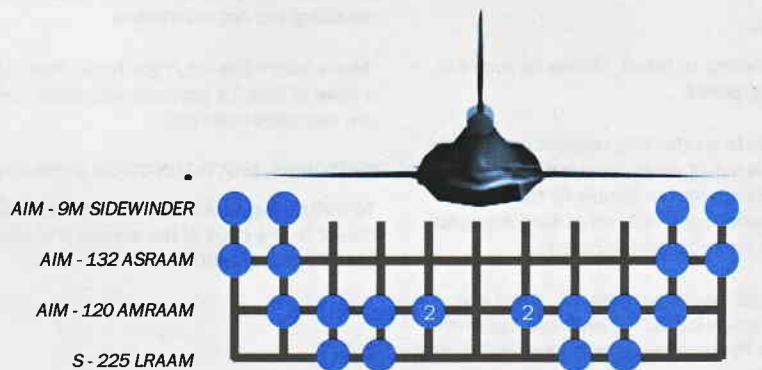
'Move astern the left/right hose' indicated that a hose is free. To succeed, you must link with the allocated hose only.

SWITCHING MULTI-FUNCTION DISPLAYS

To switch displays using the mouse, move the cursor to the edge of the screen and click on the left mouse button.

EF2000 WEAPONS

INTRODUCTION TO AIR-TO-AIR WEAPONS



EF2000 carries the latest air-to-air weapons

In recent years there have been substantial improvements in the performance of AA missiles. With better radars and missile guidance systems, designers have concentrated on building weapons and delivery platforms that excel at both Beyond Visual Range (BVR) combat and close combat. Each demands very special qualities from the aircraft and from the missile design, which is why EuroFighter and its primary weapons systems such as ASRAAM have been developed specifically for each other.

BVR MISSILES

To have a chance of hitting a difficult target such as the SU-35 at long-range, BVR missiles need endurance, speed, and jamming-resistance. They also need a degree of agility for manoeuvring in the final phase of flight, and stealth properties can make the difference between a hit and a miss. The delivery aircraft must be capable of fast acceleration to high Mach numbers, in order to give the missile maximum inertia at launch, and must offer good supersonic turn rates, in order to outrun any missiles an enemy might fire in return.

EF2000 WEAPONS

INTRODUCTION TO AIR-TO-AIR WEAPONS

DOGFIGHTING MISSILES

In contrast, shorter range missiles for use in visual dogfights need tremendous agility, so that they hit a fast manoeuvring target. ASRAAM derives snake-like agility from thrust vectoring, the technique of steering with the motor exhaust, which made the Harrier VSTOL aircraft possible. Coupled with a Helmet Mounted Sight, ASRAAM is all the more deadly because it can be fired at targets over the pilot's shoulder; for example across a circle in a turning dogfight. This is known as off-boresight weapons delivery.

CANNON

The Vietnam war taught the Americans that carrying missiles alone was not enough in close combat against an agile enemy. Even though missile performance has improved dramatically, cannons are still deemed necessary on fighter aircraft. The presence of many shoulder launched SAMs in modern battlefield environments makes strafing very risky indeed, and so cannon are less important in the Air-to-Ground role.

Weapon	Useful range		Weight	Speed	Drag Factor
	miles (head-on)	Km (head-on)			
Cannon	3		87	1.2	-
	5		220		
AIM-9M	5		87	0.3	1.01
	8		191		4.04
ASRAAM*	10		97	0.4	1.10
	15		191		4.40
AMRAAM	30		157	0.6	1.58
	48		346		6.32
S-225*	50		160	0.9	1.91
	80		353		7.64

Weapons performance comparison: EuroFighter carries NATO's best AA weapons, including: the stealthy S-225 long-range missile; the AIM-120 AMRAAM medium range missile; the ASRAAM high agility dogfighting missile; the aging but useful Sidewinder AIM-9M short-range missile; and the Mauser 27mm cannon.

**Estimated performance*

EF2000 WEAPONS

INTRODUCTION TO AIR-TO-AIR WEAPONS

EF2000 AA WEAPONS OVERVIEW

Even in the year 1995, missile manufacturers performance figures remain optimistic, with pilots quoting effectiveness of around 70% for some of the newer designs. There are many factors which determine whether or not a missile will hit its mark. Firstly, there is always the chance that the weapon will not arm itself.

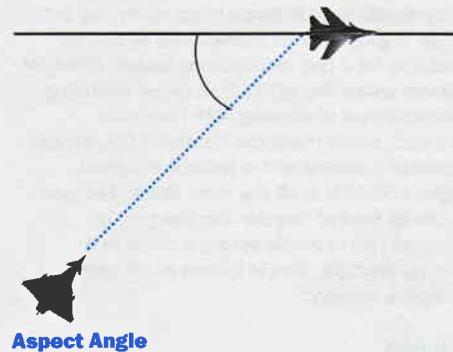
Secondly, effective range is very much determined by your aspect angle to the target; so is the PK value, or Probability of Kill. For example, when you chase a plane from behind, effective missile range is at its shortest because the weapon must first catch up with the enemy. PK, however, is high in a rear-aspect shot because there is a greater chance of hitting the target in its vulnerable jet exhaust. On a nose-to-nose heading, weapon range is at its greatest because you are travelling towards the enemy at high closing speeds.

Last but not least, weapon effectiveness is altitude dependent: the higher you go, the greater the range, with ranges at sea level being almost half the maximum range.

In EF2000 we have carefully modeled all these characteristics, which means that you will always have to fly your plane into the best possible position prior to firing. On the radar, the white range-bar helps you determine the effect that altitude and aspect angle are having on the weapon parameters.

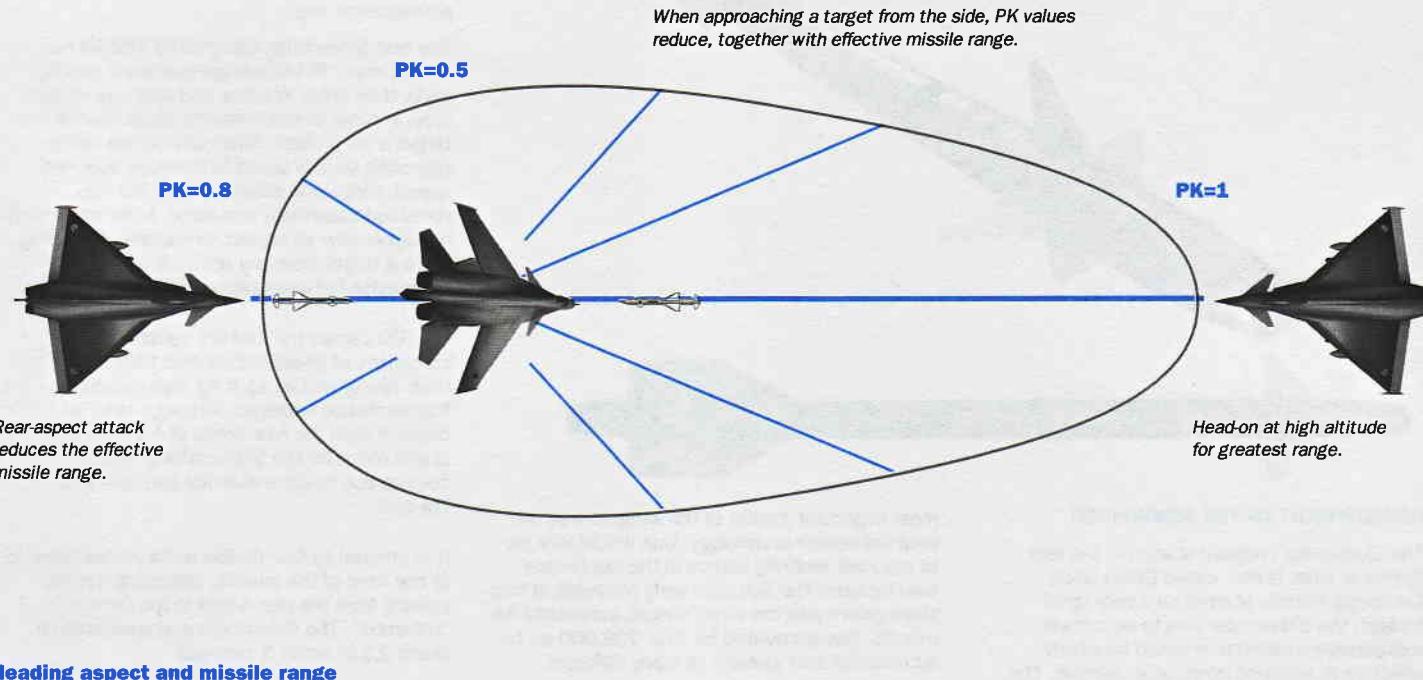
- * AIM-9M Sidewinder - An old but adequate all-aspect heat-seeking missile.
- * ASRAAM - Advanced Short-Range Air-to-Air missile, with IR seeker head.
- * AIM-120 AMRAAM - Advanced Medium-Range Air-to-Air missile, guided by an on-board radar.
- * S-225 - The new 'stealthy' long-range air-to-air missile, guided by radar.

In a typical Air-to-Air configuration, for use on intercept or Combat Air Patrol (CAP) missions, Eurofighter carries four long range S-225 missiles or four AMRAAMS, four dogfighting missiles such as the ASRAAM or Sidewinder AIM 9M, and 1760 rounds of high-explosive cannon shells. It is standard practice to carry drop tanks, because take-off and flight to cruising altitudes burn a lot of fuel.



EF2000 WEAPONS

INTRODUCTION TO AIR-TO-AIR WEAPONS



AIR-TO-AIR WEAPONS

AIM-9M SIDEWINDER



DEVELOPMENT OF THE SIDEWINDER

The Sidewinder program started in the late forties at what is now called China Lake, California. Initially started on a very small budget, the Sidewinder was to be a novel, inexpensive weapon that would be wholly effective at shooting down other aircraft. The

most important aspect of the weapon was the infra-red seeker technology, that would lock on to any heat emitting source in the sky (which also included the Sun with early models!). It has since grown into the world's most successful AA missile, has accounted for over 200,000 air to air missiles sold globally to many different

airforces. It is now coming to the end of its development life.

The first Sidewinder, designated AIM-9B had revolutionary IR technology and fewer moving parts than other missiles and was rear-aspect only; in other words it needed to be fired at the target's six o'clock. Since then it has been upgraded several times to increase accuracy, speed, range and effectiveness, but has remained essentially the same. Most importantly it has become all-aspect, or capable of locking on to a target from any angle, and is able to distinguish between target, flares and the Sun.

EF2000 carries the AIM-9M variant, this comprises of all-aspect infrared tracking, active laser fusing and an 11.4 Kg high explosive blast fragmentation warhead. Although older and less capable than the new breed of AA missile, there is still place for the Sidewinder in modern combat due to its availability and relatively low-cost.

It is steered by four double delta planes located at the front of the missile, additional control coming from the rear wings in the form of "rollerons". The Sidewinder can accelerate to Mach 2.5 in about 2 seconds.

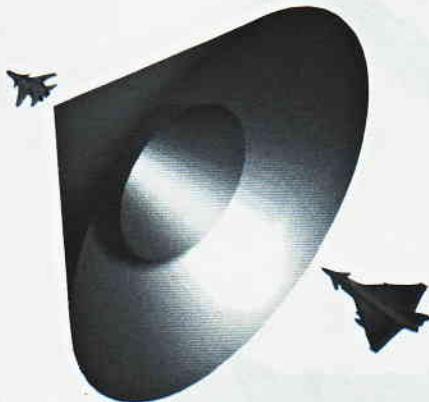
AIR-TO-AIR WEAPONS

AIM-9 SIDEWINDER

APPLICATION

In operation the EF2000 would carry Sidewinders as a secondary short range missile, favoring instead the ASRAAM. However the Sidewinders are more plentiful, so may be used in cases where the ASRAAM is in short supply or where its capabilities are not as important.

The AIM-9M is an infrared missile and even though it is 'all-aspect', the biggest heat signature will come from the rear of an enemy's aircraft. The missile's range is shorter than ASRAAM so in order to get a good kill from behind, the AIM-9M will need to be within five miles. Head on however increases the relative range of the missile according to the closing speed of the two aircraft, although the reduction of infra-red signature will reduce the likelihood of hitting the plane; i.e. a lower PK, or Probability of Kill.



The lethal cone in rear-aspect attack



Aim-9M Sidewinder

AIM-9M Sidewinder	
Length m	2.87
Diameter mm	127
Wingspan m	0.64
Weight kg	87
Warhead kg	11.4
Fuse	Active laser
Guidance	IR
Propulsion	Solid propellant
Range km	8
Range miles	5

Performance Table

When attacking a target using AIM-9M, position your aircraft so as to enable the missile's IR seeker to locate the target within your HUD. This may require a degree of violent manoeuvring at close range. Once the target has been acquired the Sidewinder will confirm it is tracking the target visually in the Track Box, and audibly through a distinctive growling tone. Once 'lock' has been achieved you may release the weapon. In adverse conditions of ECM, or when flares are being ejected by the target plane, the Sidewinder may break its lock in which case you must re-acquire it before launching. Once released, the Sidewinder requires no more thought from the pilot, enabling you to turn and leave.

AIR-TO-AIR WEAPONS

AIM-132 ASRAAM



The ASRAAM is guided by an advanced imaging infra-red seeker utilizing image processing systems in order to recognize its target and give it all-aspect capability. ASRAAM differs from conventional missiles in offering high off-boresight targeting via a helmet mounted sight. In other words, the missile may be launched over-the-shoulder. Its performance is assisted by thrust vectoring, allowing fantastic turn capability of more than 30 G. The difference this makes in difficult turning dogfights is enormous, because you no longer have to point the plane's nose directly at the target. However, these missiles travel at speeds around Mach 4, which means that a slower moving plane pulling less G's can still outsmart the missile.

DEVELOPMENT OF ASRAAM

The Advanced Short Range Air-to-Air Missile (ASRAAM) program was started in 1982 initially as a European enterprise, with the USA also producing the weapon. Although there was much interest early on in the program, this waned as the US started to look at further developments in the Sidewinder family (AIM-9X) and the

German co-contractors transferred all remaining interest to BAe. Several versions have been proposed from French weapons company Matra and also GEC-Marconi for a MICA ASRAAM, known as MICASRAAM.

AIR-TO-AIR WEAPONS

AIM-132 ASRAAM

	AIM-132 ASRAAM
Length m	2.9
Diameter mm	165
Wingspan m	0.45
Weight kg	97
Warhead kg	10
Fuse	Active laser
Guidance	Imaging IR
Propulsion	Solid propellant
Range Km	15
Range miles	10

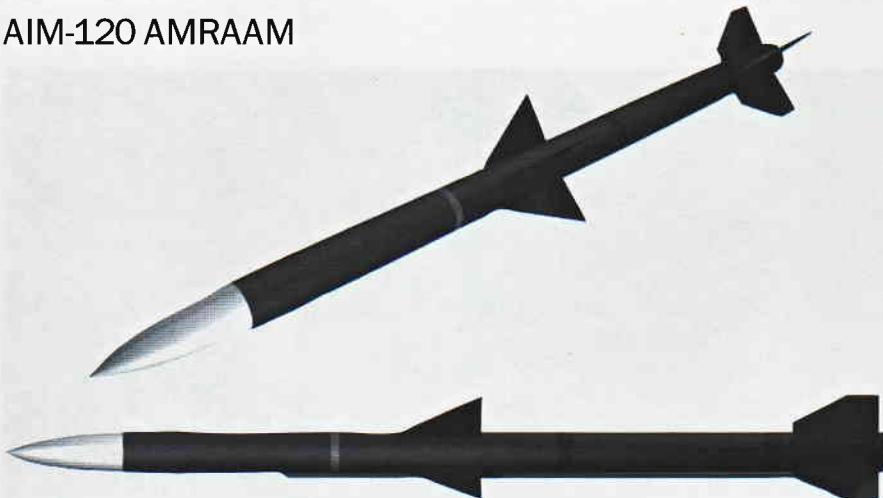
Performance Table



Over the shoulder locking

AIR-TO-AIR WEAPONS

AIM-120 AMRAAM



DEVELOPMENT OF THE AMRAAM

The Advanced Medium Range Air-to-Air Missile program was started in 1975 as a replacement for the ageing Sparrow. The advantages over the Sparrow were better manoeuvrability, speed and range as well as improved resistance to ECM.

The AMRAAM has an active radar seeker which does not require the launch aircraft to 'illuminate' the target as the Sparrow did. It is

also known as a BVR missile (Beyond Visual Range) as it can be launched from as far away as 50 kilometers, although this range can be reduced considerably if the target is receding.

The radar on board the missile falls within "I" band and has the capability to target self-screening jammer targets.

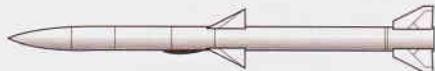
AIM-120 AMRAAM	
Length m	3.65
Diameter mm	178
Wingspan m	0.53
Weight kg	157
Warhead kg	22
Fuse	Active laser
Guidance	Inertial, active radar
Propulsion	Solid propellant
Range km	48
Range miles	30

Performance Table

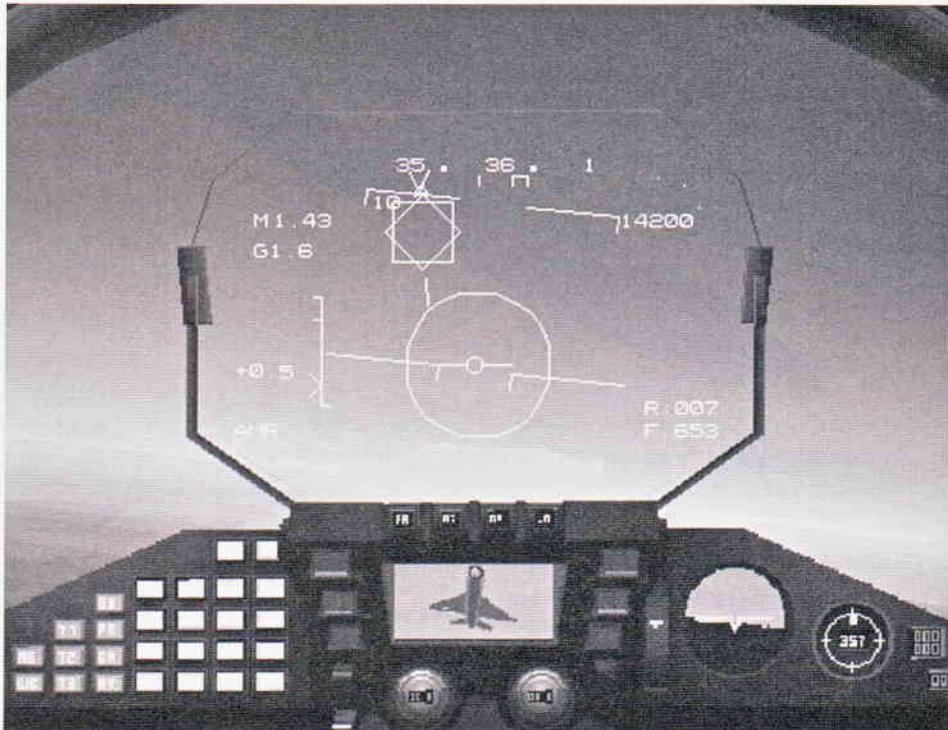
AIR-TO-AIR WEAPONS

AIM-120 AMRAAM

The primary air to air missile carried by the EF2000 will be AMRAAM for general engagement, although ASRAAM is favored for close range. It is targeted by locking the radar on a tracked enemy. Once fired, the missile then uses on board inertial guidance with command updates from the launch aircraft. In its final phase it switches on the active radar seeker. As the radar only switches on in the terminal phase, the missile is less susceptible to any jamming, it also makes the missile hard to detect until it is too late.



AIM-120 AMRAAM



AMRAAM tracking

AIR-TO-AIR WEAPONS

S-225 LRAAM



DEVELOPMENT OF THE S-225

In 1991 development started on a new breed of air to air missile. The missile would have stealth characteristics and new guidance systems, and it would be compatible with the emerging technology found in the advanced tactical fighter aircraft being developed by European and American companies.

Originally based on the Skyflash, the new missile has neither mid-body controls or tail fins, but uses tail control surfaces instead. The smoky solid rocket propellant was replaced with a new smokeless motor which lets the missile alternately propel itself then coast without power, in order to boost range and improve stealth. The motor reserves enough power to

deliver an optimal terminal velocity with which to attack the target. For the long range role, the missile was given a mid-course guidance data link, enabling range to be increased to around 100 km.

S225 LRAAM	
Length m	3.68
Diameter mm	203
Wingspan m	0.56
Weight kg	160
Warhead kg	30
Fuse	Active laser
Guidance	Data Link, active radar
Propulsion	Dual Rocket
Range Km	up to 80
Range miles	up to 50

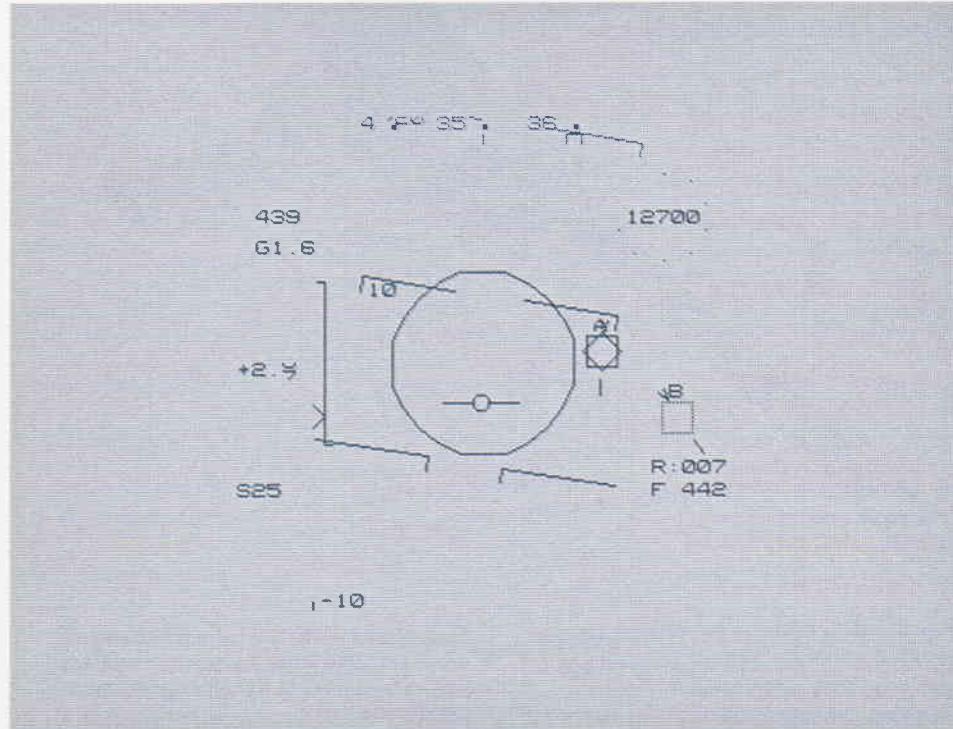
Performance Table

AIR-TO-AIR WEAPONS

S-225 LRAAM

Targeting of the long-range 'stealth' missile is identical to the ASRAAM system except that only targets within the HUD may be locked.

It is better to engage at long distance than to enter a dogfight, at the risk of giving away your position. The stealthy attributes of this missile, however, go a long way in keeping you location hidden. This weapon may also be used at a similar range to AMRAAM, although the poor availability of the weapon would make AMRAAM the preferred choice.



Multiple target tracking using the S-225

AIR-TO-AIR WEAPONS

BK-27mm CANNON



DEVELOPMENT OF THE BK 27MM CANNON

Development of the BK-27mm cannon was started in 1971 by the Mauser-Werke of Germany, although the gun borrows technology from other Mauser projects, some of which date

back to the forties. The cannon first entered service in 1979 in the Panavia Tornado, and was later adapted to a pod design for the German Alphajet.

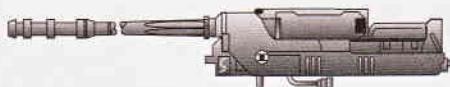
The BK-27mm cannon is based on the same principle as the revolver, and uses gas drive for the gun feed and electrical power for the firing mechanism. This gives a full rate of fire from the first round onwards. The single barrel is easily interchangeable and the five chamber drum can be fed from either left or right. One more advantage of the system is its ability to be mounted in almost any position, giving full flexibility to the system. The EF2000 has a single BK-27mm cannon mounted in the starboard wing root.

The ammunition used in the EF2000 is a high explosive round mostly suited to aerial warfare. Although there is an air-to-ground firing mode, CR-V7 rockets would be favored over the cannon.

AIR-TO-AIR WEAPONS

BK-27mm CANNON

The rate of fire is set to 1700 rounds per minute. With a total ammunition store of 1760 rounds it will not take long to deplete the guns supply. Short cannon bursts are more effective overall than keeping your finger on the trigger until the target is destroyed. In addition, it is advisable to open fire only when the target is well within range, and to avoid firing at violently manoeuvring targets unless you are depending on autofire. This triggers a short burst whenever the predictor sight crosses through the centre of the track box.



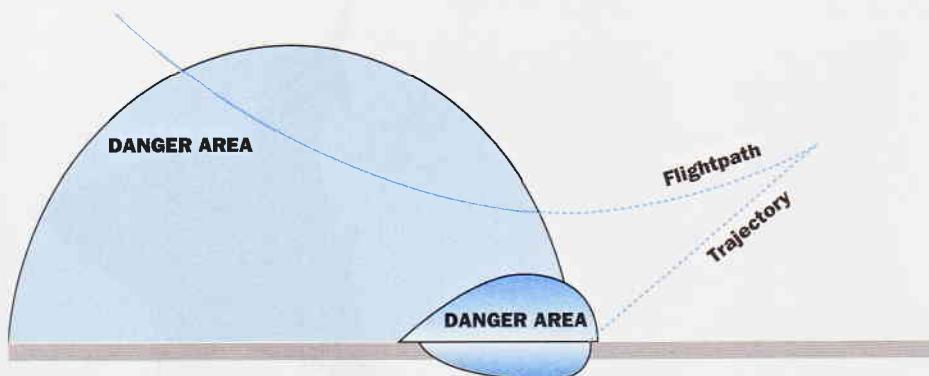
BK-27mm Cannon

BK-27mm Cannon	
Length m	2.31
Calibre mm	27
Weight kg	100
Ammunition	High explosive rounds
Guidance	HUD predictor

Performance Table



The predictor sight



The cannon may also be used for AG attacks

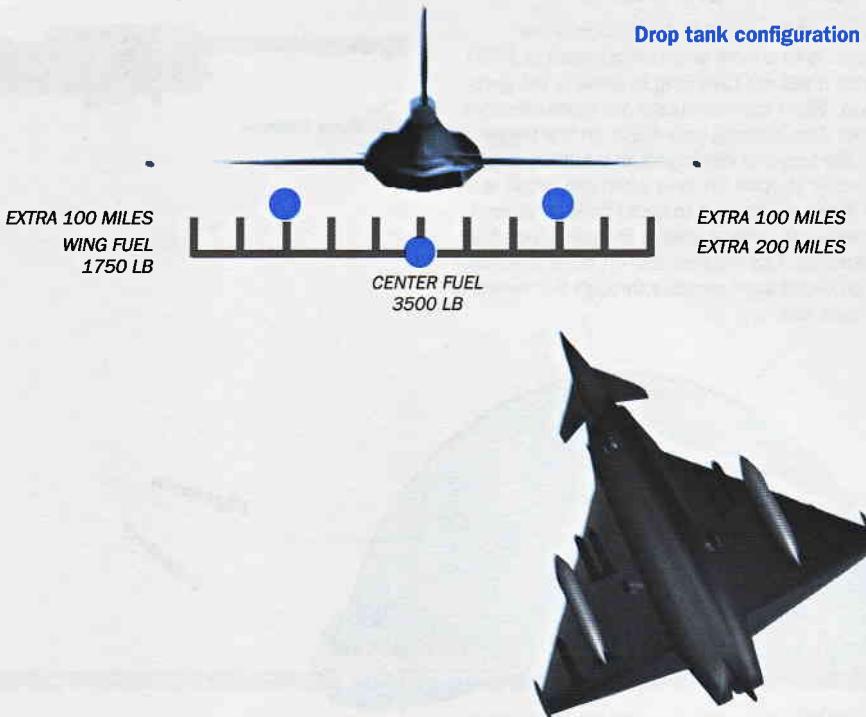
AIR-TO-AIR WEAPONS

DROP-TANKS

Drop-tanks were first used extensively during the Second World War. The advantage of being able to jettison the tanks was increased performance in dogfighting. It was found that significant increases in range gave the aircraft much greater flexibility without the need to increase their overall size so that they still retained their agility and speed.

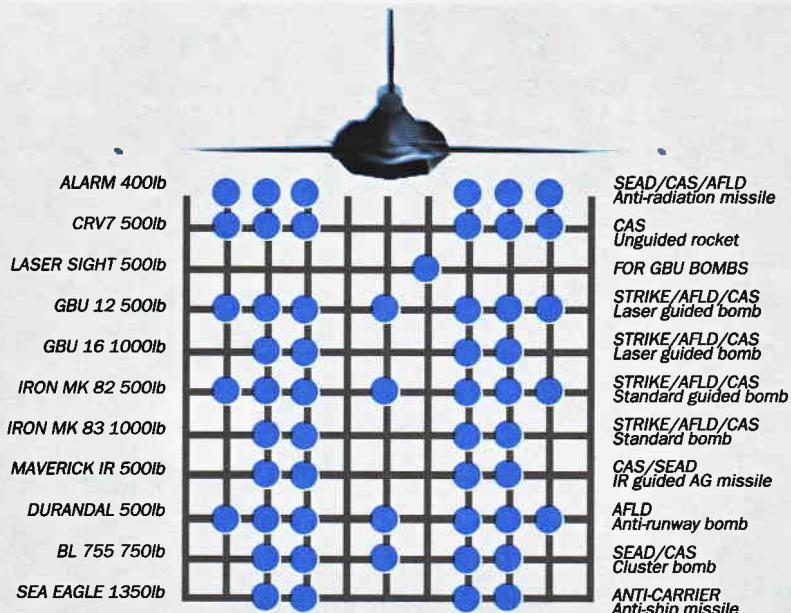
Today the increased use of mid-air refuelers gives the modern fighter almost unlimited range. This in conjunction with drop-tanks means that the aircraft can give more of its space over to other requirements such as improved engines or greater weapons payloads.

EF2000 has three 'wet' points for drop-tanks: one under the fuselage or two smaller tanks under the wings. The large center-line tank can hold 3500 kg of fuel, with the underwing tanks each holding half this amount. Put all three tanks on the EF2000 and you almost double the fuel on board. This enables the EF2000 to take off with heavy weapons loading without adversely affecting the range. Typical range increases would be in the order of 200 miles for the large drop-tank or two smaller drop-tanks, giving a total of up to 400 miles if all three are fitted.



EF2000 WEAPONS

INTRODUCTION TO AIR-TO-GROUND WEAPONS



EF2000 AG weapons loading

EuroFighter was designed from the start as a multi-role aircraft, which meant it must also perform superbly in the air-to-ground role. It has therefore been designed to carry a wide arsenal of AG ordnance, including the latest 'smart' weapons.

SMART BOMBS

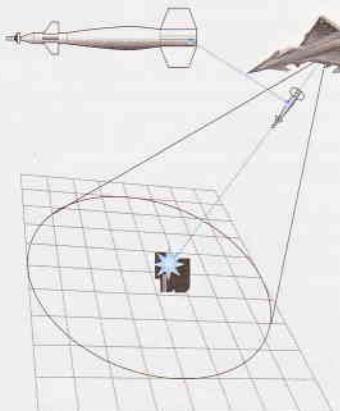
Media coverage of the Gulf war in 1991 first brought the image of 'smart' weapons to the attention of the general public. These awesome devices could be launched from an airplane or ship and travel miles and then hit a target with an accuracy measured in just a few feet or meters. The goal was maximum effectiveness with minimum collateral damage, although experience showed that even the best technology can still go tragically wrong.

Smart weapons have been developed over many years, going back to the fifties and sixties, but it was the first time they had been tested so openly. The success of the weapons was easy to see, as the public was bombarded with images of bridges and bunkers being destroyed, cruise missiles following roads into Baghdad and penetrating the window of a military headquarters, and Scud rocket launchers being detected and destroyed at night.

EF2000 WEAPONS

INTRODUCTION TO AIR-TO-GROUND WEAPONS

These weapons allow a new approach to attacking targets. For instance, a hardened aircraft shelter is tough to crack with anything but a direct hit, or a near miss with a very large bomb. The application of the laser made precision bombing possible, by illuminating the target and allowing the bomb to home in to the reflected light. Now pilots could put a relatively small bomb down ventilation shafts, making the destruction of reinforced targets a clinical task.



Laser guided bomb



TIALD for aiming LGB's

EF2000 WEAPONS

INTRODUCTION TO AIR-TO-GROUND WEAPONS

CONVENTIONAL BOMBS

Computers have made direct hits more likely with conventional weapons. They have the processing power it takes to perform complex mathematical models for ballistics and aerodynamics, which are used to predict the fall line of unguided bombs. To help pilots get their bombs on-target, modern attack aircraft feature computerized navigational attack systems, which calculate the effect of wind, airspeed, air pressure, g-loading, bank angle, altitude, rate of descent and other factors on the ballistic trajectory of bombs.

Different attack profiles also create their own problems. At low levels, strong air turbulence may upset accuracy and may also result in bombs not having enough time to arm themselves properly. This happened with Argentinian bombs during the Falklands War. Retard mechanisms are meant to solve this problem. At medium or high altitudes the margin of error obviously increases dramatically. The problems are compounded by the pilot trying to manoeuvre his aircraft to avoid enemy anti-aircraft fire or surface-to-air missiles (SAM).

AIR-TO-GROUND MISSILES

Image recognition, or pattern recognition, is another application of computers for missile guidance. Target shapes are identified by the system, and the location data is transferred to the missile, which then guides itself to the destination. Some Mavericks are guided this way, and they provide the pilot with a high degree of flexibility in targeting. However, it is worth noting that in the Gulf War, pilots often fired at previously destroyed targets, underlining the error factor.

SPECIAL BOMBS

Every target represents a different problem, which is why there are so many different types of weapons available. Two special problems are hitting widely dispersed armored vehicles in open terrain from a fast jet, and destroying enemy runways. As a result, the cluster bomb and Durandal were invented.

The cluster weapon is the bombing equivalent of a shotgun, and is a devastating weapon when used on infantry and soft-skinned vehicles. Cluster bombs scatter smaller sub-munitions or

bomblets, and each sub-munition can be tailored to specific targets; for example, anti-personnel or anti-armor.

Hitting a runway is also a difficult proposition, which is why it's important to make sure that when you hit the target, it stays damaged for the maximum duration. Durandal does just this, by powering itself through the tarmac with the help of a rocket motor, and exploding below the surface to make a huge cavity that's hard to repair.

CHOOSING THE RIGHT WEAPON

The choice of weapon is dependent on the target to be attacked. In most cases there may be a few weapons you could use, but there is usually one that is just right for the job. If the right weapon is not available, it may be better to wait rather than rush in with an unsuitable load. In the case of SAM launchers this would lead to certain death.

In EF2000, several pre-determined packages have been stored in the arming screen for different types of mission. Although you may have personal preferences, these packages represent a realistic choice of the weapons officer.

EF2000 WEAPONS

INTRODUCTION TO AIR-TO-GROUND WEAPONS

Target	First choice weapon	Second choice weapon
Ships	Sea Eagle	Maverick or LGB
Large building	LGB	MK-83
Medium building	LGB	MK-83
Small building	LGB	MK-82
Bridge	LGB	Maverick
Runway	Durandal	MK-83
Hangar	LGB	LGB
Bunker	LGB	LGB
POL tank	LGB	MK-82
SAM launcher	ALARM	BL-755 Cluster Bomb
Tank	Maverick	BL-755 Cluster Bomb
Personnel carrier	Maverick	CRV-7
SCUD launcher	LGB, Maverick	CRV-7
Personnel	BL-755 Cluster Bomb	CRV-7

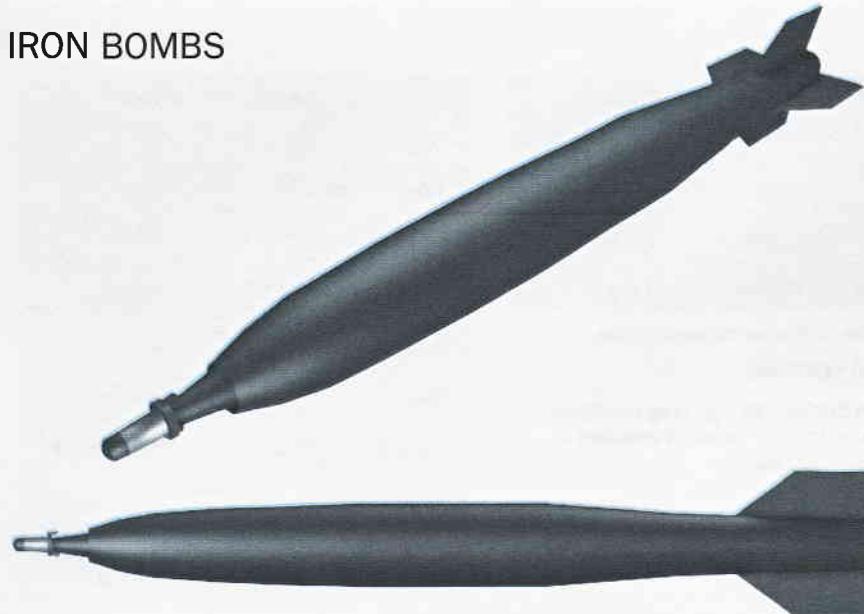
Air-to-ground weapon selection chart

Weapon	Section to look in
Iron bombs	HUD
Laser guided bombs	TIALD
Durandals	HUD
Cluster bombs	HUD
Sea Eagle	ECR-90 RADAR
ALARM anti-radiation missiles	HUD
Maverick missiles	MAVERICK AIMING
CRV-7 unguided rockets	HUD
Cannon	HUD

Aiming AG weapons - where to look

AIR-TO-GROUND WEAPONS

IRON BOMBS



DEVELOPMENT OF THE MK-80 SERIES

The development of the low drag general purpose bomb began in the fifties, and the Mk 80 Series has now become the standard adopted by many countries. The four basic types of bomb are very similar in design, differing only

in size and weight. The smallest is the Mk-81 which weighs 250lb. Each bomb is constructed in the same way; a steel body with cruciform tail and tempered steel nose.

Little has changed since the bomb was first designed except for modifications to fusing and

filling. New delivery techniques have been incorporated into the design such as retardation devices. The weapon is also produced for the Paveway series of laser guided bombs, losing its fins in favor of an upgrade kit.

Fusing for the bomb depends on its usage but the basic types for these bombs are: impact fuses, which detonate on contact with the target; impact with delay, which explode a short time after contact with the target causing cratering and structural damage; and airburst fuse, which detonates the bomb before it has hit a target causing collateral damage to the general area.

APPLICATION

Acceptable Targets:	Buildings, depots, oil facilities on land
Poor Targets:	Almost anything else
Effective Range:	Nil
Max Speed:	Free-fall bomb
Attack Technique:	Level bombing or dive bombing
Level Release:	3,000'
Dive Release:	Dive from 8,000', release at 3,000'

AIR-TO-GROUND WEAPONS

IRON BOMBS



The Mk 80 bombs have standard HE (High Explosive) warheads, which can be easily modified to improve performance in different attack scenarios. Pilots who used the bombs in the Gulf War stated that the HE was devastating if a direct hit was scored on tanks, armored vehicles, dug-in artillery or buildings. A near miss from a Mk.84 2000lb bomb was also reported to be almost sure of knocking out an armored vehicle.

Bomb type	LGB	Free-fall	MK-82	MK-83
2,000 ft	5 nm	0.5 nm	Length m	2.21
5,000 ft	7 nm	1.5 nm	Diameter mm	273
10,000 ft	10 nm	2.5 nm	Wingspan m	0.38
20,000 ft	15 nm	3.5 nm	Weight kg	241
Typical ranges at different delivery altitudes			Warhead kg	89
HIGH DRAG VERSIONS			Fuse	Various
Available in EF2000 are high drag versions of the bombs, which may be safely released at altitudes of around 500 ft.			Guidance	HUD predictor
			Propulsion	Freefall
			Range	Dependent on launch
			Dependent on launch	

Performance Table

AIR-TO-GROUND WEAPONS

GUIDED BOMB UNIT PAVEWAY II



DEVELOPMENT OF THE PAVEWAY SERIES

Although it is generally assumed that the Paveway bombs are a recent invention, they have actually been around since the mid sixties. Indeed the first production models saw service in Vietnam in 1968. The success of the weapon

led to further development in the field of modular design, enabling the guidance and tail units to be used as a kit with several types of standard free-fall bombs.

The Paveway II series has much of the technology of the earlier bombs with the addition

of new folding rear wings, which make the bomb compatible with many types of aircraft. Other modifications include the guidance unit, which now has plastic lenses, integrated circuitry and improved electronics. Manoeuvrability has also been dramatically improved.

Paveway II bombs are classed into several groups dependent on the bomb unit fitted with the kit. GBU-10 is based on the MK-84 2000 lb GP bomb; GBU-12 is based on the MK-82 500 lb bomb; and GBU-16 is based on the MK-83 1000 lb bomb.

APPLICATION

Acceptable Targets:	Almost any stationary target
Poor Targets:	Ships or moving vehicles
Effective Range:	See table
Max Speed:	Glide bomb
Attack Technique:	Toss bombing or level bombing
Toss Release:	500' and climb
Level Release:	15,000 or 5,000 ft depending upon target

AIR-TO-GROUND WEAPONS

GBU PAVEWAY II

	GBU12	GBU16
Length m	3.33	3.68
Diameter mm	273	350
Wingspan m	1.68	1.34
Weight kg	225	454
Warhead kg	89	202
Fuse	Impact	Impact
Guidance	Laser	Laser
Propulsion	Freefall	Freefall
Range	See table	See table

Performance Table

The EF2000 carries the GBU12 and GBU16 as standard. The TIALD Thermal Imaging And Laser Designation system is probably the most accurate bombing system in the world for single-seat and twin-seat aircraft. Originally fitted to the two-seat Tornado and now single-seat Jaguars, TIALD feeds the pilot with all the data needed to make the correct attack run, illuminates the target, and calculates the correct release point for the weapon. On release, the weapon derives its power from a small on-board generator, which will drive the control surfaces for just over one minute. For this reason, the delivery aircraft must always fly within one minute from the target. See the section on TIALD in EF2000 AVIONICS for more details on the delivery system.

It is claimed that approximately 90 per cent of laser-guided bombs landed on target during the Gulf War. However, contrary to popular belief, it requires great skill and good weather to ensure a bullseye. If cloud obscures the target, then the laser cannot see it and the lock will break, causing the bomb to free fall ballistically, consequently missing the target and possibly causing collateral damage.

It usually takes at least two minutes for aircraft flying at medium to high altitudes to acquire and then designate targets. While the bomb is dropping to the target the pilot has to keep the target illuminated - a procedure requires great skill, and which makes the aircraft vulnerable to SAMs and other threats.

NOTE: on some missions specially trained forces will be lasing targets from the ground, which means it will be possible to acquire targets and release weapons by looking through the HUD and steering towards the TIALD lock-box.

For more information on using the TIALD, see the TIALD section in AVIONICS.

Bomb type	LGB	Free-fall
2,000 ft	5 nm	0.5 nm
5,000 ft	7 nm	1.5 nm
10,000 ft	10 nm	2.5 nm
20,000 ft	15 nm	3.5 nm

Typical ranges at different delivery altitudes

AIR-TO-GROUND WEAPONS

CRV-7 ROCKET



DEVELOPMENT OF THE CRV-7 ROCKET

The CRV-7 rocket is Canadian in origin, and is a derivative of the unguided rockets first used in World War 2. Its principle application is ground-attack, and it provides a withering stream of destructive power which is as terrifying for those on the ground as it is deadly. It has a diameter of 70 mm and has been developed with a selection of warheads. Also built into the design

is the ability to use differing propellants, giving the rocket advantage in aeroplane and helicopter firing situations.

The choice of warheads includes High Explosives, armor piercing, incendiary, penetrator, flechette, anti-tank and phosphorous markers. The range of these rockets can be up to 6 km and they travel at up to Mach 4 plus

the launch speed of the aircraft. Impact speed is as high as 1250 meters per second. This makes the rocket a kinetic energy weapon, for example with the flechette anti-tank warhead. Flechettes are sharp darts made out of a tungsten alloy which makes them extremely hard. When the rocket is launched, five flechettes break free from the housing and disperse slightly before hitting the target. The energy of the impact coupled with the hardness of the flechette drives it straight through the armor, creating shrapnel which bounces around inside the tank. The penetrator warhead works on the same principle, letting the kinetic energy of the rocket drive a shaped penetrating rod through armor before detonating a high explosive incendiary device.

These weapons employ the same sight as the ground cannon, but do far more damage to ground targets. The number of rockets released depends on whether the player holds the fire button for continuous release, or simply clicks the trigger once for single rocket fire.

Because these weapons are more capable of destroying armored targets than the cannon,

AIR-TO-GROUND WEAPONS

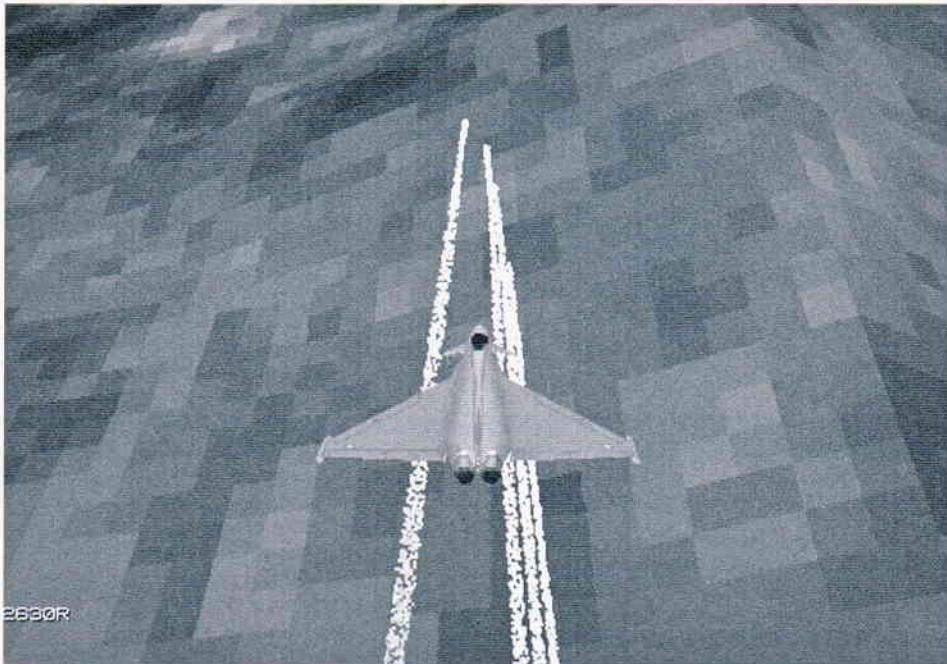
CRV-7 ROCKET

they should be chosen for the close air support missions. In case of emergencies, the cannon can be used though it will require greater skill to destroy the targets.

CRV-7 ROCKET

Length m	1.5
Diameter mm	70
Warhead kg	Various
Fuse	Various
Guidance	HUD predictor
Propulsion	Solid propellant
Range km	Up to 6
Range miles	Up to 4

Performance Table



EF2000 firing the CRV-7

AIR-TO-GROUND WEAPONS

AGM-65 SERIES MAVERICK



DEVELOPMENT OF THE AGM-65 SERIES

Guided missiles give attack aircraft the capability to put ordnance on the target without having to make dangerous bomb runs over or near to the target. Many guided missiles are specially designed for particular missions, such as destroying tanks, ships or radars.

Development of the Maverick started in the mid sixties with the first missile going into service in 1972. It saw service during the Gulf conflict, scoring an 80 percent hit rate. The USAF fired over 5,000 Mavericks, mainly at Iraqi tanks. There are four main versions, but the TV or electro-optical (EO) and imaging infra-red (IIR)

versions are the most widely used and the latter is featured in EF2000. The TV version is aimed by the pilot who locates targets via a television camera in the missile's nose. The IIR version has superior night performance because its infra-red sensors show tanks as 'hot-spots'.

The quoted range of the Maverick is up to 25 miles (40 km) if released at altitude by a fast flying aircraft. However, experience shows that you need to be within 5 miles to pick up and identify your target. This is not such a problem for the slow-flying and armored A-10s, but it may be too dangerous for the EF2000. For this reason, you will need to practice long-range targeting.

Maverick is ideal for taking out armored vehicles, but can also be used as a precision weapon against targets such as parked aircraft, control towers, radar sites, SAM sites and communication centers. It is less useful against hardened targets.

AIR-TO-GROUND WEAPONS

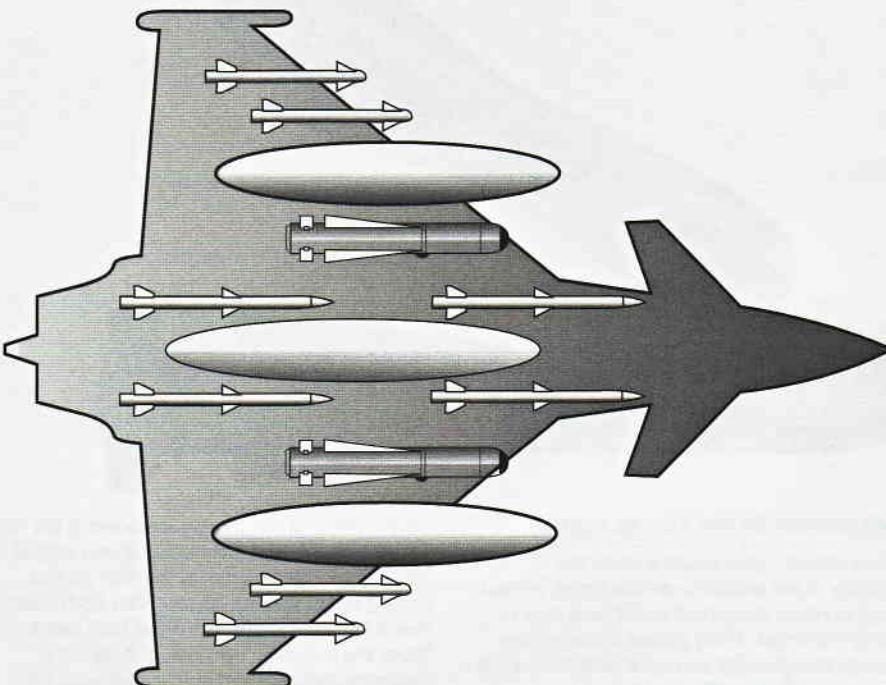
AGM-65 SERIES MAVERICK

	AGM-65B	AGM-65D
Length m	2.49	2.49
Diameter mm	305	305
Wingspan m	0.72	0.72
Weight kg	210	220
Warhead kg	57.4	57.4
Fuse	Impact	Impact
Guidance	TV	IIR
Propulsion	Solid propellant	Solid propellant
Range km	3	22
Range miles	2	13

Performance Table



AGM-65 Maverick



Air-to-Ground missile configuration

AIR-TO-GROUND WEAPONS

DURANDAL ANTI-RUNWAY BOMB



DEVELOPMENT OF THE DURANDAL

Designed in the early seventies, the Durandal was the result of the French airforce's requirement for a low level runway disablement weapon. The weapon had to penetrate the runway and explode beneath it to cause cratering and disruption to the area around the crater.

Durandal achieves its objectives using a unique delivery system. The missile is dropped in a low pass over the runway, it is then slowed by parachute to the correct delivery angle at which point a rocket motor ignites. The acceleration is enough to drive the specially shaped penetrating head through up to 400 mm of reinforced concrete. After a pre-programmed delay the

missile explodes causing the paving slabs nearby to be disturbed.

The nature of the weapon means that repair work can be hampered by unexploded Durandals as there is no way of telling when they will detonate. The damage a Durandal causes is also extensive and requires more than just earth-moving equipment to fill in the holes; all the paving slabs around the crater will need repairing. This makes the runway unusable for considerable lengths of time.

APPLICATION

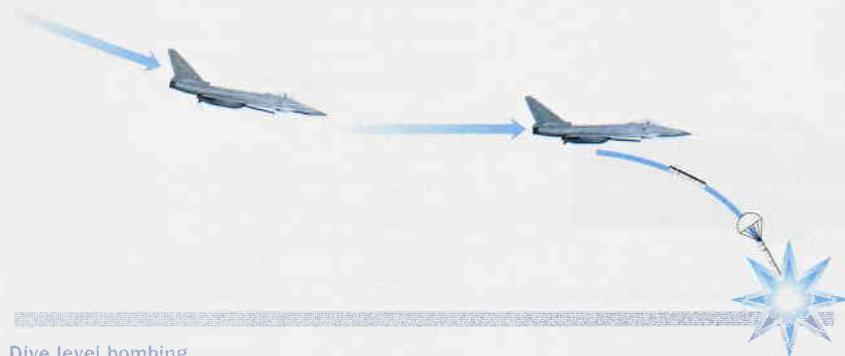
Optimum Targets:	Runways
Poor Targets:	Bridges
Effective Range:	Nil
Max. Speed:	Retarded bomb
Attack Technique:	Low-altitude level bombing
Min Release Altitude:	500'

AIR-TO-GROUND WEAPONS

DURANDAL ANTI-RUNWAY BOMB



Durandal Anti-runway bomb



Dive level bombing

DURANDAL	
Length m	2.49
Diameter mm	223
Wingspan m	0.42
Weight kg	185
Warhead kg	15
Fuse	Delay
Guidance	HUD predictor
Propulsion	Solid propellant
Range km	< 1
Range miles	<0.5

Performance Table

AIR-TO-GROUND WEAPONS

BL-755 CLUSTER BOMB



DEVELOPMENT OF THE BL-755

The BL-755 is a British designed cluster bomb which was originally developed in the sixties. A design goal for the weapon was to distribute a large number of sub-munitions over a wide area. This led to the development of a gas ejection system which, unlike earlier types, did not rely

on centrifugal forces to eject the weapon. This gave the advantage of controllable delivery; each bomblet is ejected at a different velocity giving an even spread of sub-munitions approximately the size of a football pitch.

The BL 755 cluster bomb is carried by the

EF2000, and once it falls to a pre-set altitude, it opens scattering hundreds of sub-munitions. Each submunition is designed to penetrate the weak top armor of a tank using a shaped charge. In addition, each bomblet scatters deadly red-hot shrapnel which is very effective in the anti personnel role.

In the Persian Gulf War, cluster bombs were used on a large scale. The results were devastating to the Iraqis, who christened the weapon 'Black Rain'. Around 26,000 Rockeye II cluster bombs were used by US forces in the conflict.

APPLICATION

Optimum Targets:	Grounded planes, missile sites, oil facilities
Poor Targets:	Bridges
Effective Range:	Nil
Max. Speed:	Retarded bomb
Attack Technique:	Low-altitude level bombing
Min Release Alt:	100'

AIR-TO-GROUND WEAPONS

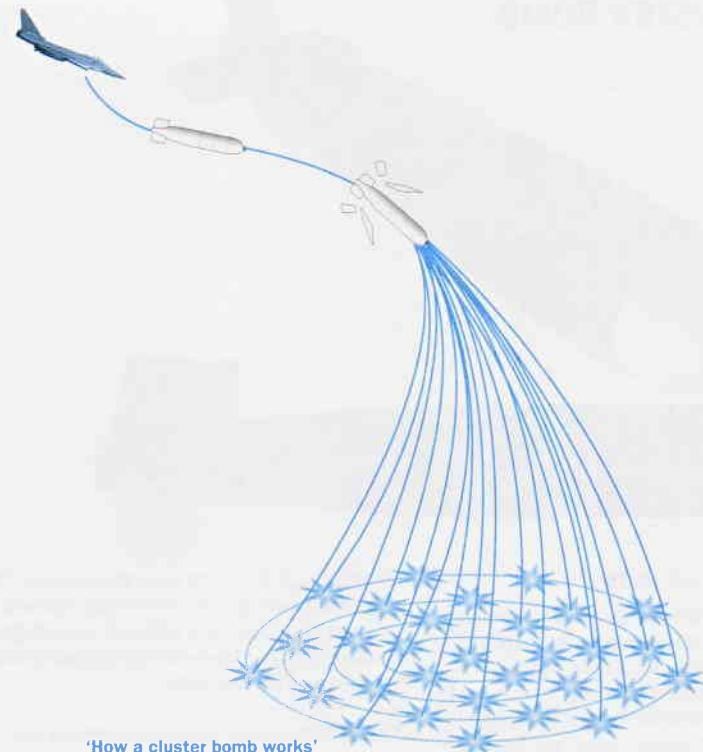
BL-755 CLUSTER BOMB

As often happens in war, pilots quickly found new applications for their weapons. For example, pilots found them ideal for destroying SAM and radar sites, which could not be attacked with anti-radiation missiles. Iraqi patrol boats and naval bases were also found to be suitable targets. In EF2000, you will find this is the only weapon to use against widely dispersed ground targets.

BL-755

Length m	2.45
Diameter mm	419
Wingspan m	0.71
Weight kg	277
Warhead	147 bomblets
Fuse	Timed
Guidance	HUD predictor

Performance Table



'How a cluster bomb works'

AIR-TO-GROUND WEAPONS

ALARM ANTI-RADIATION MISSILE



DEVELOPMENT OF THE ALARM

Anti-radiation missiles were developed during the Vietnam war as a way to strike back at SAM defenses. They work by homing in on the radar emissions from SAM guidance systems, and are extremely effective. To counter them, SAM operators began the tactic of switching off their

radars until the attacking aircraft has passed, then switching on again and firing. Later model anti-radiation missiles have been designed to counter this tactic, ALARM being one of the best examples.

The ALARM, or Air Launched Anti-Radiation

Missile, was designed as a stand off multimode anti- radiation weapon that could be fired before the aircraft could get within range of the target's aerial defenses. SAMs like the SA-6, the SA-N-9 and the SA-N-4 have ranges to about 15-20nm. ALARM can be launched from outside this range, it will then ascend to 40,000 feet from where it will deploy a parachute and descend slowly, using its seeker to search for any radiation source.

Once the target has been acquired, the missile releases the parachute and falls under gravity to the target. One other advantage with this system is that if the target shuts down before the missile has destroyed it, the missile remembers the location and will still hit the target.

ALARM also has several direct modes, the main one allowing the missile to be fired directly at the SAM once the emitter has been located. This is a very useful mode to use once the attacking aircraft is closing on the target, and there may be SAMs remaining that have not been destroyed by stand-off ALARMs.

AIR-TO-GROUND WEAPONS

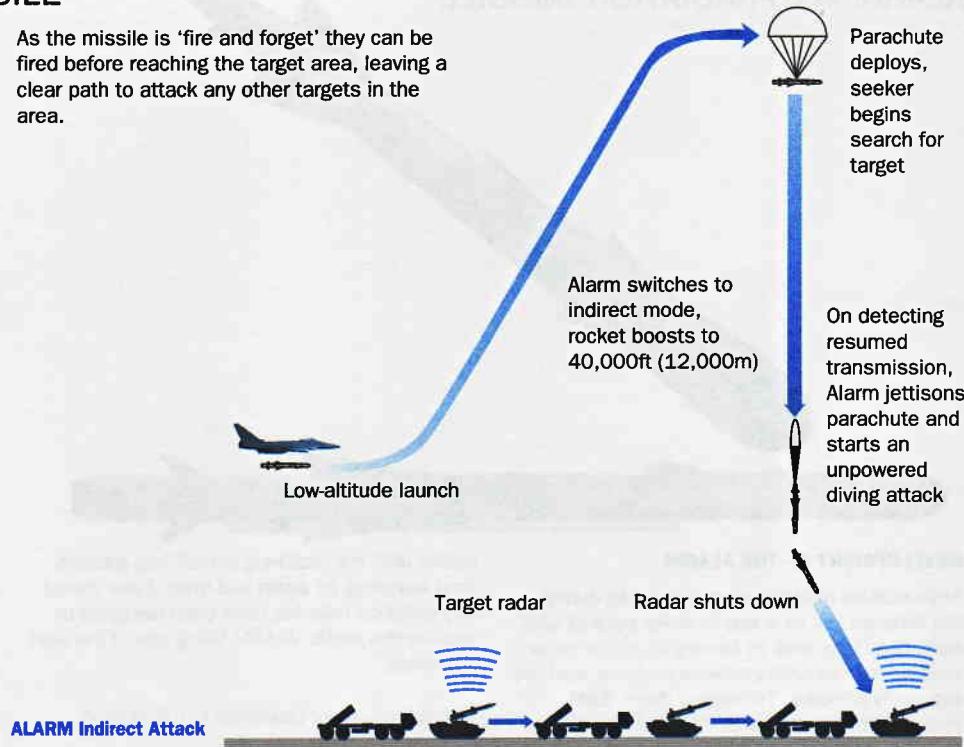
ALARM ANTI RADIATION MISSILE

The key factor in determining attack altitude is the prevalence of SA-6s and SA-4s around the target area. If there are many such weapons, a low-level attack could be the only kind possible. If there are SA-6s at the target itself, ALARM missiles should be carried and the radars attacked before the main strike force arrives. Fly in a flat formation for stand-off and low-level missions.

ALARM	
Length m	4.24
Diameter mm	224
Wingspan m	0.72
Weight kg	268
Warhead	HE
Fuse	Active laser
Guidance	Passive laser
Propulsion	Solid propellant
Range km	45
Range miles	28

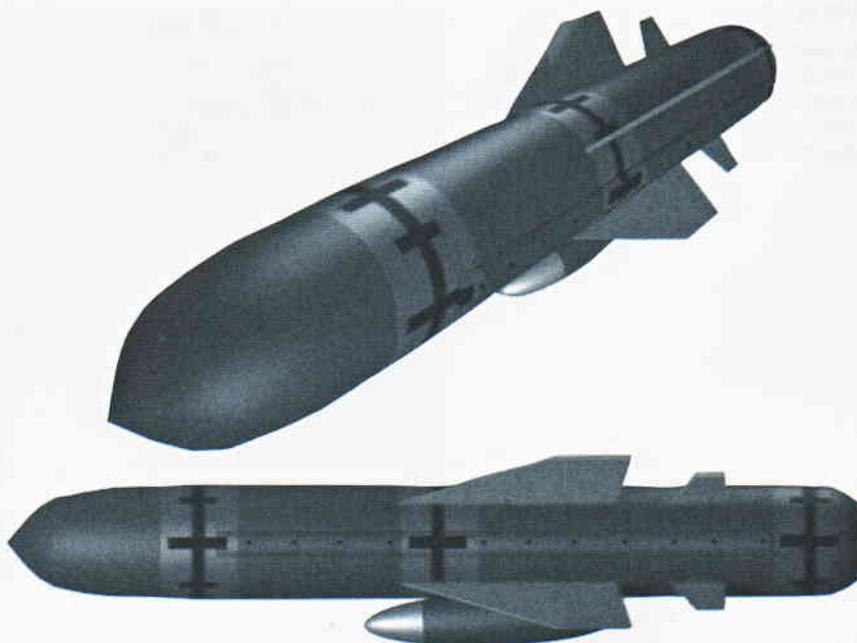
Performance Table

As the missile is 'fire and forget' they can be fired before reaching the target area, leaving a clear path to attack any other targets in the area.



AIR-TO-GROUND WEAPONS

SEA EAGLE ANTI-SHIP MISSILE



DEVELOPMENT OF THE SEA EAGLE

The range of Air-to-Surface Missiles is steadily being increased to give better stand-off capability and hence better protection for launch aircraft. In this area, naval weapons are some of the most advanced because of the great distances involved in maritime warfare. Compared to the cluttered land battlefield, the sea provides ships and aircraft with very little protection from surveillance systems such as radar or thermal imaging.

The Sea Eagle was developed in 1976, and was based on an earlier design of ASM. The difference was that the Sea Eagle had a turbofan engine, an active radar seeker and an altimeter, giving long distance sea-skimming ability. Sea Eagle approaches the target only a few feet above the waves to avoid detection by enemy radar and only illuminates the target with radar for confirmation of final guidance data. Computer data links also enable friendly surveillance aircraft to pass targeting intelligence to the missile in flight.

SAMs like the SA-6, the SA-N-9 and the SA-N-4 have ranges between 15 and 20 nm. The Sea

AIR-TO-GROUND WEAPONS

SEA EAGLE ANTI-SHIP MISSILE

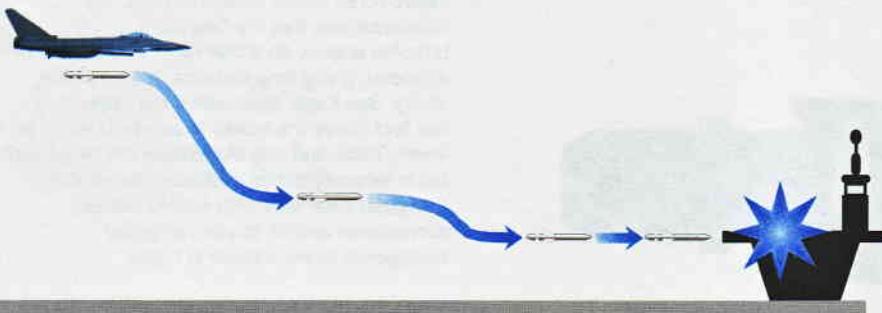
Eagle anti-ship missile can be launched from outside this range. With 50 nm ranges, the SA-N-6 and SA-4 SAMs come close to the Sea Eagle's maximum range of 70 nm. Best launch altitude is relevant to target acquisition. You must be at least 2,000 ft above sea level before the ECR-90 radar will detect targets at maximum Sea Eagle range. The best launch altitude is that at which you can detect the target at the maximum range of the weapon, which would be 2,000 ft for the 70 nm range of the Sea Eagle. Fly in a flat formation for stand-off and low-level missions.

TARGETING SEA EAGLE

When you select this weapon, a special radar mode is set-up on MFD 1. The radar now shows seaborne targets at ranges of up to 80 nm. This mode is also capable of identifying surface vessel types and displaying them on the MFD.

SEA EAGLE	
Length m	4.14
Diameter mm	400
Wingspan m	1.2
Weight kg	600
Warhead KG	230
Fuse	Delayed impact
Guidance	Inertial and active radar
Propulsion	Turbofan
Range km	110
Range miles	68

Performance Table



Typical stand-off delivery of Sea Eagle

RUSSIAN WEAPONS

WHAT THE OTHER SIDE WILL AIM AT YOU

The old Soviet Union had been developing its weapons for just as long as the Western powers, but up until a few years ago most information available was classified. Since the end of the Cold War however, the break-up of the Soviet Union has provided an opportunity for the emerging states to trade with the world in their own capacity. One of the results is that the information void surrounding the military has partly been filled. We can now estimate much more accurately how Russian weapons perform.

Most Russian weapons do the same job as their Western counterparts, and use similar technology.

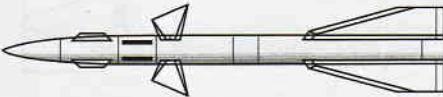
AA-8 APHID

This is an all-aspect infra-red dogfighting missile, and the AA-8B variant in EF2000 has a range of about 16km. In performance, it is comparable with some of the later model Sidewinder missiles.



AA-10 ALAMO

This missile comes in several forms. The most common is the medium range R27-R variant. Similar in operation to the AMRAAM the Alamo has semi-active radar only. It is also a larger missile with a bigger warhead. The range is similar to AMRAAM though the larger size would probably mean less manoeuvrability at higher speeds.



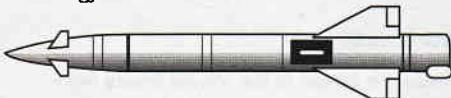
AA-11 ARCHER

This is a short range Infra-red missile with a similar performance to the ASRAAM. Roughly the same size but heavier than ASRAAM, the Archer has a complex system of vectored thrust and fin control giving very high manoeuvrability. It also has the ability to be targeted using a helmet mounted sight.



AS-7 KERRY

The AS-7 is a command guided air to surface missile which is controlled by the pilot of the launch aircraft. Relying on the missile flare the pilot steers the missile to the target. This means that the pilot will have to be able to see the target, eliminating the stand off advantage afforded by western air to ground missile technology.



AS-11 KILTER

This is a air to surface anti-radiation missile designed to destroy ground based radars. The KILTER does not have the same modes that ALARM has, but is a much bigger missile. The missile relies on passive radar to target and has a range of 70km.



RUSSIAN WEAPONS

WHAT THE OTHER SIDE WILL AIM AT YOU

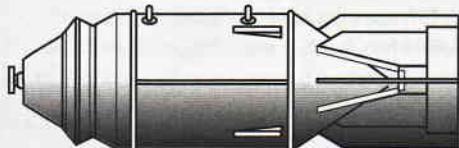
MOSKIT

This has a similar role to the SEA EAGLE although the MOSKIT is a very big missile indeed. If released from altitude the missile may have a range of 250 km using active and passive radar to home in on its target.



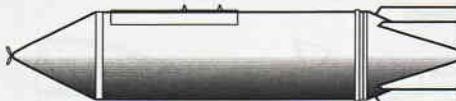
FAB BOMBS

These are similar to the MK 80 Series 'iron bombs'. They are basic free-fall bombs in several sizes. The design varies and some of the older designs may have been upgraded with newer filling materials and fuses.



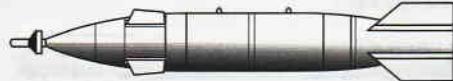
RBK 500 SPBE CLUSTER BOMB

This weapon is primarily an anti tank cluster bomb. It contains 14 Anti-tank "smart" warheads which are released after the weapon has been dropped. The warheads fall by parachute and are triggered by Infra-red sensors. A shaped charge is fired at the target, penetrating the vulnerable top armor.



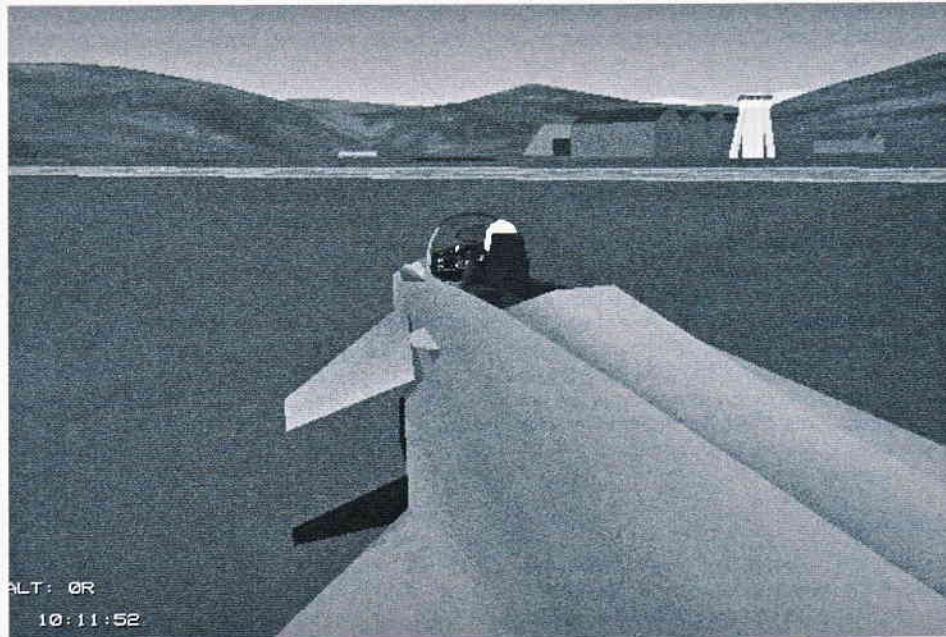
KAB-500L LASER GUIDED BOMB

Apart from the general wing layout, this weapon is very similar to the Paveway bomb in many ways. The laser designator is usually built into the launch aircraft as opposed to a pod-mounting. Accuracy details are not known but the 500 kg bomb unit has a large destructive area.



EF2000 FLIGHT TRAINING

GENERAL FLYING & NAVIGATION TIPS



TAXIING

To taxi from a dispersal point or the apron, fire up your engines and advance the throttle to 70% power. Steer using the < and > keys. Keep your ground-speed to below 20 knots by briefly applying your wheel brake from time to time (key W). Do not attempt to take right angle corners at speeds greater than 10 knots, or the plane may tip over.

TAKE-OFF

At the start of the flight you will find yourself at one end of a runway, with your engines off. Consider the following:

- If the runway is wet or icy, you require a longer take-off distance.
- If you have a full tank of fuel and a lot of stores, you require a longer take-off distance and a higher takeoff speed.
- If the wind is coming from your tail, you require a higher take-off ground speed.

EF2000 FLIGHT TRAINING

GENERAL FLYING & NAVIGATION TIPS

- If the wind is coming from in front, take-off ground speed will be lower. (It is always better to take-off into headwind.)
- If the wind is coming from either side, be careful.

You receive messages about taxiing and runway from the control tower. You will also hear communications that relate to changing radio frequencies after take-off. Normally, communication channels are pre-programmed on keys or 'studs' in the same way as modern car radios. Stud one is usually the frequency chosen for initial contact with the tower. Stud two is the regional frequency selected just after take-off, and stud three is the tactical frequency chosen when ten miles from the airfield.

Make sure wheel and airbrakes are off, then fire your engines. Increase throttle to 100 per cent, or apply afterburner for a quicker getaway. Remember, afterburner will consume large amounts of fuel, so cancel it at the earliest possible moment. As you move down the runway at increasing speed, maintain a straight-line. As the rotation speed of 120 knots is reached, pull

back on the stick and pitch the nose up 20 degrees or so. When you are flying, retract your landing gear with the 'G' key. Start to pull back on the joystick. Your angle of attack indicator should start to rise. Keep clear of the stall angle and check that you are not losing speed. You should soon see your Vertical Speed Indicator (VSI) start to rise as you become airborne.

Watch your VSI, and make sure you are gaining speed. If you aren't, increase thrust. If this doesn't work, pitch down a little, but make sure you don't start to lose altitude. Your speed should now be well clear of 200 knots, and your altitude should be over 1000 feet. Retract your undercarriage, and look ahead to avoid any hills or mountains. Now check the direction for your first waypoint. You are ready to begin the mission proper ...

CLIMBING

Climbing is a necessary but occasionally risky business. It takes a lot of energy to gain altitude, and when you are in the climb, you are not so maneuverable. It's best not to let your speed drop below 300 knots, otherwise even a simple break turn can take a little too long to

execute. In fact, if there are missiles about, don't climb at all. You cannot afford to lose the energy in these situations.

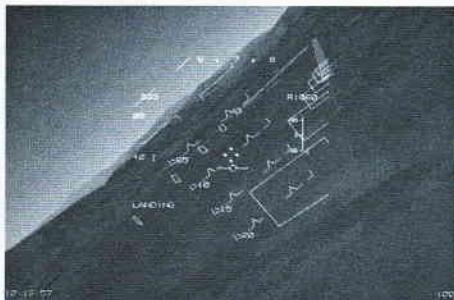
Climbing is made riskier still by a heavy load. In very dangerous situations you may have to dump all your air-to-ground stores (ALT J) in order to recover enough maneuverability. Better live to fight another day than try and beat the odds.

When climbing, you may lose sight of your air or ground target. The answer is simply to roll over on your back and keep climbing. Now you're looking out the top of the canopy.

EF2000 FLIGHT TRAINING

GENERAL FLYING & NAVIGATION TIPS

LANDING TIPS



Landing in any plane is a tricky business. You should learn how to execute a fully manual landing, because you may have a crippled plane to put on the deck. However, the autothrottle is a tremendous help for landing approaches. Set this to 150 knots and activate it during descent.

Fly at 10,000 feet to within 25 miles of the airfield. Dump any excess stores by pressing ALT 'J'. Press I to activate ILS and the Command Flight Path Display, which shows a virtual corridor in the sky extending from the runway. Head for the nearest box and align yourself so

that you are flying down the corridor. Keep a close eye on your airspeed, and make sure that your velocity vector does not drop below the CFPD boxes. With skill, you should arrive on the runway at an ideal velocity and rate of decent. Cut the autothrottle just before touchdown, so you can drop the RPM quickly.

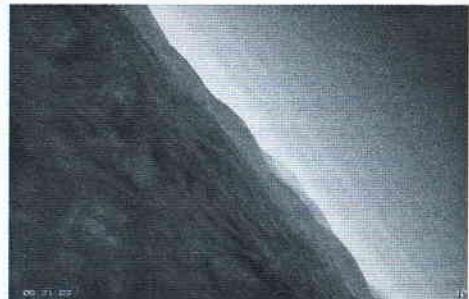
When landing without CFPD assistance, try to keep your velocity vector on the end of the runway. Remember, in an approach you use throttle to adjust altitude, and pitch to adjust speed.

HANDLING A DAMAGED PLANE

EF2000 simulates damage to your aeroplane, making it difficult to fly and land. Although the fly-by-wire system will do its best to compensate for damage, the aircraft may oscillate in the worst cases. If this happens, reduce your airspeed. It is possible to get an unstable plane down on the runway, but this requires you to use stick to counter the movements. In all emergency cases, get rid of all weapons as quickly as possible, because you need all the power you can get plus minimum drag.

Check the MFD to see what critical systems have been damaged. For instance, if it's your landing gear, then there's no option but to eject or try a belly landing - just make sure you're over friendly territory when you go. If you lose weapons control and radar, you can't fight but you can still navigate home. Drop down low and use the map to steer yourself home.

FLYING AT NIGHT



The EF2000 was designed as a night bird. However, night flying has its problems. Pilots have died simply because they became spatially disoriented (they didn't know which way up they

EF2000 FLIGHT TRAINING

GENERAL FLYING & NAVIGATION TIPS

were). For this reason, EF2000 pilots are equipped with the latest Night Vision (NV) image enhancers. This works by detecting the photons in available light, and amplifying their brightness to produce the characteristic green NV image. Press the key 'V' to access this mode when flying at night-time.

LEVEL FLIGHT

To fly at constant altitude in a constant direction, your wings must be level. Check this by looking from the front of the cockpit to the horizon. If your wings are level, then the horizon will be flat. In addition, your velocity vector should be exactly in-line with the widest bar of the pitch ladder, which represents the horizon.

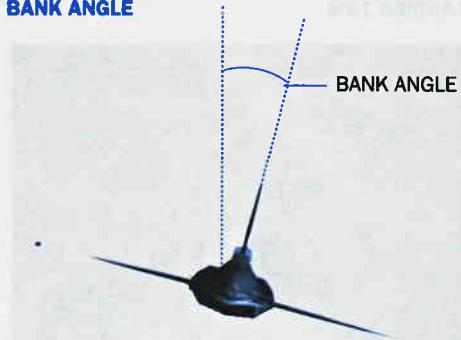
Next, ensure you are in air-to-ground mode (press backspace) and check your VSI. This is the scale in the top right corner of the Head-Up Display (HUD). The line extending up or down from the zero mark shows the change in altitude in feet per second. To fly at a constant height, you want this reading to be about zero. If it is negative, pull gently back on the stick. You will see the horizon appear to fall as the aircraft's nose rises. How fast this change occurs will

depend on how far you moved the joystick. If your VSI has a positive reading, then the same applies, but push the joystick forward.

TURNING

Although turning is only a horizontal change of direction, aeroplanes can only perform flat (unbanked) turns at low speeds. Normally, the rudders cannot be used simply to turn the aeroplane's nose towards a different heading. Aeroplanes have much more control in pitching (up-down rotation), and so turns are made by changing a yawing (sideways turning) motion into one involving pitch. This is done by banking the aircraft, that is, by raising one wing and lowering the other.

BANK ANGLE



AEROPLANE BANKING

To make a turn, you must bank the aircraft so that your desired direction is above your nose. So, push the joystick sideways for a second, then release it. The aircraft will bank and your nose should slowly begin to edge below the horizon as you yaw into the turn. Now, pull back on the joystick so as to keep your nose level. You are now executing a level turn. The more you bank, the faster you will be able to turn with a level nose.

EF2000 FLIGHT TRAINING

GENERAL FLYING & NAVIGATION TIPS

While turning, you are now using only part of your lift to keep the aircraft up. The rest of your lift is changing the direction of your aircraft's movement. Aerodynamic stability makes sure that your aircraft's nose does not stray too far from this direction at any time. Obviously, as only part of your lift is balancing out your weight, you need more lift in total to stay up. When lift is different to weight, you begin to feel the effect of the resulting acceleration. This is called G-force.

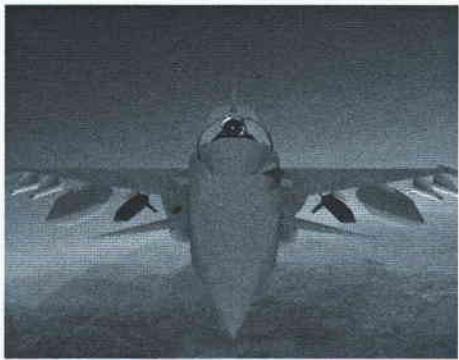
with a closing velocity of plus 50 knots and use your airbrake to modify your speed. You can also set the autothrottle to match the refueler's speed to make things easier. Apart from that, you will have to be good to succeed. If you are finding refueling too difficult in missions, simply press the event skip key (SHIFT S) to bypass it. You will be refueled automatically in the process.

REFUELING

As if landing was bad enough, we chose to put an equally difficult manoeuvre in the program: mid-air refueling. A lot of practice will be needed to perfect this, so go to the basic training section of the simulator. First, select 'To Join' from the 'Flight comms' menu. You will be told which hose to use. To help you navigate to the refueler, press SHIFT ' to bring up the refueling mode HUD. This will give you a track box on the refueler and show your closing velocity. Data on time to tanker and altitude are given in the lower right-hand side of the HUD. In the full cockpit view, press key ' to extend the refueling probe. The objective is simply to insert this into the basket and keep it there. Approach the tanker

EF2000 FLIGHT TRAINING

COPING WITH GRAVITY - THE BIG 'G'



Now you weigh 1,500 pounds!

If you really want to know just how much hard work is involved in flying a fighter plane, use the full 'G-LOC' (Gravity induced Loss Of Consciousness) option in the options menu. Not only does it black-out your vision in tight turns, but it is the first to simulate how breathing sounds at high Gs. Through your PC speakers it's painful to hear - but who said G forces are pleasant?

Turning hard loads the plane with extra G forces. One G is the norm, but a modern fighter can quickly reach the limit for a fit pilot... around nine Gs. That means your 160 lb body suddenly weighs around 1500 lbs. Ouch! What's more, your blood no longer wants to go upwards into your brain, but prefers to collect in your feet. This leads to swollen ankles, varicose veins and a black-out, which may last long enough for you to die at the hands of your enemy or hit the ground.

The opposite of black-out occurs when you suddenly drop your plane's nose and the blood rushes to your head. As a result, your eyelids close involuntarily, causing 'red-out'. It happens with just a few negative Gs, and in practice, you should never deliberately execute manoeuvres that cause it.

The EuroFighter is equipped with a 'G-limiter', which prevents the plane turning at more than 9 G. However, a breakthrough mechanism is incorporated which enables a fit pilot to exert 40 pounds of pressure on the stick to break through the G-limit. Experiments are currently under way to force air into the pilot in order to

increase his G tolerance. These 'pressure breathing' suits are able to raise G resistance to around 12 G or 13 G for short time, but pilots suffer from burst minor blood vessels throughout their body.

In contrast to plane and pilot, advanced AA missiles like ASRAAM will be able to pull 30 G plus manoeuvres, but don't worry too much. A missile pulling 30 G at Mach 4 can be easily out-turned by a plane pulling only 4 G.

EF2000 FLIGHT TRAINING

COPING WITH GRAVITY - THE BIG 'G'



Modern G-suit

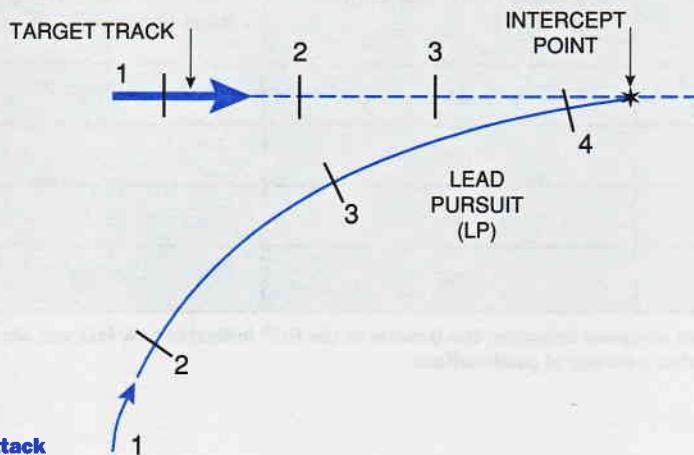
G-suits are designed to stop blood pooling in your feet or brain by squeezing key parts of the body tightly. In some modern fighters, the seat is also reclined so that the pilot is not sitting at right angles to the forces of acceleration that induce the G-effects.

SPEED IN KTS	SECONDS FOR A 180 DEGREE TURN AT 4G	SECONDS FOR A 180 DEGREE TURN AT 9G
400	16	7
450	18	8
500	20	9
MACH 1	26	12

Together with your air-speed indicator, the G-meter in the HUD indicates how fast you are turning. This table illustrates a variety of combinations.

AIR-TO-AIR COMBAT

WEAPON TACTICS



Target attack

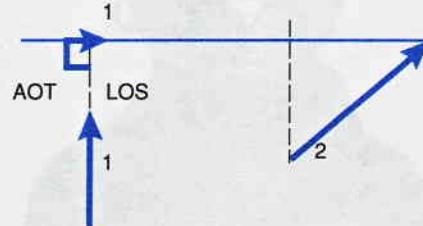
USING CANNON

The modern fighter pilot has an exceptional arsenal of weaponry for air to air combat. The weapon you use will determine the way you fly. Only by putting the aeroplane within aiming parameters will you be able to defeat your enemy. Only by denying your opponent these parameters will you be safe.

The oldest weapon, the cannon, is rarely used today, but is the last line of defense when the more complex missiles have (as is often the case) failed to eliminate the threat. Mounted close to the centre of mass for minimum impact on flight path, the fighter cannon shoots explosive shells in the direction the aeroplane is pointing.

ATTACK

To hit a moving target, the fighter must shoot at where the target will be when the shells intersect the target's flight path, using lead pursuit (pointing ahead of the target).



Approaching abeam

The gunsight pipper helps to calculate lead, but only with low AOT (angle off-tail) can the fighter have a reasonable chance of a hit. Approaching from the side ('abeam' the target) at about 90 degrees AOT, the fighter must keep turning to maintain a steady target in his sights, because the line of sight (LOS) to the target is changing rapidly.

With low AOT, even with a manoeuvring target, LOS rate is low, and a good tracking shot is

AIR-TO-AIR COMBAT

WEAPON TACTICS



Guns attack from abeam, followed by break turn

easier to obtain. If unable to obtain a steady LOS, the snapshot may be a better option. This involves taking the opportunity of a shot when the target passes through the pipper, but lead is much harder to calculate.

DEFENSE

The key to guns defense is to offer your opponent a high LOS rate and a high AOT. The diagram on this page shows the bandit moving in from abeam for a tracking shot. The bandit

turns towards the fighter as AOT decreases. Noticing the threat, the fighter rolls left and pulls towards the bandit. Continuing to turn in this direction would offer the bandit an excellent snapshot, so the fighter rolls further left and pulls into the vertical plane. This change of manoeuvring plane unbalances the bandit, who must rethink his attack.

AIR-TO-AIR COMBAT

WEAPON TACTICS

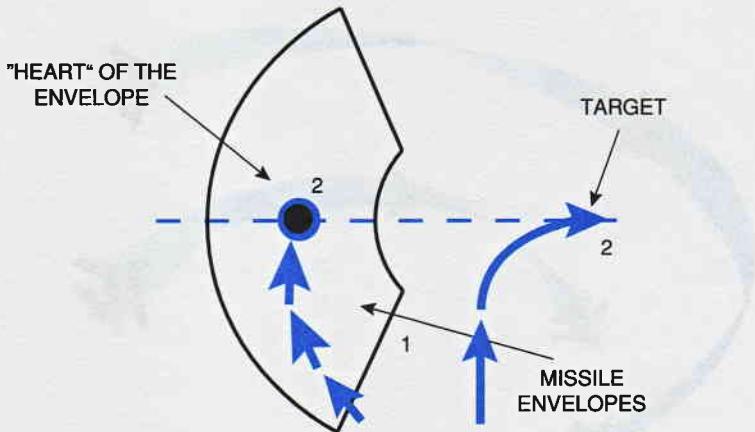
USING MISSILES

IR Missiles come in two types. The older heat-seekers (Infra-Red guided missiles) are rear-aspect weapons, which need to be behind the target to home on the hot tailpipe. More recent IR missiles have been able to track hot exhaust gases and the warm aircraft body, even from head on or abeam.

Radar guided missiles are all-aspect, and work best at angles which maximize the radar signature. These also come in two types. The Semi-Active Radar Homing (SARH) missiles, such as Sparrow and Skyflash, home on reflected radar signals bounced off the target from the launching fighter. The newer missiles, like AMRAAM, are fire-and-forget, like the IR guided types. These have their own radar transmitters, allowing the fighter to turn away after launching.

ATTACK

The missile type will determine the required offensive manoeuvres for the fighter. The firing envelope for rear aspect missiles is shown in the diagram on this page.



Firing envelope

Using pure pursuit (pointing directly at the target) can cause the fighter to get too close to the target. To keep out of minimum range, lag pursuit or pointing behind the target is best. As the fighter approaches the heart of the

envelope, turn rate should increase towards pure pursuit before launch.

Some modern missiles like ASRAAM can be fired off-boresight, using helmet-mounted sights.

AIR-TO-AIR COMBAT

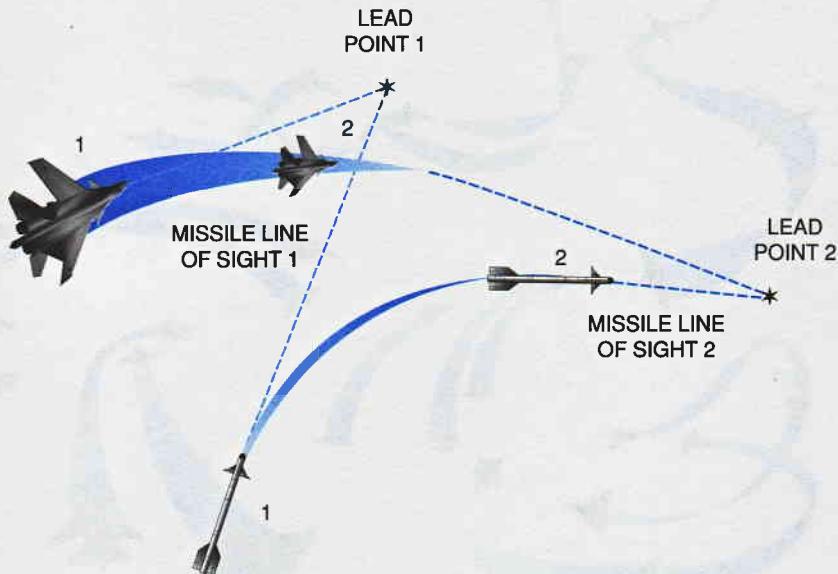
WEAPON TACTICS

However, even modern all-aspect, off-boresight missiles perform best when launched like other missiles.

DEFENSE

The fighter should avoid presenting either bandits or SAMs with the opportunity for a missile launch. The best defense against a missile approaching from abeam is a sharp break up or down. This is because the missile will use lead pursuit, following a point ahead of the target's nose. So a change in the pointing direction of the target makes a big difference to the missile's aiming point.

If a missile is approaching from ahead or behind, the fighter should break hard to present a beam aspect and follow the procedure above.



Missile leading from abeam on breaking target

AIR-TO-AIR COMBAT

BASIC FIGHTER MANOEUVRES



Combat tactics

BASIC COMBAT TACTICS

Contrary to popular belief, fighting in a modern jet aircraft is not just a push-button affair. It is true that these days the fight begins over the horizon, using AWACS, radar and smart missiles. But the enemy may survive this high-tech phase of combat, and quickly close to the kind of ranges where pure skill and nerve replace micro-chip and sensors. Remember, in many cases the opposition is as highly trained as Nato pilots, and they also have the same goal in their mission - to shoot-down anyone they meet.

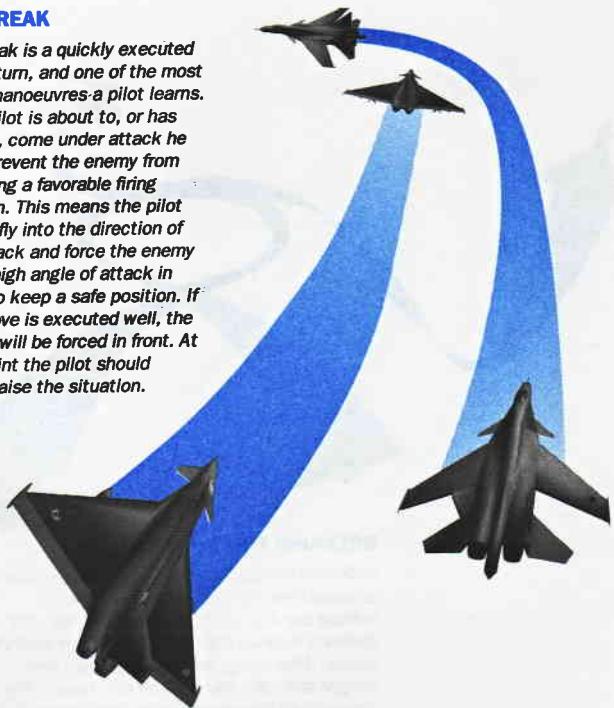
A close-in dogfight often takes on the appearance of a ritual dance, each pilot using all the techniques in his repertoire to out-smart the opponent. This has led to standard manoeuvres being developed for aerial combat. These are learned by all pilots, who will attempt to perfect every aspect of timing and positioning. The outcome will be pilots who can face the enemy in an even fight, and be reasonably sure of winning. The basic manoeuvres are fine if executed well but in an unfair fight there is little option than to retreat and regroup. All aspects of combat need to be perfected if a pilot is to be successful and long-lived.

AIR-TO-AIR COMBAT

BASIC FIGHTER MANOEUVRES

THE BREAK

The break is a quickly executed high-G turn, and one of the most basic manoeuvres a pilot learns. If the pilot is about to, or has already, come under attack he must prevent the enemy from achieving a favorable firing position. This means the pilot should fly into the direction of the attack and force the enemy into a high angle of attack in order to keep a safe position. If this move is executed well, the enemy will be forced in front. At this point the pilot should re-appraise the situation.



SLOWING FORWARD VELOCITY

In order to force an opponent to take the lead the plane must slow down. This is achieved by using the air-brake and snaking the aircraft from side to side. The violent action slows the plane, and the snaking path is a longer distance to travel. This kind of action forms the basis of the scissors manoeuvre.



AIR-TO-AIR COMBAT

BASIC FIGHTER MANOEUVRES



THE SCISSORS

If the break is successful, the pilot will want the opponent to be forced into an undesirable position. The scissors manoeuvre will slow the plane's velocity in a certain direction. Each pilot will be attempting to do the same thing so the victor will be the pilot with the best timing and technique. One wrong decision in this manoeuvre is bad news. The pilots will repeat the scissors a few times and then break because their airspeeds will quickly diminish.



BREAKING THE SCISSORS

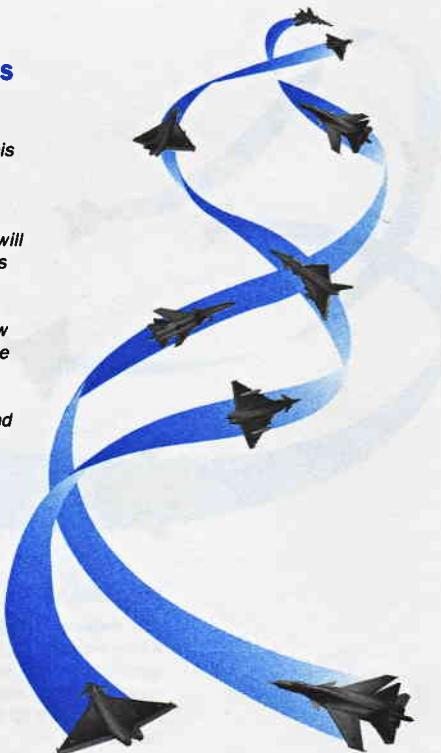
If there is no clear advantage gained from the scissors then the next option is to get out without any loss of tactical position. The pilot makes a reversal then heads straight toward the enemy. After diving away the pilot then rolls upright and can head into the sun, leaving the opponent to turn around to try and re-acquire his target.

AIR-TO-AIR COMBAT

BASIC FIGHTER MANOEUVRES

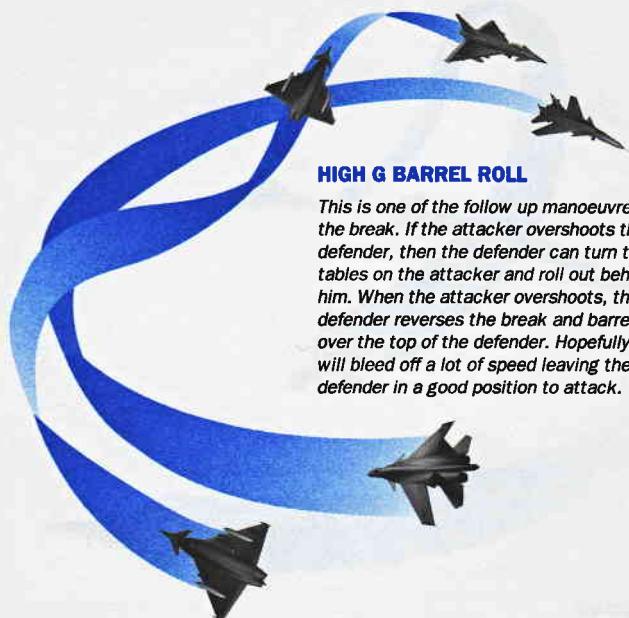
THE VERTICAL SCISSORS

The scissors may also be performed vertically, either upwards or downwards. In this case the reverses take the form of barrel rolls. The pilot who enters this manoeuvre with the higher energy state will lose advantage as the planes are slowed by gravity. In a diving scissors the defender should position himself below the enemy so he may execute a Split-S manoeuvre and escape. The Split-S lets a defender roll upside down and dive away and pull out in the opposite direction.



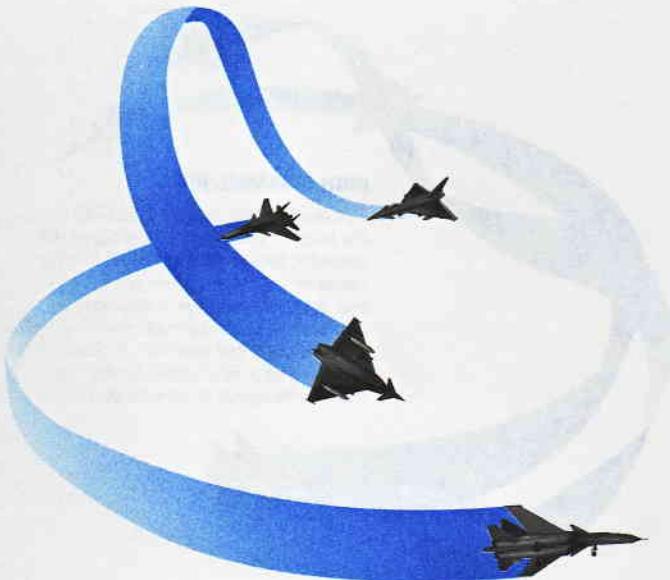
HIGH G BARREL ROLL

This is one of the follow up manoeuvres to the break. If the attacker overshoots the defender, then the defender can turn the tables on the attacker and roll out behind him. When the attacker overshoots, the defender reverses the break and barrel rolls over the top of the attacker. Hopefully this will bleed off a lot of speed leaving the defender in a good position to attack.



AIR-TO-AIR COMBAT

BASIC FIGHTER MANOEUVRES



HIGH YO-YO

If the opposition forces you to overshoot with one of the examples previously described, then you may be able to counter in several ways. The high yo-yo allows the pilot to use gravity to avoid overshooting. As the defending pilot breaks, the opponent pulls back and rolls over in effect cutting the circle and dropping in behind the enemy.



THE ROLLAWAY

The rollaway is a variant of the high speed yo-yo where the attacking pilot pulls up but instead of cutting the circle, he instead rolls the opposite way. When he is level again he will be in a position to pick up the opponent and drop in behind him.

AIR-TO-AIR COMBAT

BASIC FIGHTER MANOEUVRES



THE LOW YO-YO

This is a similar manoeuvre to the high yo-yo except that it is used when the attacker doesn't have enough speed to reach an opponent. The pilot rolls upside down and dives across the circle, trading height for speed and catching up to the enemy. This method can be employed when the defending aircraft is running away. The attacking aircraft starts a shallow dive and catches up to his opponent. When close, he will be in the enemy's blind spot.



THE COUNTER LOW YO-YO

There is a standard counter to the low yo-yo. After the attacker dives down to cut across, the defender pulls up and rolls the opposite direction. When he pulls level he will be heading towards the attacker ready to make another move.

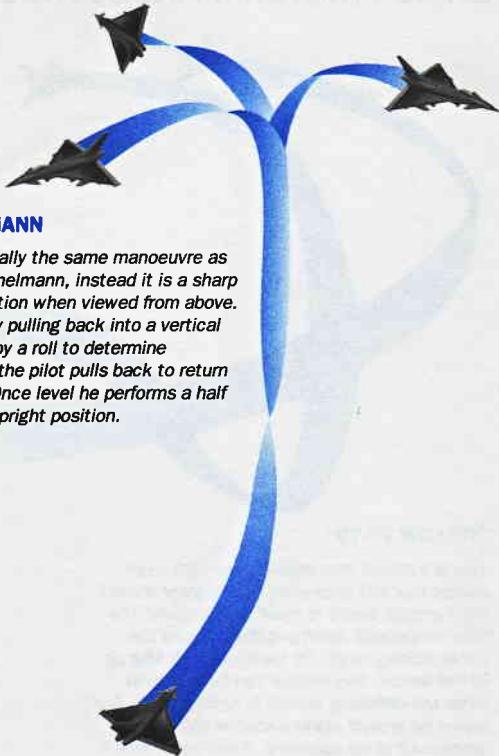
AIR-TO-AIR COMBAT

BASIC FIGHTER MANOEUVRES



THE BARREL ROLL ATTACK

If an opponent breaks in front of the pilot and he risks overshooting the enemy he can employ the barrel roll attack. As the defender breaks the attacker rolls the opposite way, climbing at the same time so as to exit the roll in the same direction as the opponent but still with tactical advantage. Countering this means diving away and looking out for missile attack.



THE IMMELMANN

This is not actually the same manoeuvre as the original Immelmann, instead it is a sharp change of direction when viewed from above. It is achieved by pulling back into a vertical climb followed by a roll to determine direction. Then the pilot pulls back to return to level flight. Once level he performs a half roll to recover upright position.

AIR-TO-AIR COMBAT

SECTION MANOEUVRES

DOUBLE ATTACK

Fighters most often work in sections, which comprise a section leader and his wingman. In WWII, they would move as a fighting wing, the wingman sticking close to his leader's tail. In engagements, the leader fights as a singleton; his wingman is a second pair of eyes, sometimes offering extra firepower.

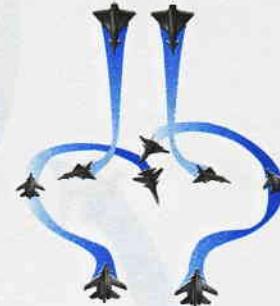
Although fighting wing doctrine is still used today, the preferred system is the double attack. Cruising in combat spread for mutual protection, the section engages, and whichever of the fighters is in the best tactical position attacks. The engaged fighter manoeuvres for a kill, while the other, free fighter, orbits close to the fight. During the fight, the engaged fighter is effectively the section leader. The free fighter should watch his partner's tail, keeping a higher altitude for energy advantage. When the engaged fighter feels in danger of losing the offensive, he will command the free fighter to engage and the pair will swap places.

The result of this system is that the wingleader-wingman relationship becomes fluid, and the fighter with the offensive advantage will be in effective command.



TWO ON ONE BRACKET

The bracket is a form of offensive split. The two fighters break in opposite directions and reverse back towards each other. The manoeuvre forces a lone enemy to make a choice of target, and as he turns towards one fighter, he leaves his tail open to attack by the other.



TWO ON TWO BRACKET

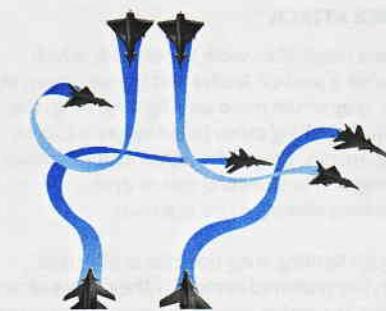
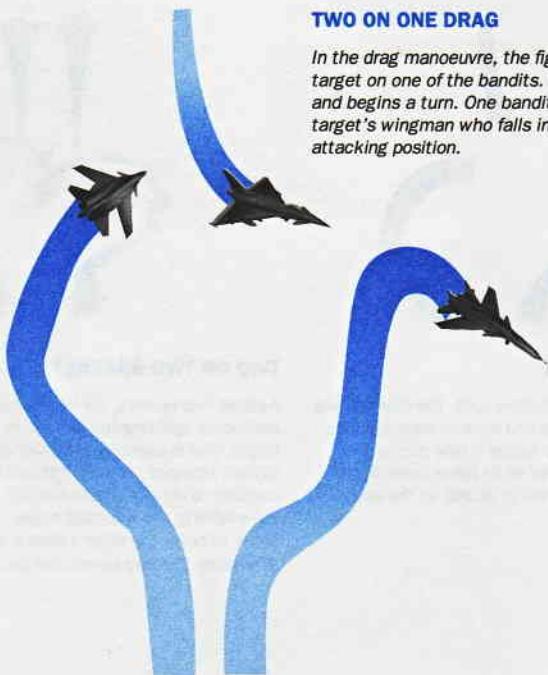
Against two bandits, the bracket can put both on the defensive. Splitting too late, each bandit chooses a target, and is promptly attacked on the tail by the other fighter. However, for both fighters to press the attack is contrary to double attack doctrine, as it leaves them vulnerable to the wild-card bogey. One fighter should break to cover the other's attack while both bandits are defensive. The free bandit can be dealt with later.

AIR-TO-AIR COMBAT

SECTION MANOEUVRES

TWO ON ONE DRAG

In the drag manoeuvre, the fighters attempt to force a target on one of the bandits. The dragger moves ahead and begins a turn. One bandit follows, unaware of his target's wingman who falls in behind him in a favorable attacking position.

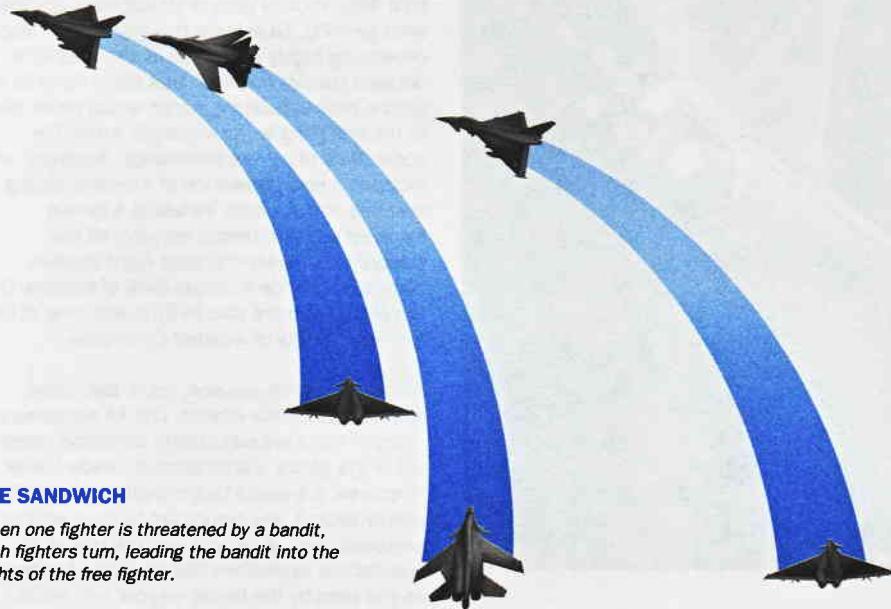


TWO ON TWO DRAG

The following diagram shows a combination manoeuvre in a 2 on 2 engagement. Starting a bracket to split the bandits, the fighters then initiate a drag manoeuvre. The left hand fighter makes a head on pass across the nearest bandit to back up the dragger on the right. As the right hand bandit chases an easy target his partner sees the danger, but cannot make the about turn necessary to prevent the trap being sprung.

AIR-TO-AIR COMBAT

SECTION MANOEUVRES

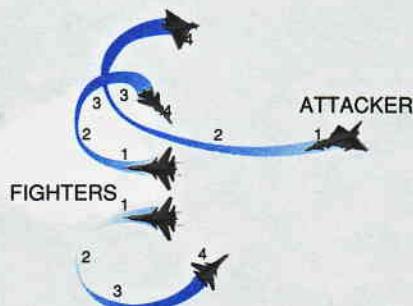


THE SANDWICH

When one fighter is threatened by a bandit, both fighters turn, leading the bandit into the sights of the free fighter.

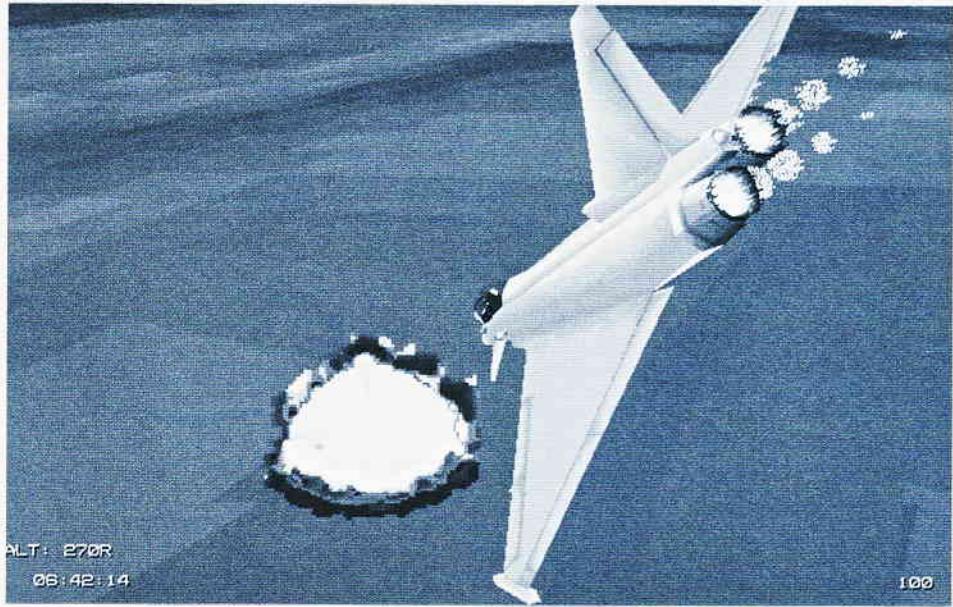
THE DEFENSIVE SPLIT

If the bandit has not clearly chosen a target, the defensive split forces the choice. The engaged fighter avoids getting into a scissors and leads the fight back towards the free fighter.



GROUND ATTACK

WEAPON TACTICS



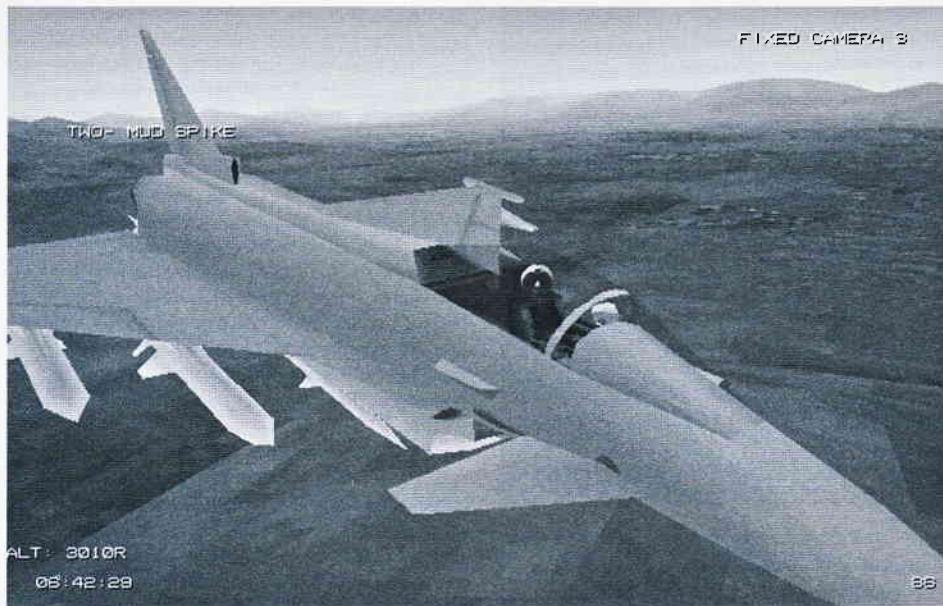
EF2000 is an effective ground attack aircraft

From the start, we designed EF2000 to be the best simulation of ground attack missions ever seen on a PC. To achieve this goal meant firstly developing highly contoured landscapes with detailed texture maps, so that flying close to the ground over undulating terrain would be as close to the real thing as we could get within the constraints of current technology. Secondly, we included a new generation of weapons aiming systems and avionics, including a terrain following aid. And thirdly, we gave all the weapons their own individual flight models, helping to provide a unique level of realism. On top of this, you are able to fly at any time of day in a wide variety of weather conditions.

On ground attack mission, you'll also come across spectacular effects. The AA batteries in cities at night are particularly awesome, sending out bright glows and streams of deadly tracer. Of course, it's also a tough challenge too, with enemy aircraft and ground-fire to keep your mind occupied. Best of all, you are able to watch spectacular explosions and view your handiwork as you pass by the target on your way home...

GROUND ATTACK

WEAPON TACTICS



Use the views to get a better picture of your situation

TARGET ZONE INGRESS/EGRESS

If you are preparing for a mission, give plenty of attention to the intelligence data on your target. Study the satellite views and memorize key details. If you are making a high-level attack, for example, it's easy to mistake buildings and details from 20,000 ft. And if you are attacking a site such as an airfield, you need to know which way the runway lies, so you can line up properly for an anti-runway attack.

Also try and plan your escape route on the MMD. If there are hills nearby, you can use these to cover your escape. Watch out for SAM sites!

APPROACHING ENEMY GROUND UNITS EQUIPPED WITH SAMS

Be careful when making a low level approach on enemy troops. Invariably there are one or more SAMs down there, and these will take you by surprise. As you prepare your bombing run, have ALARM missiles active until the last possible moment. Switch back to ALARMS the moment your weapons have gone. Do not use afterburner at low-level, as this attracts IR SAMs like a magnet!

GROUND ATTACK

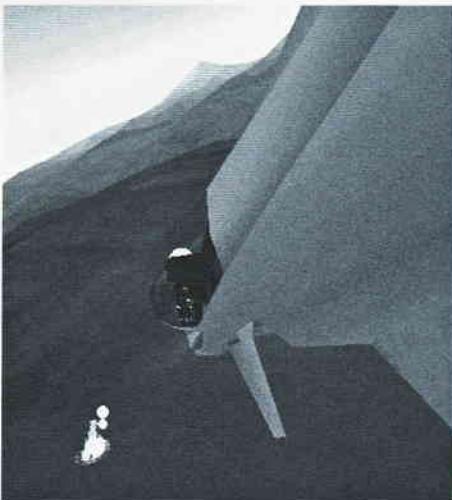
WEAPON TACTICS

DESTROYING SAM SITES

Compared to a modern jet aircraft, SAM equipment is cheap. And deadly. It provides lethal protection for all manner of sites and mobile units, and comes in all shapes and sizes: from small, shoulder mounted IR rockets to big long-range, high altitude missiles with massive proximity warheads that can bring down large bombers or several aircraft in a closely grouped formation.

After bitter experiences with SAM in modern theatres of war, the Israelis and Americans were quick to develop anti-SAM missiles. These lock onto the radar emissions of the SAM site, and zoom to the target at high speed to eliminate it. F-4 Phantom aircraft were adapted to the role of eliminating SAM threats, and became known as 'Wild Weasels'. Their dangerous air-defense suppression missions became known as 'Iron Hand'. Watch the film 'Flight of the Intruder' to get a idea of what SAM suppression is all about.

However, SAM operators have wised up to these tactics and weapons. Now a radar set is only switched on when the SAM operator thinks he has a fair chance of making a kill. That's usually



at a range that exceeds your anti-SAM weapons, so he'll deny you a missile lock. If you avoid the SAM and approach the launch site directly, chances are the radar won't be switched on. However, fly past and the moment you show your six, the radar is on and you'll have a SAM screaming up your jet-pipe with no time to avoid it.

During the Gulf war, missiles were used that could detect the radar tubes cooling down after they had been switched off. The ALARM anti-SAM missiles in EF2000 are of the type that can lock on to a brief SAM radar emission, and memorize the co-ordinates of the signal source. So if the SAM operator switches on for just a second while you're in range, you've got him. But don't bank on it. Either fly around at a distance just inside your missiles' range waiting for the lock, or carry secondary weapons to wipe out the site; for example, Maverick missiles or BL-755 cluster bombs. Don't use a conventional MK 82 unguided bomb because you'll have to overfly the site and if you haven't nailed it, the SAM operators will nail you.

The height at which you approach a SAM site is also important. Fly below 500 ft and you will avoid radar detection until you are relatively close. Even if the site launches, the SAM may find it difficult to lock on to you at low level. For extra measure, switch on stealth mode and use your map to navigate to the site. If there are mountains or hills nearby, use these to mask you approach as much as possible. Radar cannot see through solid earth!

GROUND ATTACK

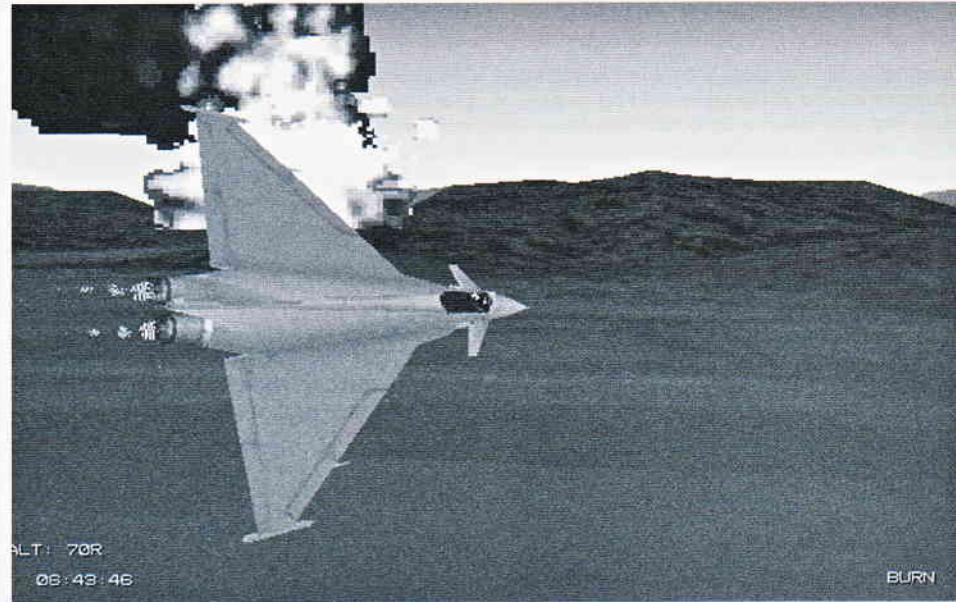
WEAPON TACTICS

USING STEALTH

In simple terms, a plane not emitting any electronic signals is being 'stealthy'. But that doesn't make it a stealth fighter. A true stealth plane is designed to reflect radar waves in any direction except back to the receiver. It even absorbs some of them by using Radar Absorbing Materials (RAMS).

The EF2000 has stealth features; for example, the engine compressor turbines, which are a major radar reflector, are hidden from view by an 'S' shaped air intake. In addition, the use of composites and radar absorbent materials reduces the aircraft's Radar Cross Section (RCS) to about one fifth the RCS of an FA-18 Hornet. Even with a full weapons load, EF2000 has an unusually small RCS, which can help make it practically invisible at low level.

If you are on a bombing mission, always use JTIDS to monitor enemy ground and air movements in preference to radar. Use JTIDS with the map overlay to compare targets with the terrain. Try and ascertain the heading of enemy aircraft before switching on your radar in panic. Then plot an evasive course. Stay stealthy by keeping radar and ECM off. If possible, use



mountains to mask yourself. If the threat light comes on, you have been spotted, so prepare to take combat countermeasures. If JTIDS is unavailable, simply keep an eye on your DASS to

see whether any enemy aircraft or ground defenses are tracking you. Switch on your radar only as a last resort, when defense becomes vital for survival.

GROUND ATTACK

WEAPON TACTICS

APPROACHING SHIPS AND FLOTILLAS

Getting too close to enemy fleets can be dangerous, as most ships are well equipped with advanced ship to air defenses and long-range radar that can detect a plane from 300 miles. Some shipboard weapons are even designed to shoot down cruise missiles, which caused so much damage to the British fleet during the Falklands War. What's worse, you'll have no terrain to hide behind.



AVOIDING FLAK AND SAMS

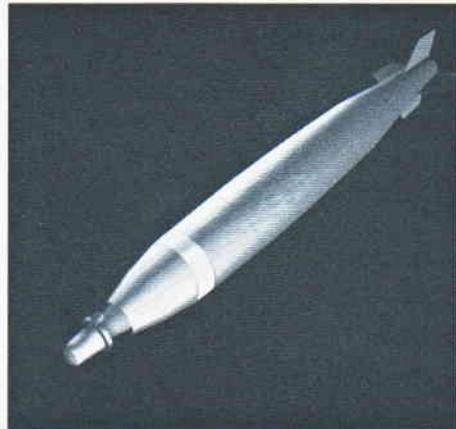
Flying at around 10,000 ft will keep you out of flak trouble, but higher altitude has its drawbacks. It makes you easier to detect, both for SAM and other aircraft. The alternative is to fly as low as possible, using stealth where possible. This will hide you from detection for longer, but makes you highly susceptible to ground fire - especially from shoulder launched SAMs.

To avoid ground based SAMs, treat them in the same way as AA missiles. Get ready to break at the right moment, and let the DASS dump chaff or flares when a missile gets too close to your tail. If you are at high altitude, try a diving manoeuvre.

GROUND ATTACK

USING AG WEAPONS

IRON BOMBS



TYPICAL TARGETS

Hardened aircraft shelters, Runways, Underground bunkers.

DELIVERY TECHNIQUES

Just because there are plenty of high tech weapons available in EF2000, don't ignore the plain-old iron bomb. In the Gulf War, more iron

bombs were dropped than any other, simply because they are cheaper and more plentiful. Learn to drop an iron bomb accurately, and you really deserve the title of bombardier.

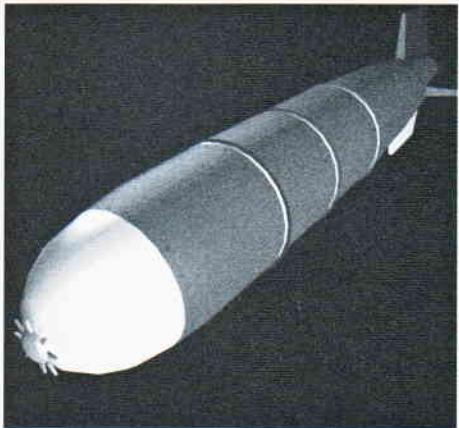
1. Medium altitude, starting at 15,000 ft above the Man Portable Air Defenses (MANPAD). Wingmen should split to gain the separation needed to avoid the blast of the bombs from the man in front.
2. When you reach 7 nms from the target, fly at 15 degrees offset to the target.
3. When 3 nms from the target, tip in towards it and begin a dive. Fly the bomb fall line through the target, and release the weapon as soon as the CCIP marker passes through it.
4. Recover from the dive, preferably before 5000 ft, and climb to a safe altitude.

NOTE: The steeper the dive, the more accurate your bombing will be. DO NOT RELEASE THE BOMBS BELOW 2000 FT, OR YOUR PLANE WILL BE DAMAGED BY THE BLAST.

GROUND ATTACK

USING AG WEAPONS

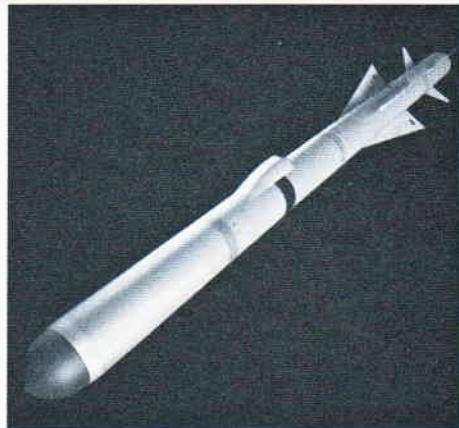
USING THE BL-755 CLUSTER BOMB



bomblets that cover an area the size of a football pitch. The problems of self damage are much lower with cluster weapons, although the lower they are dropped, the smaller the area covered. The best height for delivery will be around 150 ft. Only 5 seconds spacing is required between aircraft delivering this weapon. Formations should attempt to achieve the minimum throughput time for aircraft over the target, in order to saturate the enemy defenses and overwhelm them.

Delivery procedures are the same as for the iron bombs, except that the wingmen do not need to split in order to gain separation.

USING ALARM ANTI-RADIATION MISSILES



TYPICAL TARGETS

Tanks, Soft-skinned vehicles, Trains, Personnel, Artillery, Radar heads

DELIVERY TECHNIQUES

This weapon is designed for use against area targets. After release from the aircraft, the weapon dispenses large numbers of small

TYPICAL TARGETS

SAM sites and EWR, Naval SAMS and EWR

DELIVERY TECHNIQUES

There are two delivery techniques for ALARM in EF2000. The first is 'direct' mode, in which the missile will lock on to any radar emission within range and line of sight. All the pilot has to do is

GROUND ATTACK

USING AG WEAPONS

make the decision to fire the missile, or hide from the radar by using terrain masking. The direct mode is best reserved for attack runs at low level, where the aircraft may be surprised by an active SAM battery. The missile will react quickly to the SAM radar, and should enable you to fire before the SAM has a chance to launch.

Use the indirect mode for clearing heavily defended territory. Fly in low, below 500 ft and when 15 miles from the target, release the ALARM in the general direction of the target. The missile will zoom climb to 40,000 ft and hang on a parachute until a radar emission is detected. When you are closer than 10 miles, turn on a parallel course to the target and 'pop-up' in order to encourage the enemy to switch on their radar, which in turn will cause a missile to fall on them.

1. Fly in fast and low.
2. Launch ALARM when fifteen miles from a suspected SAM site (indirect mode).
3. If the missile acquires a target automatically in the HUD, fire the weapon.

USING SEA EAGLE MISSILES



TYPICAL TARGETS

Large surface vessels, oil rigs.

DELIVERY TECHNIQUES

The Sea Eagle is a stand-off weapon, which helps to keep the launch aircraft out of the lethal radius of naval SAM coverage. This is particularly

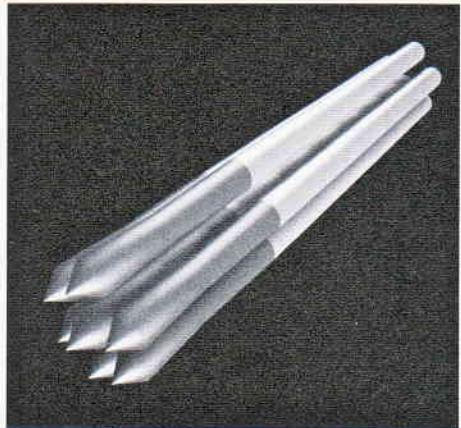
important at sea, because terrain masking is simply not possible.

1. Fly to the ingress point at less than 500 ft to avoid detection.
2. At the ingress point the flight should split to attack the target from different directions. Pay attention to the required speed to achieve a correct Time On Target (TOT).
3. At 60 nm or less, pop-up to 2,000 ft and acquire your target using the Sea Eagle radar.
4. Cycle targets with the 'C' key. To get a closer look, use the Zoom key on the MFD.
5. When you have identified and acquired the right target, launch your weapon.
6. Drop to less than 500 ft and turn away from the target as quickly as possible.
7. Check your DASS to ensure that no SAMs are chasing you.

GROUND ATTACK

USING AG WEAPONS

USING CRV-7 ROCKETS



TYPICAL TARGETS

Beach landing craft, coastal patrol boats, inflatable beach toys, tank convoys, trains, industrial sites.

DELIVERY TECHNIQUES

The CRV-7 rockets are designed to be used with a large stand-off from the target - typically 3

miles. The weapon is well-suited to the anti-shipping role against small craft that are not well defended, such as spy trawlers and landing craft. The weapon could be used against many other types of target, but becomes the second choice to the cluster bomb. The weapon is very fast (about Mach 4), and is reckoned by pilots to be 'the best fun you can have with your clothes on'. It goes wherever you point your aircraft.

- 1.** Fly towards an offset from the target of 4 nms at 480 kts, 500 ft.
- 2.** At the offset point, pull-up hard - passing 5000 ft - then roll towards the target and begin a dive.
- 3.** Aim with the pipper (death dot). Take a second or so to track the target then fire.
- 4.** After the last rocket has gone, pull hard away from the target and egress at low level.

USING THE MAVERICK IR GUIDED AG MISSILE



TYPICAL TARGETS

Armored vehicles, parked aeroplanes, presidential limousines.

DELIVERY TECHNIQUES

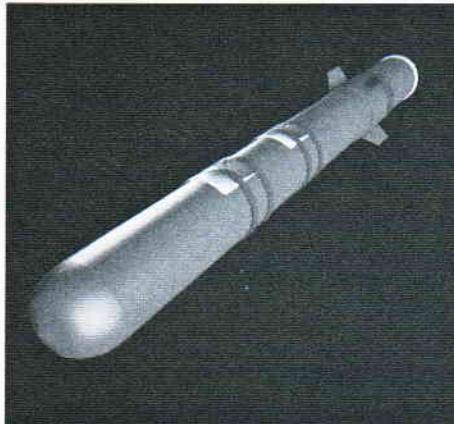
The Maverick AGM-65D is designed for stand-off use at ranges of up to 12 miles.

GROUND ATTACK

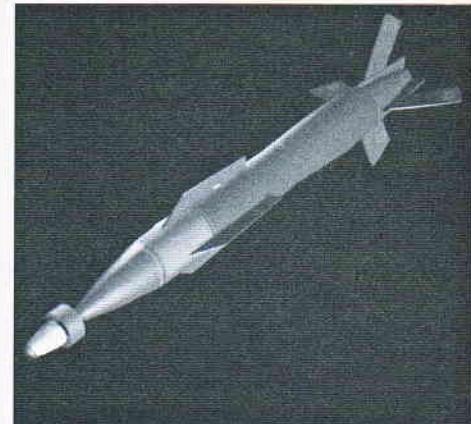
USING AG WEAPONS

1. Fly towards the target at 480 kts.
2. When about 12 nms from the target, offset to one side by about 15 degrees.
3. Select the left-hand MFD and slew the seeker head using the SHIFT Cursor keys.
4. The seeker will lock onto a target automatically. Check its identity in the IR screen under the HUD.
5. Vacate the area as quickly as possible.

USING THE DURANDAL BOMBS



USING LASER GUIDED BOMBS



TYPICAL TARGETS

Runways.

DELIVERY TECHNIQUES

The Durandal is a retarded bomb designed specifically for runways. The delivery technique is identical to that of High Drag bombs.

TYPICAL TARGETS

HAS, High Value Buildings, Command bunkers.

1. Fly towards the target and switch to TIALD (T key) when 15 miles away.
2. The TIALD pod should already be pointing at the waypoint.

GROUND ATTACK

USING AG WEAPONS

3. If necessary, expand the Field-Of-View with the FOV MFD key.

4. Pick a point for tracking and press the TRK MFD key. Slew the track box with the SHIFT cursor keys until you are satisfied with the position.

5. Press the OFT key and slew the laser cross-hairs with the SHIFT cursor keys until you are satisfied with the positioning.

6. Press LAS of the MFD to begin lasing the target.

7. When the release marker is between the parameter markers, release the bomb.

8. Continue lasing the target until bomb impact.



Approach the target in a shallow dive. The cannon pipper is calibrated to three miles, so wait until the range clock starts to count down. Start firing just before the target and 'walk' the cannon fire across it. You should not strafe too late or in too steep a dive, because considerable debris can be thrown into the air and this may damage your aircraft.

TYPICAL TARGETS

Soft-skinned vehicles, trains, personnel, artillery, radar heads.

STRAFING TECHNIQUES

Strafing is now far less popular than it used to be in days of old. This is mainly because of the dangers that the aircraft is exposed to while making an attack. In addition, strafing from a fast moving jet with any accuracy is very hard indeed. However, it is great fun in EF2000 so go ahead and strafe. The technique is simple.

USING THE MAUSER 27mm CANNON

GROUND ATTACK

STRIKE MISSIONS

The strike mission will either be carried out at low level to avoid detection by the enemy or at high level to conserve fuel. Flying low gives you the best chance of avoiding detection by enemy AWACS and early warning sites.

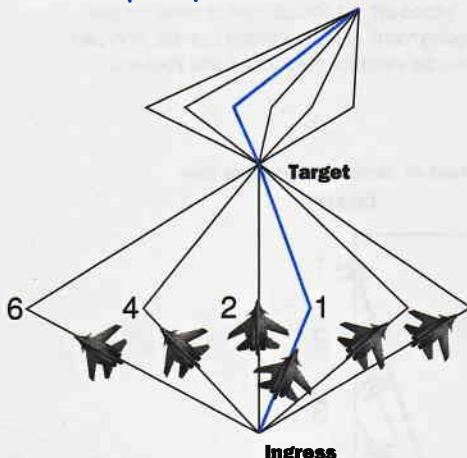
Follow your waypoint route to target, defending your airspace and responding to any threats you encounter. Remember the primary objective of the strike mission is to destroy the target, so you want to avoid air-to-air combat if possible as this will inevitably deplete your fuel reserves and could even lose you wingmen. If you are flying with escort then let the escort fighters deal with any threat while you turn away from the fight to ensure your safety before returning to the waypoint route. Your waypoint route may take you through neutral territory, so remember not to shoot anything down or target any ground installations unless you are threatened. Combat against neutral forces can have implications far beyond the immediate threat of air interception.

When you get to your ingress waypoint (or IP, Initial Point) you must begin your attack pattern route to target to allow accurate and safe deployment of your weapons. There are four main types of attack pattern which correspond to

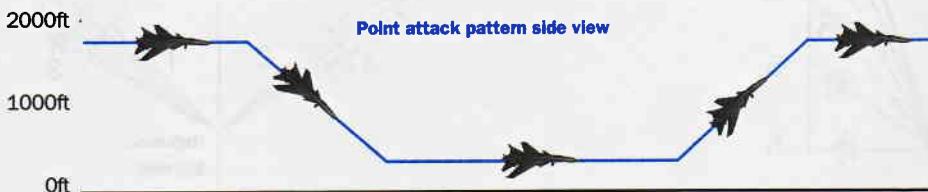
the weapons packages for the EF 2000. You must study these patterns before flight to ensure that your weapons are delivered correctly.

A 'point attack' pattern is used for free-fall bombs, cluster bombs, Durandals and rockets. The diagram below shows your route relative to your wingmen. Make note of the turning points and their relative distance from target as well the altitude at each point, in particular the release altitude for the weapon.

Point attack pattern plane view



Point attack pattern side view



GROUND ATTACK

STRIKE MISSIONS

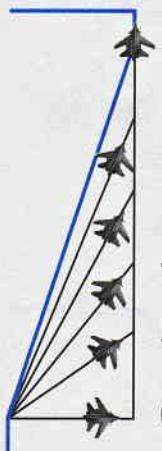
A 'stand-off' attack pattern is used for the deployment of laser guided bombs, and can also be used for Mavericks and rockets.

The Sea Eagle attack pattern is used only for the deployment of the Sea Eagle anti-ship missile. Make note of the turning points and their relative distance from target as well the altitude at each point, in particular the release altitude for the weapon.

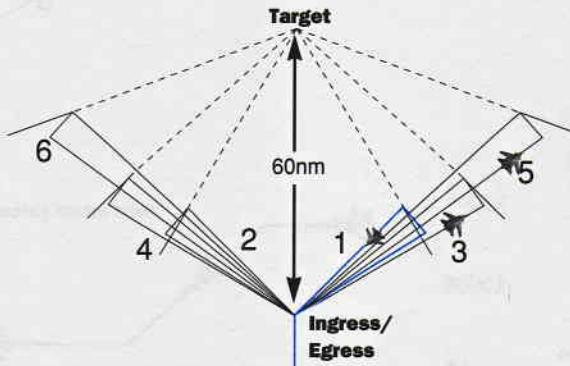
The Alarm attack pattern is used only for the deployment of the Alarm anti-radiation missile.

Stand-off attack pattern plane view

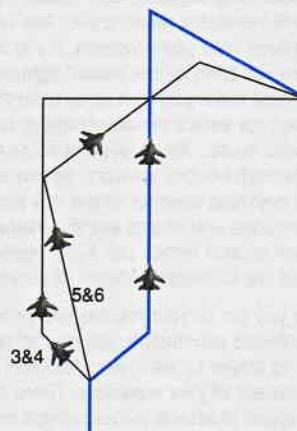
Target



Sea Eagle attack pattern plan view



ALARM attack pattern plan view



GROUND ATTACK

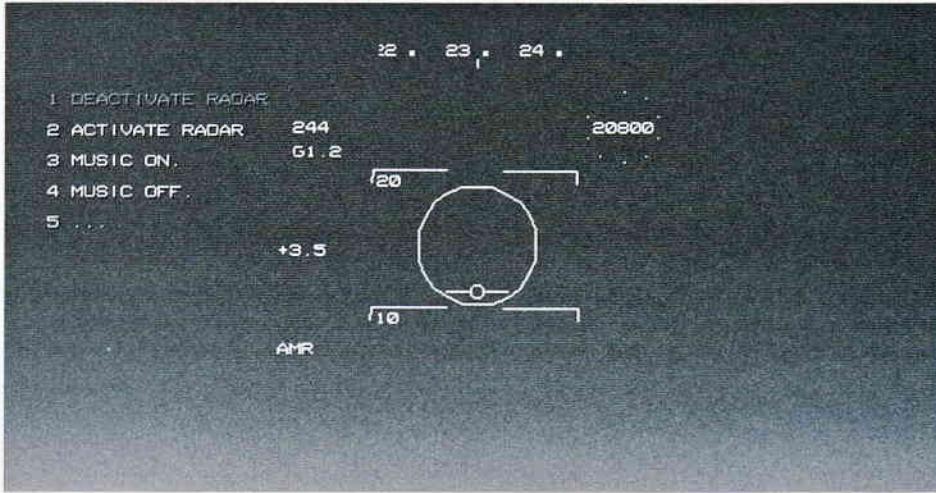
STRIKE MISSIONS

When you have released your weapons it is time to regroup with your wingmen and head back to base. If you encountered any SAM threats on route to target and your route home takes you close to these areas, remember to make a diversion to avoid them. If you have the opportunity of destroying any additional enemy targets on the route back to base then do so, but be careful to only strike enemy and not neutral targets.

On return to base there is the possibility that your base will have been destroyed and you will be unable to land. In this case you will need to fly to your diversion airfield. In general this airfield will be less than 50 nm from your home base so your fuel should get you there. If the worst happens and your diversion field has also been destroyed, it is up to you to find the closest NATO base to make an emergency landing - good luck!

EF2000 COMMUNICATIONS

SENDING & RECEIVING MESSAGES



The Wingman control menu

In EF2000, you can communicate with other aeroplanes and with airbases by radio. Pressing TAB or a number key activates the communications menu system. A series of messages or commands will appear on screen, each preceded by a number. Simply press the number of the one you want on the main

keyboard. Commands followed by '...' represent sub-menus. Messages will be spoken by your pilot, and acted on by whoever you are speaking with.

In the SmartPilots system, the messages you send are the same messages which the

computer-controlled aircraft use to communicate with each other. Their pilots are unaware that your messages originate from a human pilot and not another computer-controlled aircraft. Similarly, you will be sent messages from the other pilots, and these will appear on screen for you to respond to.

MAIN MENU

TACTICAL... Selects the TACTICAL MENU.

FORMATION... Selects the FORMATION MENU.

ENGAGE... Instructs your wingmen to engage enemy aircraft and selects engagement menu.

FLIGHT COMMS... Selects the FLIGHT COMMUNICATIONS MENU.

REPORT... Selects the REPORT MENU.

EF2000 COMMUNICATIONS

SENDING & RECEIVING MESSAGES

TACTICAL MENU

ACTIVATE RADAR: Instructs all wingmen to turn on their radar. Most of the aeroplanes in EF2000 are equipped with a scanning radar, which takes into account radar cross-section, pulse-doppler effects and terrain masking. Your wingmen will report any radar sightings, but using radar will alert enemies to your presence.

DEACTIVATE RADAR: Instructs all wingmen to turn off their radar. They will still use IRST, and activate radar for close combat.

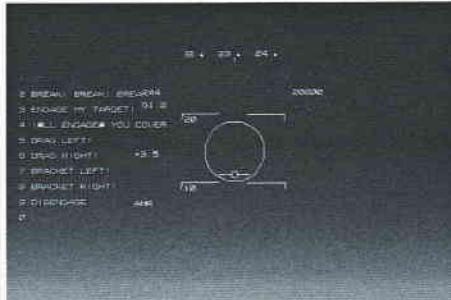
MUSIC ON: Instructs all wingmen to activate ECM. If flying as an Escort ECM group, use ECM to protect the strike group when it is attacked. Otherwise, use in combat, but only after being detected, as ECM, like radar, acts as a beacon to the enemy.

MUSIC OFF: Instructs all wingmen to deactivate ECM. Do so as soon as the danger is over.

FORMATION MENU

ARROW GO: This is a close formation in the shape of an arrowhead. Use only in friendly territory to keep an eye on your wingmen.

BATTLE GO: This selects combat spread, or battle formation, which is ideal for CAPs and missions in enemy territory, due to mutual visual and positional coverage.



More Wingman menus

ECHELON GO: This selects echelon, a very close formation which can disguise the flights numbers from some enemy radars.

ENGAGEMENT MENU

HELP: If you are in serious trouble, ask your wingmen to help you out. Usually, your own partner will respond, unless incapacitated.

BREAK, BREAK, BREAK: Instructs your wingman to break turn in response to an enemy aircraft or missile.

I'LL ENGAGE, YOU COVER: Instructs your wingman to act as free fighter in the double attack system. You should then engage.

ENGAGE MY TARGET: Instructs your wingman to engage your current target.

BRACKET LEFT/BRACKET RIGHT: Instructs your wingman to take the left or right arm of a bracket manoeuvre.

DRAG LEFT/DRAG RIGHT: Instructs your wingman to attempt a drag manoeuvre.

DISENGAGE: Instructs the whole group to cease fighting.

EF2000 COMMUNICATIONS

SENDING & RECEIVING MESSAGES

FLIGHT COMMS MENU

To talk to other flights, or the control tower, this is the menu that you require.

TO JOIN: To obtain extra fuel for yourself and your wingmen, a radio request for the nearest tanker. Use whenever fuel looks like being a problem, and always on reaching a refuel waypoint.

FOR RECOVERY: This issues a request to air traffic control for clearance to land for your entire flight. If no runways are clear, you will need to enter a holding pattern.

REQUEST EMERGENCY LANDING: When your aeroplane is damaged and you simply want to put it on the deck, send this message. It will override all regular ATC and allow you to touch down almost immediately.

MAYDAY! WE ARE UNDER ATTACK!: If you are under attack by enemy fighters, this requests backup from AWACS or your designated cover flight. If you have a cover flight, let them do the work; don't waste time and fuel in air-to-air combat.

REPORT MENU

It is your responsibility to inform the flight of any new information or hazards. This is especially important if you are a wingman, as you must report anything of interest to your wing leader.

SPIKE: Reports enemy radar detected on your DASS.

BANDIT: Reports an enemy attacking your flight.

MISSILE: Reports launch of a missile by a SAM site or enemy aircraft.

MUD SPIKE: Reports enemy ground radar tracking you.

CONTACT: Reports radar orIRST sighting of hostiles.

RECEIVING MESSAGES

On many occasions, other aircraft or airbases will need to send messages to you. You will hear these if you have an appropriate sound card or enough RAM, and they will also appear at the top of the screen. Up to 10 messages will be stored, and appear in turn when you acknowledge the previous message. Messages are acknowledged by pressing the 'Y' or 'N' keys. Some messages take the form of requests or questions. In this case, press 'Y' to comply with the request, or 'N' to refuse. For example, AWACS might send a message like:

'INCURSION BY HOSTILES AT 5 DEGREES, 90 NM, ANGELS 10. CAN YOU INTERCEPT?'

If you are low on fuel, this might not be possible. Just press 'N', and your pilot will reply:

'NEGATIVE!'

The AWACS aeroplane will find another CAP to perform the intercept (and get the glory)!

EF2000 COMMUNICATIONS

SENDING & RECEIVING MESSAGES

ACTIVATE RADAR - Instruction from wingleader to turn radar on.

AIRBORNE - Indicates that a pilot has taken off.

ARROW GO - Instruction from wingleader to change to arrow formation.

ACTIVATE RADAR - Instruction from wingleader to turn radar on.

BANDIT - Warning of enemy aircraft.

BATTLE GO - Instruction from wingleader to change to battle formation.

BINGO - Pilot has only enough fuel to reach base.

BRACKET LEFT COPY! - Acknowledgement from wingman of bracket left instruction.

BRACKET LEFT! - Instruction to form the left arm of a bracket manoeuvre.

BREAK LEFT - Command to execute a hard turn left.

BREAK! BREAK! BREAK! - Command to leave the refueller in a hurry.

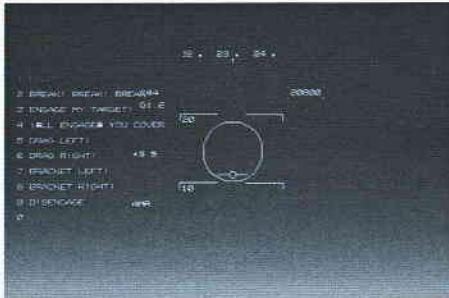
BUDDY SPIKE - Message indicating that the pilot has detected friendly radar on his DASS.

CHECK - Affirmative confirmation of an action or message.

COPY - Affirmative confirmation of an action or message.

COPY,ON MY WAY - A response to a request for help.

CLEARED TAXI COUGAR - ATC message that your flight should prepare to taxi.



More Wingman menus

CLEARED TO BREAK - Instruction that you may detach from the tanker.

CLEARED TO JOIN LEFT SIDE - Instruction to formate behind the tanker.

CLEARED DEPARTURE - Message from ATC that the aircraft is cleared to depart.

CONTACT LEFT HOSE - Confirmation of a good connection with the refueler.

CONTACT 340, 22, ANGELS 10 - Sighting on

heading 340, range 22 nm, altitude 10,000 ft
CONTINUE, HE'S FOLLOWING - Report that a drag manoeuvre is working.

CLEARED TAKE-OFF, WIND 360, 10 KNOTS - ATC grants permission to take-off; wind is blowing on 360 degrees at 10 knots.

CLEARED TAXI RUNWAY 22 - Indicates where a pilot should taxi to.

DEACTIVATE RADAR - Instruction from wingleader to turn radar off.

DISENGAGING - Message indicating that the fighter is disengaging from air-to-air combat.

DRAG RIGHT COPY! - Acknowledgement from wingman of drag right instruction.

DRAG RIGHT! - Instruction to attempt a drag manoeuvre to the right.

ECHELON GO - Instruction from wingleader to change to echelon formation.

ENGAGE! - Instruction from wingleader to engage air targets.

ENGAGE MY TARGET! - Instruction to engage the sender's target.

ENGAGING! - Report that the fighter is engaging.

ENGINE FIRE - Report that one or both of the aeroplane's engines is on fire.

EF2000 COMMUNICATIONS

MESSAGE SUMMARY

FINALS, GEAR DOWN - Aeroplane is on final approach.

FOR RECOVERY - Flight is ready to begin landing initials.

FOX ONE! - Report of launch of radar guided missile.

FOX TWO! - Report of launch of short range IR missile.

FUEL FLOWS - Tanker indicates that refueling is in progress.

FUEL LEAK - The aeroplane has a fuel leak due to damage.

GEAR DAMAGE - Problem with undercarriage.

GUNS GUNS GUNS! - The aircraft is firing cannon.

HELP! - Message from a plane requesting urgent assistance.

HOSTILES HEADING FOR BATTLE GROUP - Report from AWACS that enemy fighters are approaching Bottlegroup.

HOSTILES - Report from AWACS of enemy fighters nearby.

HYDRAULIC FAILURE - The aeroplane hydraulics have failed due to damage.

INCURSION BY HOSTILES AT... CAN YOU INTERCEPT? - Report from AWACS of enemy

incursion into allied territory, followed by request for CAP to intercept.

I'LL ENGAGE, YOU COVER - Instruction that the fighter will engage; the wingman should act as free fighter.

I'M HIT! - Report that the aircraft has taken damage.

INDICATING FULL - Tanker reports refueling is complete.

INITIALS - Aeroplane has begun landing initials.

I.P. - Pilot has reached ingress point on mission.

KNOCK IT OFF - Instruction to disengage from combat.

LOSING CABIN PRESSURE - The aeroplane is losing pressure due to damage.

LOSING OIL PRESSURE - The engine lubrication system has failed due to damage.

MAYDAY MAYDAY! EJECTING! - Message from any plane that the pilot is ejecting.

MAYDAY! MAYDAY! WE ARE UNDER ATTACK! - Message from another group that they are under attack from enemy aircraft.

MISSILE! - Warning of incoming missile.

MOVE ASTERN RIGHT HOSE - Command from the refueler to join to the right hose.

MUD SPIKE - Warning of SAM radar threat.

MUSIC! - The pilot is being jammed.

MUSIC ON! - Instruction from wing leader to turn ECM on.

MUSIC OFF! - Instruction from wing leader to turn ECM off.

NEGATIVE! - Negative response to a wingman or AWACs request.

NEGATIVE, HOLD-OFF, AIRFIELD BUSY - Message to enter a holding pattern at a busy airfield.

ON THE BRAKE - Aeroplane is slowing down for finals.

OXYGEN FAILURE - Report of damaged oxygen system.

PAN, PAN, PAN! REQUEST IMMEDIATE LANDING! Request for emergency landing clearance.

POSSIBLE FIGHTERS LAUNCHING FROM TRONDHEIM - Report from AWACS of enemy aircraft taking off from Trondheim airbase.

READY FOR DEPARTURE - Wing leader indicates readiness for take-off.

REHEAT FIRE - The afterburners are on fire.

EF2000 COMMUNICATIONS

MESSAGE SUMMARY

REQUEST PERMISSION TO ENGAGE - Message from wingman requesting clearance to engage in air combat.

REVERSE - Report that a drag manoeuvre has failed.

ROGER! - Acknowledgement from AWACS, tanker, JSTARS or ATC.

RUNNING IN - The pilot has commenced a ground attack run.

RUNWAY VACATED - Flight has cleared the runway.

SCRAMBLE! SCRAMBLE! - Take-off immediately!

SPIKE - Message indicating that the pilot has detected enemy radar on DASS.

SPLASH TWO - Report of second air-to-air kill.

SPLASH EIGHT COMPLETE - All bandits destroyed after eighth kill.

STRUCTURAL DAMAGE - Problem with the airframe.

STUD ONE GO - Change to ATC frequency.

STUD TWO GO - Change to departure frequency.

STUD THREE GO - Change to tactical frequency.

STUD... Indicates a change of radio frequency.

TALLY-HO - Enemy in sight.

TARGET TANKS BEARING 240, RANGE 10. CAN

YOU ATTACK? - JSTARS or FAC request to destroy enemy vehicles at a given bearing and range.

TO JOIN - Request for air-to-air refueling.

TOWER, COUGAR TAXI - ATC tells Cougar flight to prepare to taxi.

TURNING TO BANDIT - Message from wingman in bracket manoeuvre indicating a turn towards the bandits in the final phase.

UPDATE YOUR TARGET - Report from AWACS, JSTARS or FAC providing new target intercept data.

USING RUNWAY 22 - Message from tower granting landing clearance and giving runway number.

VECTOR TO INTERCEPT - Instruction from wingleader to wingmen of intercept.

WEAPONS GONE - Notification that AG weapons have been released.

YOU ARE CLEARED TO ENGAGE - Instruction from AWACS to engage at will.

YOU ARE VIOLATING NEUTRAL AIRSPACE... - Request to leave neutral airspace.

YOU ENGAGE, I'LL COVER - Request for wingman to take the offensive.

YOU'RE CLEARED LIVE - JSTARS or FAC is granting permission to drop live ordnance.

NATO AIRCRAFT

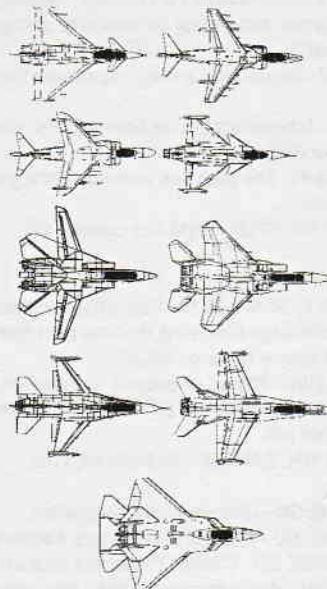
NATO FIGHTERS



In contrast to the Soviet approach, development of NATO fighter aircraft has largely tended towards complexity and high quality, rather than simplicity and ease of manufacture. The reason for this has been mainly due to the West's superior technology, and a paranoia of losing its leading-edge position during the 'Cold War'. Perhaps the greatest example of 'Cold War' reactionary design philosophy was the enormously expensive F-15, which was developed to counter the supposedly unparalleled performance of the MiG-25 Foxbat. The myth was shattered when a Russian pilot defected to Japan in his Foxbat, where it was quickly shown to be less capable than previously

thought. The F-22 Advanced Tactical Fighter is also a very expensive aircraft, although the F-16 and Saab Gripen are rare examples of high-quality, low-cost fighters incorporating the best of modern technology.

It's hardly surprising that inexpensive yet potent Russian aircraft have found a ready market in many of the world's less wealthy countries, while Western aircraft have proved less adaptable to the needs of other nations. Even today, the task of maintaining a diversely equipped NATO airforce is a major logistics challenge compared with the upkeep of standardized Russian aircraft designs with their low-cost spares. However, this situation has changed in recent years, as new generation of NATO aircraft have been developed by consortium, in order to spread the enormous costs of modern combat aircraft development. Tornado and the EuroFighter are good examples. Furthermore, collaboration between Europe and the United States has increased, as a stealthy replacement is being sought for the Panavia Tornado and other reconnaissance and attack aircraft.



Anti-clockwise from top-left: EuroFighter, Harrier GR7, F-14, F-16, F-22, FA-18, F-15, JAS39, Sea Harrier

NATO FIGHTERS

EUROFIGHTER EF2000



The EF2000 is the product of a four nation consortium made up of the UK, Germany, Italy and Spain. As with many modern aircraft, development has been marred by political wrangling leading to major design compromises. The technology was tested extensively by British Aerospace in the form of the EAP (Experimental Aircraft Program), which the EF2000 closely resembles. This demonstrator was to save millions of pounds of development costs, and reduce the EF2000 development time by several years.

The EF2000 is a canard equipped delta aircraft optimized for the air superiority role but able to be used for ground attack. Extensive use of high

technology materials has been made including carbon composites, glass reinforced plastics, titanium, and aluminum lithium, in 80% of the airframe. The cockpit environment is one of the most advanced in the world using digital fly-by-wire and multi function displays. The pilot wears a helmet with built in sight and night-vision enhancements. Like the Gripen and Rafale the EF2000 uses canards and a broad delta wing to get the best combination of agility, lift and speed.

ARMAMENT

One 27mm Mauser cannon, with thirteen hardpoints (three wet) for: the S-225 long-range, AIM 120 AMRAAM medium range, ASRAAM and AIM 9S short range air-to-air missiles, a wide range of air-to-surface missiles including the AGM65 Maverick, the ALARM anti radar missile, the Sea Eagle anti-ship missile, Paveway laser guided bombs, CR-V7 unguided rockets, BL755 cluster bombs, free fall, and retarded bombs. Maximum external fuel or weapons payload is 6500 kg (14330 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wingspan	10.5m (34 ft 5.5 in)
Length	19.5m (47 ft 7 in)
Height	6.4m (21 ft)

EF2000	
Max level speed at height	Mach 2 1472 knots 2060 kmh 1280 mph
Max level speed at sea-level	NA
Service ceiling	18290m 60000 ft
Required runway length	500m 1640 ft
Max Range: with max internal fuel	600 n miles 1112 km 690 miles
Max Range: with drop tanks	NA
Equipment for inflight refueling is fitted.	

Performance Table

NATO FIGHTERS

SEA HARRIER FRS-2



The Sea Harrier was a development of the highly successful Harrier vertical and short take off attack aircraft, featuring a high mounted cockpit with vastly improved all-round visibility. It is designed for use from Royal Navy warships, principally the Invincible Class aircraft carriers equipped with 'Ski Jump' take-off ramps, which allow fully laden aircraft to launch without catapult assistance. The new design features an extended nose, which houses the Blue Vixen radar, forerunner to the powerful ECR-90 type used in EuroFighter. This adds powerful medium range air-to-air capabilities, as well as an anti-ship ability, to this accomplished small aircraft. The amazing agility of the Harrier was proven in the Falklands war. The vectored thrust nozzles

can be used in flight to tighten turns, or to suddenly stop the aircraft in mid manoeuvre.

ARMAMENT

One hardpoint mounted 30mm gun pod, with seven hardpoints for: the AIM 120 AMRAAM medium range, the AIM 9 Sidewinder Short-Range air-to-air missiles, a range of air-to-surface missiles, laser guided bombs, unguided rockets, cluster bombs, free fall, and retarded bombs.

Maximum external fuel or weapons payload is STOL (short takeoff and landing) 3630 kg (8000 lb) VTOL (vertical takeoff and landing) 2270 kg (5000 lb)

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wingspan	7.7m (25 ft 3 in)
Length	14.17m (47 ft 7 in)
Height	3.71m (12 ft 2 in)

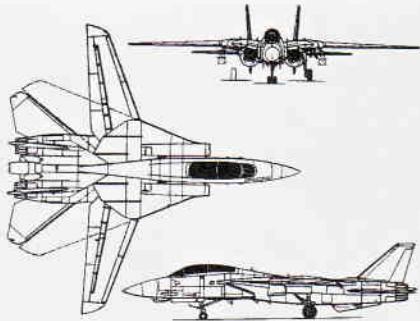
	FRS-2
Max level speed at height	Mach 1.25 846 knots 1185 kmh 736 mph
Max level speed at sea-level	Mach 1.11 635 knots 1176 kmh 730 mph
Required runway length	1000 ft or 450 ft with ski jump
Maximum range with internal fuel	1800 n miles 3333 km 2071 miles
Maximum range with drop tanks	1850 n miles 3428 km 2130 miles

Equipment for inflight refueling is fitted.

Performance Table

NATO FIGHTERS

GRUMMAN F-14 TOMCAT



The F-14 was born out of the failed Navy F-111B project. It was the first aircraft to use the swing wing design at sea. Even after twenty years of service the F-14 remains an extremely powerful fighter. The Hughes AWG9 radar is capable of tracking twenty four targets simultaneously and engaging six targets at once, with the long-range (up to 150 miles) AIM 54 Phoenix air-to-air missile.

The designers adopted the swing wing design to meet the many conflicting requirements of aircraft carrier operations. For the first ten years of service the engines proved unreliable.

This was solved by replacing the original engines with a later design.

The F-14 is the only Navy aircraft capable of carrying the TARPS (Tactical Air Reconnaissance Pod System).

ARMAMENT

One 20mm 6 barrel rotary gun, AIM 54 Phoenix long-range missile, AIM 120 AMRAAM medium range missile, and AIM 9 Sidewinder short-range air-to-air missile. The F14 D can also carry the full range of free fall, retarded, and precision guided air to ground munitions.

Maximum external fuel or weapons payload is 6,577 kg (14,500 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wingspan (spread)	19.54m (64 ft 1.5 in)
Wingspan (swept)	11.65m (38 ft 2.5 in)
Length	19.1m (62 ft 8 in)
Height	4.88m (16ft)

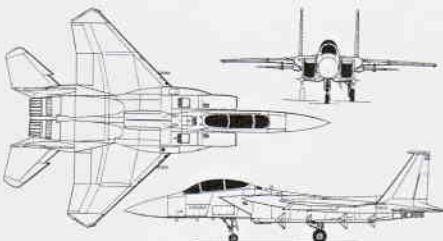
	F-14
Max level speed at height	Mach 2.34 1,340 knots 2,480 km/h 1,540 mph
Max level speed at sea-level	Mach 1.2 795 knots 1,470 km/h 915 mph
Service ceiling	16,765 m 55,000 ft
Required runway length	396 m 1,300 ft
Max Range: with max internal fuel	N/A
Max Range: with drop tanks	1,730 nm 3,204 km 1,991 miles

Equipment for inflight refueling is fitted.

Performance Table

NATO FIGHTERS

MC DONNELL DOUGLAS F-15 EAGLE



The F-15 was first designed to excel in the air superiority role as a maneuverable dogfight aircraft. It was later adapted to become an extremely capable attack fighter, especially in the twin seat F-15E version. Prototype F15s set a number of time to height records including a time of 207 seconds to an altitude of 18,290 m (60,000 ft).

The largely glass instrument cockpit pointed the way forward in the design of all future flight controls and cockpit instrumentation.

The F-15 was a 'panic' reaction to rumors concerning the capabilities of the MiG-25. After billions of dollars in development costs, the defection of a Russian pilot complete with 'Foxbat'

aircraft revealed that the fears were unjustified. The F-15 also embodies many of the lessons learned in Vietnam concerning the need for agility.

ARMAMENT

One 20mm 6 barrel rotary gun, AIM 120 AMRAAM medium range, AIM 9 Sidewinder short-range air-to-air missiles, AGM65 Maverick, GBU15 optically guided bombs, Paveway laser guided bombs, unguided rockets, Rockeye cluster bombs, free fall and retarded bombs from 113 kg (250 lb) to 907 kg (2000 lb). Maximum external fuel or weapons payload is 7257 kg (16000 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wingspan	13.05m (42 ft 9.75 in)
Length	19.43m (63 ft 9 in)
Height	5.63m (18ft 5.5 in)

	F-15
Max level speed at height	Mach 2.5 1,430 knots 2,650 km/h 1,650 mph
Max level speed at sea-level	Mach 1.22 800 - knots 1,480 km/h 920 mph
Service ceiling	18,290 m 60,000 ft
Required runway length	275 m 900 ft
Max Range: with max internal fuel	1,042 n miles 1,930 km 1,200 miles
Max Range: with drop tanks	2,500 nm 4,633 km 2,879 miles

Equipment for inflight refueling is fitted.

Performance Table

NATO FIGHTERS

LOCKHEED F-16 FIGHTING FALCON



The United States Airforce chose the F-16 as the winner of the 1972 lightweight fighter competition between the Lockheed YF-16, and the Northrop YF-17. Since entering service with the US Air Force the F-16 has been bought by 17 airforces around the world.

Though originally intended to be a simple and affordable fighter using the latest fly-by-wire flight system, and side mounted control stick, the F-16 was developed into a highly effective dogfight, and ground attack aircraft. The F-16 is still used as *the yardstick* by which other fighters measure their close combat maneuverability. The under fuselage air intake set a design trend continued in the EF 2000.

ARMAMENT

One 20mm 6 barrel rotary gun. The F-16 has nine hardpoints for: The AIM 120 AMRAAM medium range, the AIM 9 Sidewinder short-range air-to-air missiles, the AGM65 Maverick air-to-surface missile, the AGM88 HARM anti radar missile, Paveway laser guided bombs, unguided rockets, Rockeye cluster bombs, free fall, and retarded bombs.

Maximum external fuel or weapons payload is 6895 kg (15200 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

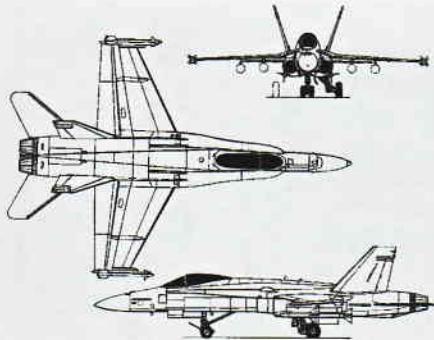
Wingspan	9.45m (31 ft)
Length	15.03m (49 ft 4 in)
Height	5.09m (16ft 8.5 in)

F-16	
Max level speed at height	Mach 1.6 1,140 knots 2,125 km/h 1,320 mph
Max level speed at sea-level	Mach 1.2 795 knots 1,470 km/h 915 mph
Service ceiling	15,240 m 50,000 ft
Required runway length	533 m 1,750 ft
Max Range: with max internal fuel	1,129 nm 2,100 km 1,300 miles
Max Range: with drop tanks	2,100 nm 3,890 km 2,420 miles
Equipment for inflight refueling is fitted.	

Performance Table

NATO FIGHTERS

MC DONNELL DOUGLAS FA-18 HORNET



The FA-18 arose out of the US Navy concern about the escalating costs of the F-14, and the need to replace the A6 Intruder. This aircraft was chosen as a development of the losing YF-17 design in the 1972 lightweight fighter competition as the YF-17 was a far more expandable, and suitable design for over water operation. The FA-18 has been developed into a truly all capable fighter, incorporating the by-now standard fly by wire controls and very advanced digital cockpit instruments.

The aerodynamic design allows this aircraft to fly at high angles of attack while maneuvering fully loaded. The FA-18 is able to carry a huge range

of weapons including nuclear stand off missiles, and is able to attack a ground target, or fly an interception mission with equal capability, and fly its own fighter sweep on the way home!

The FA-18 still has a huge development potential which is being pursued in the form of the bigger FA-18E, the lightweight export F-18L Cobra, and the canard equipped FA-18G.

ARMAMENT

One 20mm 6 barrel rotary gun. The FA-18 has nine hardpoints for: The AIM 120 AMRAAM medium range, the AIM 9 Sidewinder short-range air-to-air missiles, the AGM62 Walleye, and AGM65 Maverick air-to-surface missiles, the AGM88 HARM anti radar missile, the AGM84 Harpoon anti ship missile, Paveway laser guided bombs, unguided rockets, Rockeye cluster bombs, free fall, and retarded bombs, plus a nuclear stand off capability.

Maximum external fuel or weapons payload is 7031 kg (15500 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

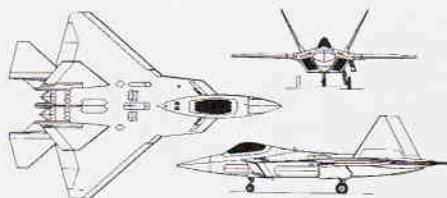
Wingspan	11.43m (37 ft 6 in)
Length	17.07m (56 ft)
Height	4.66m (15ft)

	FA-18
Max level speed at height	Mach 1.8 1,034 knots 1,915 km/h 1,190 mph
Max level speed at sea-level	Mach 1.2 795 knots 1,470 km/h 915 mph
Service ceiling	18,290 m 60,000 ft
Required runway length	426 m 1,400 ft
Max Range: with max internal fuel	1,800 nm 3,333 km 2,071 miles
Max Range: with drop tanks	1,998 nm 3,700 km 2,300 miles
Equipment for inflight refueling is fitted.	

Performance Table

NATO FIGHTERS

LOCKHEED F-22A



The F-22A is the result of a collaboration between Lockheed, General Dynamics, and Boeing to design and build a stealthy combined air-superiority, and ground attack fighter. The F-22A was the winner of the 1990 Fly-Off Competition narrowly beating the Northrop-McDonnell Douglas YF-23.

The F-22A makes extensive use of ultra-modern materials and 3D computer modeling for its blended surfaces. The aerodynamics have been optimized for a stealthy, agile shape compromise. Reliability and front line maintainability were much improved over previous fighter designs. All weapons are carried in three internal bays, two lateral and one ventral

The aircraft also features the ability to cruise supersonically without afterburner ('supercruise'), 2D thrust vectoring nozzles for dramatically improved agility, and short takeoff and landing. The aircraft uses fly-by-wire, side-stick controls and features the very latest cockpit design.

ARMAMENT

One long barrel 20mm 6 barrel rotary gun, with three internal bays for: the AIM 120 AMRAAM medium range, the AIM 9 Sidewinder Short-Range air-to-air missiles, the HAVE SLICK air-to-surface missiles, Joint Direct Attack Missiles, Tri Service Stand Off Attack Missiles, and Paveway laser guided bombs. There are also four under wing hard points.

Maximum fuel or weapons payload NA

TECHNICAL SPECIFICATIONS

DIMENSIONS

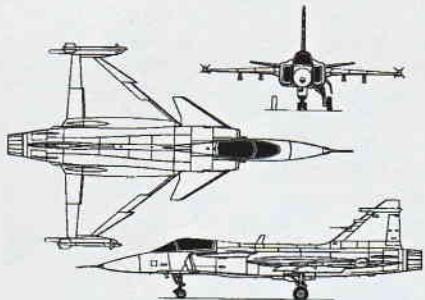
Wingspan	13.56 m (44 ft 6 ins)
Length	18.92 m (62 ft 1 in)
Height	5 m (16 ft 5 ins)

F-22A	
Max level speed at height	Mach 2.2 1260 knots 2,333 kmh 1,450 kmh
Max level speed at sea-level	NA
Service ceiling	19800 m 65000 ft
Required runway length	3500 ft
Max Range: with max internal fuel	1550 n miles 2870 km 1784 miles
Max Range: with drop tanks	NA
Equipment for inflight refueling	fitted.

Performance Table

NEUTRAL FIGHTER

JAS 39 GRIPEN



The JAS 39 Gripen is a remarkable achievement by a Swedish consortium to develop an aircraft to replace the Draken and Viggen of the Swedish airforce, and for a lightweight export rival to the F16. The Gripen bears a resemblance to the EuroFighter 2000, and the Dassault Rafale with its agile canard delta shape and fly-by-wire controls. It is however a more economical aircraft, due to its single engine, and light weight.

The aircraft is smaller and half the weight of the Saab Viggen it is designed to replace yet can carry the same weight and number of weapons. Like the Viggen, the Gripen has also been

designed for use on short-airstrips, with operation from road dispersal sights a key consideration. More than 30% of the airframe is made up of advanced materials, and its cockpit is an advanced design based on Multi-Function Displays. The aircraft is now being marketed by British Aerospace.

ARMAMENT

One 27mm gun, with five hardpoints for: the AIM 120 AMRAAM medium range, the AIM 9 Sidewinder Short-Range air-to-air missiles, the RB75 Maverick air-to-surface missiles, the RB15F anti ship missile, sub munition dispensers, unguided rockets, cluster bombs, free fall, and retarded bombs.
Maximum external fuel or weapons payload is 4000 kg (8800 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

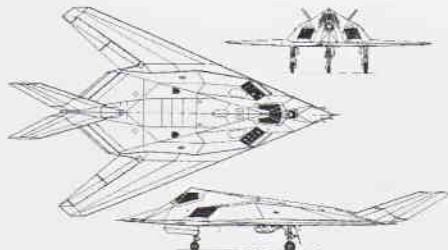
Wingspan	8.4m (27 ft 6.7 in)
Length	14.1m (46 ft 3 in)
Height	4.5m (14 ft 9 in)

JAS 39 GRIPEN	
Max level speed at height	NA
Max level speed at sea-level	NA
Service ceiling	NA
Required runway length	800 m 2625 ft
Max Range: with max internal fuel	NA
Max Range: with drop tanks	NA

Performance Table

NATO STRIKE AIRCRAFT/BOMBERS

LOCKHEED F-117A STEALTH FIGHTER



The F-117A was a result of the highly secret 'Have Blue' Program to develop aircraft that are virtually undetectable by radar and infra-red.

For several years the US Government tried to keep the existence of the F-117A an absolute secret. However, after the crashes of two aircraft, and the need to train pilots during daylight, plus the growing rumors about the aircraft's existence, the US airforce reluctantly released retouched photographs of the F-117A.

The Gulf war gave the F-117A an unprecedented opportunity to prove its worth. Operating at night without interference the aircraft was able to bomb high value targets with impunity and to great effect.

The solution to radar stealth had been locked away in a century-old set of equations by a Scottish physicist, James Clerk Maxwell. 3D computing had not developed sufficiently in the late 70s to predict all the possible radar reflections from an aircraft in flight. However, by the use of "faceting" (flat skin panels) the number of calculations could be kept to a minimum, hence the F-117A is made entirely of flat panels. The sharp delta shape also reduces radar reflections. The unusual jet pipe design helps to cool the exhaust so as to prevent infrared detection, and missile "lock on".

ARMAMENT

All weapons are carried internally in a large ventral bay. Precision guided weapons are carried such as the laser guided GBU10, GBU12 Paveway 2, and GBU27 Paveway 3. Air-to-air defensive missiles are carried by later variants. Maximum weapons payload is 2270 kg (5000 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wingspan	13.2 m (43 ft 4 in)
Length	20.1 m (65 ft 11 in)
Height	3.78 m (12 ft 5 in)

F-117A	
Max level speed at height	Mach 0.95 545 knots 1,010 kmh 628 mph
Max level speed at sea-level	Mach 1 560 knots 1010kmh 646 mph
Service ceiling	NA
Required runway length	NA
Max Range: with max internal fuel	1000 n miles 1860 km 1156 miles
Max Range: with drop tanks	No external fuel can be carried.
Equipment for inflight refueling is fitted.	

Performance Table

NATO STRIKE AIRCRAFT/BOMBERS

PANAVIA TORNADO GR7



The Tornado was called the MRCA (multi role combat aircraft) by the consortium of British, German and Italian aircraft manufacturers who co-operated to produce this exceptional, low-level strike aircraft, and its reconnaissance, and air-defense variants.

The Tornado features continuously adjustable swing wings to allow it to achieve its ultra low level, high-speed strike mission, and sea-skimming anti-ship role with the German and Italian Navies. During the Gulf war the Tornado's of the RAF were given some of the most heavily defended targets to attack in the first few days.

The Tornado's small wings help it to avoid being deflected by wind gusts at levels as low as 50 feet off the ground. The pilot is assisted by

onboard computers which can automatically fly the aircraft blind in an 'on the deck' terrain following mode down to an altitude of 200 feet.

ARMAMENT

Two 27mm Mauser cannons, with seven hardpoints (wing hardpoints align with the fuselage on wing sweep) for: AIM 9 Sidewinder Short-Range air-to-air missiles, JP233 low-altitude anti airfield sub munitions dispensers, AGM88 HARM, and ALARM anti-radar missile, Sea Eagle and Kormoran anti-ship missiles, Paveway laser guided bombs, unguided rockets, cluster bombs, free fall, and retarded bombs. It can also carry the Matra Apache stand off missile, and has a nuclear capability. Maximum external fuel or weapons payload is 9000 kg (19840 lb.).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wingspan (extended)	13.91 m (45 ft 7.5 in)
Wingspan (swept)	8.6 m (28 ft 2.5 in)
Length	16.72 m (54 ft 10.25 in)
Height	5.95 m (19ft 6.25 in)

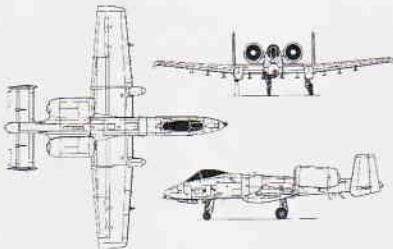
GR7	
Max level speed at height	Mach 2.2 1260 knots 2338 kmh 1453 mph
Max level speed at sea-level	Mach 1.29 850 knots 1575 kmh 980 mph
Service ceiling	15240m 50000 ft
Required runway length	900m 2950ft
Maximum range with internal fuel	1500 n miles 2780 km 1726 mile
Maximum range with drop tanks	2100 n miles 3890 km 2420 miles

Equipment for inflight refueling is fitted.

Performance Table

NATO STRIKE AIRCRAFT

REPUBLIC A-10 THUNDERBOLT



Like many other American aircraft of its generation, the A10 was built after lessons learned in the Vietnam war, and was a radical and ground breaking design that moved away from the quick strike, fast-jet concepts of ground attack.

Though slow, the A10 is a heavily Armored machine, very agile at low altitude with a huge weapons carrying ability. Emphasis was placed on battlefield survival in the face of intense ground fire and the ability to loiter for long periods while choosing suitable victims. Pilots are protected by a titanium bathtub cockpit and, if necessary, the A10 can fly with an engine missing and remain aloft even after severe damage to wing surfaces.

Carried internally along the aircraft centre line is a rapid-fire, rotating barrel gun which fires high explosive and armor penetrating shells the size of pint milk bottles.

ARMAMENT

One 30mm 7 barrel rotary gun. Rate of fire 2100-4200 rounds per minute. The A10 has eleven hardpoints for: the AIM 9 sidewinder short-range air-to-air missiles, the AGM62 Walleye, the Rockeye cluster bomb, and AGM65 Maverick air-to-surface missile, the AGM88 HARM anti radar missile, the AGM114 anti tank missile, laser guided bombs, GBU optically guided bombs, BLU1 or BLU27 napalm bombs, CBU52 or CBU71 bomblet dispensers, unguided rockets, free fall, cluster, and retarded bombs, SUU23 20mm gun pods. Maximum external fuel or weapons payload is 7257 kg (16000 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

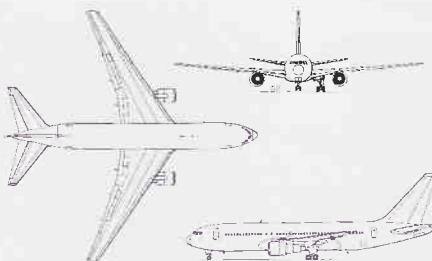
Wingspan	17.53m (57 ft 6 in)
Length	16.26m (53 ft 4 in)
Height	4.4m (14ft 5.5 in)

A-10	
Max speed	399 kts 740 kmh 460 mph
Service ceiling	NA
Required runway length	NA
Maximum range with internal fuel	NA
Maximum range with drop tanks	2365 n miles 4382 km 2723 miles
Close air support radius of action including a 2 hour loiter	250 n miles 463 km 288 miles
Equipment for inflight refueling is fitted.	

Performance Table

NATO SUPPORT AIRCRAFT

BOEING E9 JSTARS



The JSTARS (Joint Surveillance Target Attack Radar System) is carried on the E9 which is based on the Boeing 767* airliner and is designed to operate in conjunction with and to enhance the capabilities of the E3 and E767 AWACS aircraft. The AWACS aircraft with their rotating saucer type radars are excellent for detecting airborne threats and ships at sea but have only limited capability for the detection and tracking of ground vehicles and troop movements.

The surveillance equipment and computers are able to monitor movements on the ground deep within enemy territory while flying in heavily

defended airspace, just as in AWACS, and are able to vector attack aircraft onto threats. Data can be passed to other JSTARS, or AWACS aircraft, attack aircraft, and to ground commanders. The original E8 was rushed into service for the Gulf war while still under development and proved extremely useful for directing the flights of thousands of aircraft and the movements of troops.

The use of airborne control aircraft allows NATO commanders a very fluid real time approach to control of battlefield assets, and all tactical considerations.

ARMAMENT

Wing tip ECM pods, and chaff/flare dispensers are carried. In war time the aircraft would be protected by a combat air patrol.

TECHNICAL SPECIFICATIONS

Dimensions

Wingspan	47.57m (156 ft 1 in)
Length	48.51m (159 ft 2 in)
Height	15.85m (52 ft)

	E9 JSTARS
Max speed	N/A
Cruising speed	Mach 0.8 535 kts 991 kmh 616 mph
Service ceiling	13,100 m 43,000 ft
Required runway length	2,774 m 9,100 ft
Maximum range with internal fuel	5,000 n miles 9,260 km 5,754 miles
Endurance at radius	7 hours 1,000 n miles 1,852 km 1,151 miles
Equipment for inflight refueling is fitted.	

Performance Table

* EF2000 Game only.

NATO SUPPORT AIRCRAFT

BOEING R767



The R767 is based on the same Boeing 767-200 airframe as the E767. The aircraft is fitted with a combined boom and drogue refueling probe. US Airforce aircraft use the boom for Refueling, Navy and Marines aircraft use the same drogue refueling method as the RAF and Royal Navy.

The twin turbofan Boeing airframe is more economical to use than previous refueling tankers based on the triple engine McDonnel

Douglas DC10. This combined with the huge amount of onboard fuel allows the aircraft to remain on refueling station for longer, or to refuel a greater number of aircraft.

Future versions of the R767 will be based on the 300 series airliner which features a stretched fuselage and is able to carry a greater weight of fuel.

ARMAMENT

The R767 is equipped with ECM, and chaff/flare dispensers.

TECHNICAL SPECIFICATIONS

Dimensions

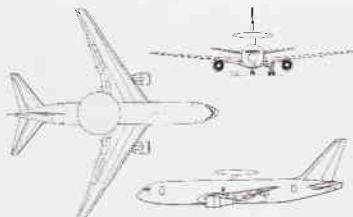
Wingspan	47.57m (156 ft 1 in)
Length	48.51m (159 ft 2 in)
Height	15.85m (52 ft)

	R767
Cruising speed	Mach 0.8 535 kts 991 kmh 616 mph
Service ceiling	13,100 m 43,000 ft
Required runway length	2,774 m 9,100 ft
Maximum range with internal fuel	5,000 n miles 9,260 km 5,754 miles
Equipment for inflight refueling is fitted.	

Performance Table

NATO SUPPORT AIRCRAFT

BOEING E767 SENTRY



Based on the extended range versions of the Boeing 767/200 Airliner, the E767 carries up rated and enhanced versions of equipment originally fitted in the Boeing 767 based E3 AWACS (airborne warning and control system) aircraft. Originally inspired by a Japanese AWACS requirement, the E767 has since gone into service with the US Airforce and other military users.

The saucer like radome mounted on the rear fuselage rotates through 360 degrees at a constant 6 rpm, and is able to pick up targets as small as cruise missiles flying rapidly at low level over water or land. To avoid air turbulence problems caused by the large radome in the tanker aircraft's slip stream the E767 airborne refueling point is on the port outer wing. With a

range of 370 km (230 miles) and covering all altitudes from ground to stratosphere the radar system can locate and track multiple aircraft and ship targets with automatic interrogation. Computers on board can pass digital information to other AWACS, or JSTARS aircraft, directly to attacking fighters or strike aircraft, and also to forces on the ground. It is even possible for an air interception officer on the AWACS aircraft to take positive control of a fighter 100 miles away during a live intercept, and to see on his console what the fighter pilot's radar is displaying.

ARMAMENT

The E767 is equipped with extensive ECM, and chaff/flare dispensers. The aircraft is unarmed but in wartime would be protected by a CAP (combat air patrol). Radars can be turned off and surveillance or tracking continued in the stealthy infrared band.

TECHNICAL SPECIFICATIONS

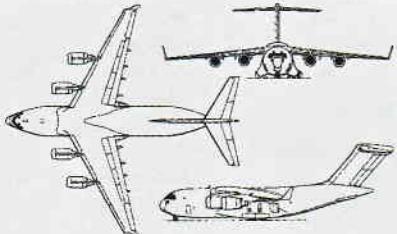
Dimensions

Wingspan	47.57m (156 ft 1 in)
Length	48.51m (159 ft 2 in)
Height	15.85m (52 ft)

	E767
Max speed	NA
Cruising speed	Mach 0.8 535 kts 991 kmh 616 mph
Service ceiling	13,100 m 43,000 ft
Required runway length	2,774 m 9,100 ft
Maximum range with internal fuel	5,000n miles 9,260 km 5,754 miles
Endurance at radius	7 hours. 1,000 n miles, 1,852 km, 1,151 miles
Maximum endurance with inflight refueling	22 hours.
Equipment for inflight refueling is fitted	

NATO SUPPORT AIRCRAFT

LOCKHEED C-17 GLOBEMASTER



The US Airforce normally moves freight in peacetime and war, through a hub and spoke system. Large transports such as the C-5 Galaxy carry a cargo to the destination, where a smaller transporter capable of landing on rough airstrips, usually the C-130 Hercules, will distribute the cargo to the exact location. However, the C-130 is not able to carry large items of equipment such as main battle tanks.

Against this background the US Airforce realized it had a need for an aircraft capable of carrying the large, heavy loads handled by the C-5 with its intercontinental range, able to fly direct from the USA and land at the battlefield on hastily prepared airstrips like the C-130.

The C-17 Globemaster won the competition to fulfill this role. Despite Government changes of plan and escalating costs, the aircraft entered

service in 1994. The first US transport to combine fly by wire, glass screen instruments, and a HUD (Head Up Display), the C-17 is partly constructed from composite structures. The wings employ tip mounted winglets for cruise efficiency, and the four turbo fans blow their exhaust stream through and across large double-slotted flaps for a superb STOL (short take off and landing) performance.

The fuselage diameter is equal to that of the C-5 Galaxy, the hold measures 26.82 meters (88 feet) long, and 5.49 meters (18 feet) wide, being able to swallow main battle tanks through the rear ramp/door.

The C-17 is compatible with LAPES (low altitude parachute extraction system). Pallets containing up to 60,000 lb of cargo each can be dragged from the rear of the cargo bay by chutes while the aircraft is kept automatically at a constant ten feet altitude. Surprisingly this is a very effective delivery method when the ground is too rough to land on!

ARMAMENT

Chaff/Flare dispensers and ECM pods can be fitted. Maximum payload is 76,657 kg (169,000 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

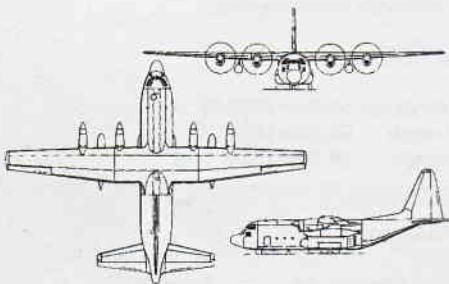
Wingspan 50.29m (165 ft)
Length 53.04m (174 ft)
Height 16.79m (55 ft 1 in)

	C-17
Max speed	NA
Cruising speed	Mach 0.77 515 kts 954 kmh 593 mph
Service ceiling	13,715 m 45,000 ft
Required runway length	915 m 3000 ft
Maximum range with internal fuel	4,700 n miles 8,704 km 5,408 miles
Equipment for inflight refueling is fitted.	

Performance Table

NATO SUPPORT AIRCRAFT

LOCKHEED HERCULES C130



In 1950 the US Airforce became involved in the Korean war and found that its C119 Flying Boxcar tactical transport which had only just entered service lacked adequate range and payload carrying ability. The US Airforce issued a requirement calling for a transport with the ability to carry ninety two men over a radius of 1,100 nautical miles, 2,038 kilometers, 1,267 miles, or able to carry a freight payload of 30,000 lb over a radius of 950 nautical miles, 1,760 kilometers, 1,093 miles. The aircraft must have side and rear doors capable of being opened in flight and be able to fly slow enough to deploy paratroopers or parachute equipped freight from these doors.

Provision had been made for the C130 to use the RATO (rocket assisted take off) system for dramatically short take offs. The aircraft's range with internal fuel was improved, it was later able to be fitted with two non-jettisonable external fuel tanks between the engine nacelles.

The C130 has over the last forty years taken on the tough role of the much loved C47 Dakota.

ARMAMENT

The Hercules is not armed, though usually carries flare launchers used to decoy infrared missiles. Maximum payload is 17,555 kg (38,702 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wingspan	40.41m (132 ft 7 in)
Length	29.79m (97 ft 9 in)
Height	11.66m (38 ft 3 in)

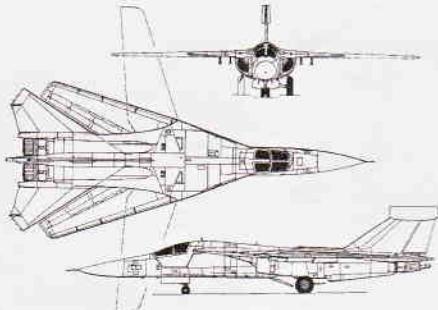
	C130
Max speed	335 kts 621 kmh 386 mph
Cruising speed	325 kts 602 kmh 374 mph
Service ceiling	7,010m 23,000 ft
Required runway length	1,311m 4,300 ft
Maximum range with Internal fuel	2,100 n miles 3,890 km 2,418 mls
Maximum range with drop tanks	4,745 n miles 8,793 km 5,464 miles

Equipment for inflight refueling is fitted.

Performance Table

NATO SUPPORT AIRCRAFT

LOCKHEED EF-111 RAVEN



Entering service in 1967, the EF-111 had a difficult start to life when three of the first six aircraft were lost in Vietnam within the first few days of the type's combat debut, amid Government criticism of escalating costs and complexity.

The EF-111 has shown in service that it was worth all the extra costs, an aircraft way ahead of its time with its swing wings, and automated ground-hugging attack capability. For many years the EF-111 was considered to be the most effective all-weather strike aircraft in the world.

The EF-111 has consistently proved its ability to deliver precision ground attack munitions in any weather. The EF-111 was undoubtedly the 'improved tactics' mentioned in briefings during the Gulf War being the only aircraft able to drop the huge GBU28 4700 lb laser guided bomb.

The EF-111 featured in the game is an all weather electronic counter measures variant, used to provide disruptive jamming for Anti-AWACS, interdiction and other strike missions.

ARMAMENT

One large internal weapons bay, used for counter-measures equipment in the EF-111 Raven. No other weapons are carried.

Maximum external fuel or weapons payload is 12290 kg (31500 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wingspan (spread)	19.2m (63 ft)
Wingspan (swept)	9.74m (31ft 1.5 in)
Length	22.4m (73 ft 6 in)
Height	5.22m (17ft 1.5 in)

	EF-111
Max level speed at height	Mach 2.2 1260 knots 2335 kmh 1450 mph
Max level speed at sea-level	Mach 1.2 790 knots 1470 kmh 910 mph
Service ceiling	18300 m 60000 ft
Required runway length	914m 3000 ft
Max Range: with max internal fuel	3304 n miles 6115 km 3800 miles
Max Range: with drop tanks	NA
Equipment for inflight refueling is fitted.	

Performance Table

RUSSIAN AIRCRAFT

RUSSIAN FIGHTERS



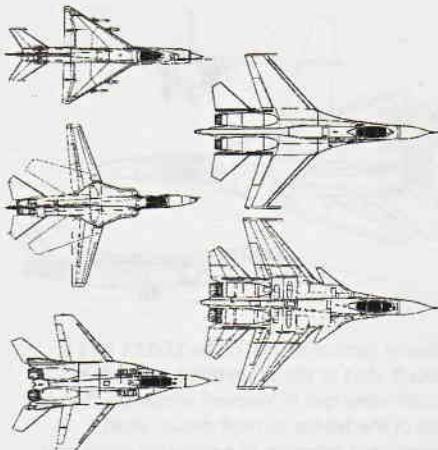
Following the collapse of the USSR, the Russian aerospace industry fell into sharp decline, with factories being converted to produce anything from kitchen sieves to knitting machines. However, there were eager customers for the Russian's low-priced, high-performance aircraft, and before the turn of the century, production was back in full swing. Buyers include many regimes hostile to NATO, and profits are being ploughed back into research. The West is once more under threat, in both a commercial and military sense.

A favorite export model is the Sukhoi SU-35 the threat which EuroFighter is designed to beat. However, new developments in avionics, engines and weaponry have given the plane remarkable

performance. . . an aircraft worthy of respect, even by the EF2000 pilot.

At the outbreak of war, rumors quickly spread of a new generation of Russian Super-Fighter based on the MIG-1.42, later designated MIG-33 and code-named Flashback. Satellite photography suggests the presence of a new type in the North Cape area, but combat reports are non-existent – possibly because no NATO pilot ever survived an encounter.

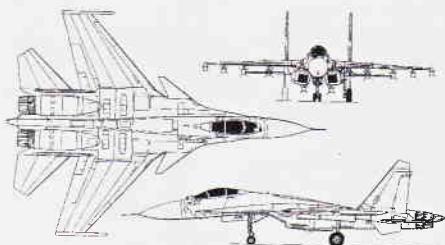
In contrast, the Russians hold a great many ageing planes in reserve, including the venerable MiG-21, which is relegated to back-line defense and close air-support in times of great need. Hopelessly out-of date in 2010, they are theoretically easy game for an EF2000, but thanks to upgraded avionics and sheer numbers, are still proving dangerous in close combat.



Anti-clockwise from top left: MiG-21, MiG-27, MiG-29, Su-35, Su-27

RUSSIAN FIGHTERS

SUKHOI SU-35



An impressive single-seat all-weather counter-air fighter and ground attack aircraft, derived from the SU-27, with an up rated airframe containing a high proportion of carbon-fibre and aluminium-lithium alloy. The engines, avionics and armaments are also improvements on those originally installed in the SU-27.

The SU-35 features fly-by-wire, relaxed static instability, and three-dimensional thrust vectoring, all of which give the aircraft tremendous agility. It incorporates state-of-the-art ECM in wing-tip pods, allowing improved survivability in electronic warfare environments. The N011 multi-mode radar is effective at ranges up to 250 miles, and has the ability to engage six targets simultaneously. Some models also

feature a rearward facing radar. Like EuroFighter, the SU-35 is equipped with TIALD, providing pinpoint precision in the delivery of laser-guided weapons.

Enormous power is delivered by two Saturn/Lyulka AL-31 FM turbofans, developing 30,865 lb st each with afterburning – almost one third more power than the standard EuroFighter engine.

ARMAMENT

One 30 mm GSh-30 gun, plus hard-points for 14 stores, including R-27 (AA-10 Alamo-A/B/C/D), R-40 (AA-6 Acrid), R-60 (AA-8 Aphid), R-73A (AA-1 Archer) and R-77 (AA-12) AMRAAM air-to-air missiles, Kh-21ML (AS-10 Karen), Kh-25MP (AS-12 Kegler), Kh-29 (AS-14 Kedge) and Kh-31 (AS-17 Krypton) air-to-surface missiles, KAB-500 bombs and rocket packs. Maximum weapons payload load is 8,000 kg (17,635 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wing span: 15.00 m (49 ft 2.5 in)
Length: 22.00 m (72 ft 2.4 in)
Height: 6.00 m (19 ft 8 in)

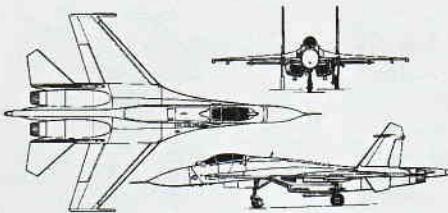
SU-35	
Max level speed at height	Mach 2.35 1,349 knots 2,500 km/h 1,553 mph
Max level speed at sea-level	Mach 1.18 737 knots 1,364 km/h 848 mph
Service ceiling	18,000 m 59,055 ft
Balanced runway length	600 m 1,970 ft
Range: with max internal fuel	2,160 nm + 4,000 km + 2,485 miles +

Equipment for inflight refueling is fitted

[Performance Table](#)

RUSSIAN FIGHTERS

SUKHOI SU-27 AND SU-33



The SU-27 was built to replace the YAK-28, SU-15, and the TU-28 Interceptors. The fighter was intended to fulfill an escort role for the SU-24 deep penetration strike aircraft during which operations the SU-27 was expected to be able to engage F-15 and F-16 fighters.

The SU-27 was given exceptional range on internal fuel as the SU-24 was not capable of inflight refueling, an error rectified in later versions of the aircraft. The SU-27 is controlled with an analogue fly by wire system and features exceptionally powerful engines rated at 27550 lbs thrust with afterburning. The long swooping nose, widely spaced engine pods, and twin-tailed design resembles the MIG-29 which was designed at the same time.

The pilot has a helmet mounted target designator which is integrated with the fire control system and operates a slave laser range finder and infrared tracker. The onboard computers can return the aircraft to level flight from any angle if the "panic button" is used.

The SU-33 is the latest naval version of the SU-27, and has canards like the SU-35.

ARMAMENT

One 30mm gun, and ten hardpoints for: the R27R (AA10 ALAMO A), R27T (AA10 ALAMO B), R27ER (AA10 ALAMO C), R27ET (AA10 ALAMO D), R73A (AA11 ARCHER), R60 (AA8 APHID), and R33 (AA9 AMOS) air to air missiles. Bombs, and unguided rockets can be carried in a secondary air-to-ground role.

Maximum external weapons payload is 6000 kg (13228 lb).

TECHNICAL SPECIFICATIONS

Dimensions

Wingspan	14.7m (48 ft 2.75 in)
Length	21.93m (71 ft 11.5 in)
Height	5.93m (19 ft 5.5 in)

	SU-27
Max level speed at height	Mach 2.35 1,349 knots 2,500 km/h 1,553 mph
Max level speed at sea-level	Mach 1.1 635 knots 1,176 km/h 730 mph
Service ceiling	18,000 m 59,055 ft
Required runway length	600 m 1,970 ft
Range: with max internal fuel	2,159 nm 4,000 km 2,486 miles

Performance Table

RUSSIAN FIGHTERS

MIKOYAN GUREVICH MiG-29



The MiG-29 was a result of a 1972 Soviet airforce requirement for a fighter to replace the MiG-21, and SU-15 air combat fighters, plus a secondary role replacing the MiG-23, and SU-17 ground attack aircraft. Mikoyan Gurevich aimed to produce an aircraft that was at least as good as the F-15.

As most Russian aircraft are designed to operate from rough airfields when necessary, the MiG-29 has a very unusual door system which blanks the large under-fuselage intakes from mud and ice thrown up from the front wheel. From the MiG-29M onwards this system was deleted because of weight, and replaced by a retractable grille system.

The radar laser range finder and infra-red detectors are all linked together by the fire control system and work with the pilot's helmet mounted target designator as on the SU-27.

In the late 80's the MiG-29 competed against the SU-27 for more Russian airforce orders, but lost the competition through not having enough range, and weapon capability. The MiG-29M was developed after this competition with improved range, performance, and weapon carrying ability.

ARMAMENT

One 30 mm gun. The MiG-29 has six hardpoints (eight on the MiG-29M) for: the R27R (AA10 ALAMO A), R60MK (AA8 aphid), R73E (AA11 archer), air-to-air missiles, KMGU-2 submunitions dispensers, napalm, free fall and unguided rockets. Maximum external weapons payload is 3000 kg (6614 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

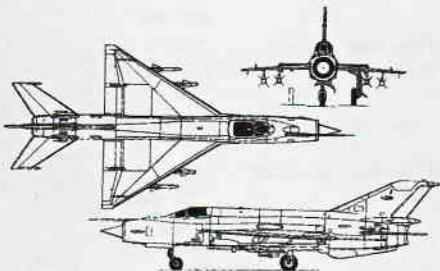
Wingspan 11.36m (37 ft 3.25 in)
Length 17.32m (56 ft 9.85 in)
Height 4.73m (15 ft 6.2 in)

MIG-29	
Max. level speed at height	Mach 2.3 1319 knots 2445 kmh 1519 mph
Max. level speed at sea level	Mach 1.06 700 knots 1300 kmh 805 mph
Service ceiling	17000 m 55775 ft
Required runway length	600 m
Maximum range with internal fuel	1970 ft 810 n miles 1500 km 932 miles
Maximum range with drop tanks	1565 n miles 2900 km 1800 miles

Performance Table

RUSSIAN FIGHTERS

MIKOYAN GUREVICH MiG-21



The MiG-21 was designed after lessons learned by the Russians during the Korean war. Intended to fulfill the same air superiority mission as the contemporary American F-104 Starfighter, and the French Mirage, the MiG-21 adopted a different design layout to either of these aircraft. Initially the Mikoyan Gurevich design team could not decide between the swept wing prototype and the delta wing prototype. Eventually after much flight testing they selected the delta wing prototype on the grounds that it would carry more fuel and have more development potential.

The MiG-21 has been produced in more versions and in far greater numbers than any aircraft since the Second World War, and is probably the best known Soviet aircraft. Originally an

interceptor the designers kept the weight of fuel carried to a minimum to give the aircraft the best rate of climb possible. This lack of internal fuel and the inability to carry more than three small drop tanks, has left the MiG-21 short on range. The MiG-21 has been used by all the airforces of the ex-Eastern Bloc, and many others including airforces as far apart as Finland and China. Despite the age of this fighter design, its small size, agility, and speed make it a difficult target and a dangerous opponent. Because the radar is situated in the inlet duct, the MiG-21 cannot be equipped with the latest radars, and even the most up-to-date versions have very limited all weather capability.

ARMAMENT

One 30mm gun and four wing hardpoints for: the R3 (AA2 ATOLL), and R3 (AA2-2 advanced ATOLL) air-to-air missiles, free fall bombs, and unguided rockets.
Maximum external weapons payload is 1500 kg (3307 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

Wing span:	7.15m (23ft 5.5in)
Length	15.76m (51 ft 8.5 in)
Height	5m (14 ft 9 in)

MIG-21	
Max level speed at height	Mach 2.1 1,203 knots 2,230 km/h 1,385 mph
Max level speed at sea-level	Mach 1.06 702 knots 1,300 km/h 807 mph
Service ceiling	15,250 m 50,035 ft
Balanced runway length	1,200 m 3,940 ft
Required runway length	600 m 1970 ft
Range: with max internal fuel	593 nm 1,100 km 683 miles
Range: with drop tanks	971 nm 1,800 km 1,118 miles

Performance Table

RUSSIAN STRIKE AIRCRAFT

MIKOYAN GUREVICH MiG-27



The MiG-27 is an improved version of the close air support and ground attack MiG-23 swing-wing fighter bomber, designed to fly at a slower speed, and lower altitude, carrying a larger weapon load with better radar and precision missile aiming equipment. The pilot is seated higher for better visibility, and enjoys the protection of improved armor. Navigation and attack systems have been included in the design to give the MiG-27 an all weather attack capability. The nose has a flattened glass underside, which contains the TV tracker unit and laser range finder/designator.

The aircraft is able to carry an under fuselage gun pack that has depressable barrels, so the aircraft can strafe the ground while in level flight. Alternatively a battlefield reconnaissance pod can be fitted. The MiG-27 has also been operated from Soviet aircraft carriers.

ARMAMENT

One 23mm twin barrel gun, with seven hardpoints for: the R3 (AA2 ATOLL), and R60 (AA8 APHID) air-to-air missiles, KH23 (AS7 KERRY), KH25ML (AS10 KAREN), and KH25MP (AS12 KEGLER), air-to-surface missiles, AS9 (KYLE) anti radar missiles, free fall bombs, napalm, and unguided rockets. Maximum external fuel and weapons payload is 4000 kg (8818 lb).

TECHNICAL SPECIFICATIONS

DIMENSIONS

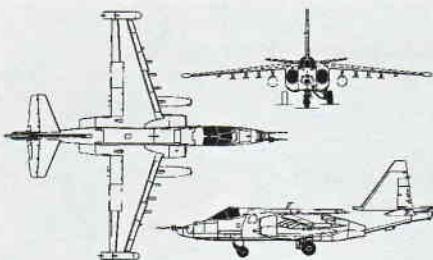
Wingspan (spread)	13.96m (45 ft 9.8 in)
Wingspan (swept)	7.78m (25 ft 6.25 in)
Length	17.08m (56 ft 0.25 in)
Height	5m (16 ft 5 in)

	MiG-27
Max level speed at height	Mach 1.77 1,017 knots 1,885 km/h 1,170 mph
Max level speed at sea-level	Mach 1.1 635 knots 1,176 km/h 730 mph
Service ceiling	14,000 m 45,930 ft
Required runway length	950 m 3,120 ft
Range: with max internal fuel	242 nm 450 km 280 miles
Range: with drop tanks	1,737 nm 3,220 km 2,000 miles

Performance Table

RUSSIAN STRIKE AIRCRAFT/BOMBERS

SUKHOI SU25/39



The SU-25 follows the design of the trail blazing A10 of the USA. The layout is different from the A10 but similar in many areas including the pilot's seating within a "bathtub" of titanium armor, and the ability to operate from rough frontline airstrips. All fuel lines are shrouded in fire resistant foam, the engines are enclosed in stainless steel boxes. Early aircraft were very basic in their flying controls but of greater performance than the A10 due to lighter unladen weight and higher performance engines.

Later versions (SU-28), like the A10 have the nose wheel offset to port to allow the gun to be center line mounted in the front fuselage. Targeting equipment has been fitted, including a

magnifying TV camera, and targets are picked out on the pilot's head up display. Infrared sensors are fitted for all weather attack.

The latest version is designated SU-39 and carries much more fuel, better sensors, and has much improved performance, being optimized for battlefield and anti-tank attacks.

ARMAMENT

One 30mm twin barrel gun. The SU25 has ten hardpoints for: two R3 (AA2 ATOLL), or R60 (AA8 APHID), defensive air-to-air missiles, KH58 (AS11 KITTEN) anti radar missiles, free fall and retarded bombs, laser guided bombs, and unguided rockets SPPU22 gun pods each containing one 23 mm twin barrel gun with depressed barrels for strafing attacks. Maximum weapons payload is 4400kg (9700 lb).

TECHNICAL SPECIFICATIONS

Dimensions

Wingspan	14.36m (47 ft 1.4 in)
Length	15.53m (50 ft 11.5 in)
Height	4.8m (15 ft 9 in)

	SU25
Max level speed	526 knots 975 kmh 606 mph
Service ceiling	7000 m 22965 ft
Required runway length	1300 m 4265 ft
Maximum range with internal fuel	515 n miles 950 km 590 miles
Maximum range with drop tanks	565 n miles 1050 km 650 miles

Performance Table

RUSSIAN STRIKE AIRCRAFT

SUKHOI SU-34



The SU-34 is a development of the SU-27 but intended for the long range strike and ground attack role. Its airframe is similar but has a wider nose with side by side seating in a similar fashion to the F-111 and small canard foreplanes. The tail cone now houses a rearward facing warning radar. The aircraft is believed to carry defensive rearward facing air-to-air missiles.

The SU-34 has a new terrain following and navigation/attack radar combined with a modern multi function display cockpit. While the foreplanes are sited in the same position as on the SU-35 fighter, the main undercarriage has noticeably bigger all terrain twin wheel gear units. Internal fuel tankage is large by western standards.

ARMAMENT

One 30mm gun. The SU-34 has ten hardpoints for R73 (AA11 archer), and R77 (AA12 AMRAAM type) air-to-air missiles, unspecified precision guided air to surface missiles, KAB 500 laser guided bombs, cluster bombs, free fall and retarded bombs, nuclear bomb and missile carrying ability.

Maximum external fuel or weapons payload is unknown, but likely to exceed that of the SU-27/SU-35.

TECHNICAL SPECIFICATIONS

Dimensions

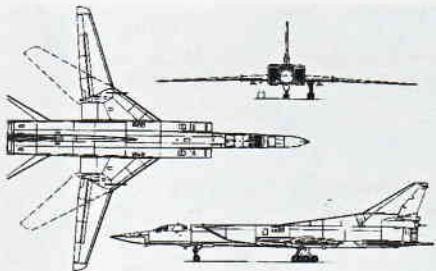
Wingspan	14.7m (48 ft 2.75 in)
Length	22.4m (73 ft 6 in)
Height	5.93m (19ft 5.5 in)

Max level speed at height	M SU-34 Mach 1.8 1035 knots 1915 kmh 1190 mph
Max level speed at sea level	Mach 1.15 695 knots 1,287 kmh 800 mph
Service ceiling	18000 m 59055 f
Required runway length	NA
Maximum range with internal fuel	2160 n miles 4000 km 2485 miles
Maximum range with drop tanks	NA

Performance Table

RUSSIAN STRIKE AIRCRAFT/BOMBERS

TUPOLEV TU22M



The TU22M is a considerably reworked version of the TU22 supersonic bomber which had proved very disappointing in range and airfield performance. The turbojet engines were changed for more economical turbofans, and moved from their tail fin side by side location to a fighter like position side by side in the rear fuselage fed by side mounted wedge intakes.

The outer panels of the wings are of variable geometry (swing wing) to reduce the takeoff run, and are equipped with lift improving flaps, and full span slats.

The radar operated tail gun was aerodynamically smoothed out to reduce drag, and a rotary missile launcher added within the ventral weapons bay.

The aircraft is used for strategic nuclear attack by the Airforce, and for electronic reconnaissance, and anti shipping strikes by the Navy. The TU22M was originally thought to be designated the TU26 by Western observers, however after the Cold War eased in the early 90's this was found to be wrong.

ARMAMENT

Two 23mm radar controlled guns in a turret. The TU22M has four hardpoints and a ventral weapons bay for: The AS4 (Kitchen) long range air to surface missile, free fall nuclear or conventional bombs.
Maximum weapons payload is 12000 kg (26455 lb).

TECHNICAL SPECIFICATIONS

Dimensions

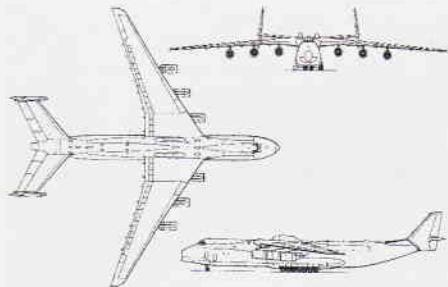
Wingspan	34.3m (112 ft 6.5 in)
Wingspan (swept)	23.4m (76 ft 9.25 in)
Length	39.6m (129 ft 11 in)
Height	10.8m (35 ft 5.25 in)

Max level speed at height	TU22M Mach 2 1146 knots 2125 kmh 1320 mph
Max level speed at sea level	Mach 0.86 567 knots 1050 kmh 652 mph
Service ceiling	18000 m 59055 ft
Required runway length	2000 m 6560 ft
Maximum range with internal fuel	1188 n miles 2200 km 1365 miles
Maximum range with drop tanks	6476 n miles 12000 km 7457 miles

Performance Table

RUSSIAN SUPPORT AIRCRAFT

ANTONOV AN225



The AN225 is the world's biggest aircraft, and was the first to fly weighing more than 1,000,000 lb. The aircraft is based on the four turbofan Antonov 124 with the addition of two extra engines, longer wings, and fuselage. The tail surfaces were replaced by substantially larger horizontal stabilizers and twin vertical tails placed widely apart so as to receive adequate air flow when carrying outsize loads on top of the fuselage, roof rack fashion!

Behind the wing and above the hold there is a cabin with seating for sixty to seventy people.

In order to cope with the huge weight of the aircraft on landing, the AN225 is equipped with twin steerable nose undercarriage mounted side by side, and no less than seven independently retracting twin wheel main legs per side. In order to help loading, the aircraft nose undercarriage can retract while on the ground allowing the aircraft to settle on to two extendible feet. The AN225 was planned to be enlarged further with a total of eight engines for use as an airborne launcher for European reusable space planes.

ARMAMENT

ECM pods and Chaff/Flare dispensers can be carried. Maximum payload carried internally or externally is 250,000 kg (551,150 lb).

TECHNICAL SPECIFICATIONS

Dimensions

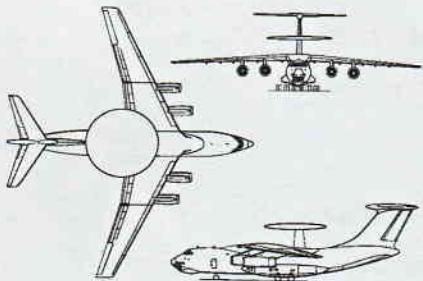
Wingspan	88.4m (290 ft)
Length	84m (275 ft 7 in)
Height	18.2m (59 ft 8.5 in)

	AN225
Max speed	NA
Cruising speed	Mach 0.64 432 kts 800 kmh 497 mph
Service ceiling	NA
Required runway length	3,500 m 11,485 ft
Maximum range with internal fuel	8,310 n miles 15,4000 km 9,570 miles
Maximum range with full (internal) load on internal fuel	2,425 n miles 4,500 km 2,795 miles
Maximum range with drop tanks	not fitted

Performance Table

RUSSIAN SUPPORT AIRCRAFT

BERIEV A50



A development of the IL76 airframe, the A50 is altered and fitted out by Beriev. The tail doors and cargo deck are replaced by comprehensive electronics and seating for a crew of fifteen. As in Western AEW (airborne early warning aircraft), a large rotating "saucer" radome has been added on twin struts on top of the aircraft fuselage. This radome is capable of locating and tracking aircraft through 360 degrees over land or water. The A50 is not fully developed. Due to the weight of equipment on board, the aircraft cannot take off with a full fuel load and has great difficulty refueling in flight due to buffeting caused by the radome in a tanker's slip stream.

As a result the A50 is short on endurance. Furthermore the lack of a crew rest area and proper toilet/galley facilities ensures early crew fatigue.

Due to economic shortages during the breakup of the USSR the production rate slowed down with the result that the modern Russian Airforce has been hampered by an insufficient number of AEW aircraft on occasion to control available resources. The A50 will almost certainly be developed further.

ARMAMENT

The A50 is fitted with wing tip ECM pods and chaff/flare dispensers.

TECHNICAL SPECIFICATIONS

Dimensions

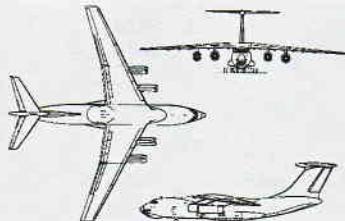
Wingspan	50.5m (165 ft 8 in)
Length	46.59m (152 ft 10.5 in)
Height	14.76m (48 ft 5 in)

	A50
Max speed	Mach 0.68 459 kts 850 kmh 528 mph
Cruising speed	Mach 0.64 432 kts 800 kmh 497 mph
Service ceiling	14,500 m 47,570 ft
Required runway length	850 m 2790 ft
Maximum range with internal fuel	Unknown but considerably less than the IL76
Maximum range with drop tanks	Not equipped
Equipment for inflight refueling is fitted but virtually unusable due to aerodynamic turbulence.	

Performance Table

RUSSIAN SUPPORT AIRCRAFT

ILYUSHIN IL76/78



Inspired by the American C141 Star lifter in shape and layout, the IL76 was however designed to meet much tougher requirements placed by the Soviet airforce in the late 1960's. The new transport must be able to carry 40,000 kg (88,183 lb) a distance of 2,698 nautical miles, 5,000 kilometers, 3,107 miles in less than six hours. It must also be able to operate in all weathers, night and day in the worst weather that the far flung parts of Arctic Russia and Siberia could muster. Furthermore the aircraft must be able to land and take off from rough airstrips that might be no more than an expanse of grass or compacted snow! The wings carry high lift devices for an impressive short field performance, including full span slats, and triple slot flaps over 75% of the span. The success of the IL76 airframe is such that a tanker version called the IL78 has been developed.

Each aircraft carries three refueling drogues which are trailed from pods fitted under each wing outer panel and one on the port side of the rear fuselage. The pods use a windmill ram air powered pump to deliver fuel at a rate far above any Western system for very quick aerial "pit-stops". The IL76/78 has further become the basis of the IL76 flying command post and the Beriev A50 Airborne early warning aircraft, and has been bought by military and civil users in both East and the West.

ARMAMENT

All IL76 are equipped for use of chaff/flare dispensers. Military transports have a tail position for two 23mm guns, though these are not always fitted. Maximum payload is 40,000 kg (88,183 lb).

TECHNICAL SPECIFICATIONS

Dimensions

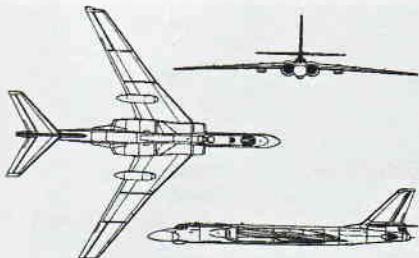
Wingspan	50.5m (165 ft 8 in)
Length	46.59m (152 ft 10.5 in)
Height	14.76m (48 ft 5 in)

IL76/78	
Max speed	Mach 0.68 459 kts 850 kmh/528 mph
Cruising speed	Mach 0.64 432 kts 800 kmh/497 mph
Cruising speed IL78	Mach 0.6 405 kts 750 kmh/466 mph
Service ceiling	14,500m/47,570 ft
Required runway length	3,617 n miles 2790 ft
Maximum range with internal fuel	6,700 km 4,163 miles
Maximum range fully with internal fuel	1,970 n miles loaded 3,650 km 2,265 miles
Maximum range with drop tanks	Not equipped
Equipment for inflight refueling is fitted.	

Performance Table

RUSSIAN SUPPORT AIRCRAFT

TUPOLEV TU16



When the Tupolev 16 entered service in 1954 it was quite a remarkable aircraft, being built from a new lightweight aluminum alloy, and having a considerable range made possible by the newly designed Mikulin AM3 turbo jet.

Originally the main bomb load was to be one huge 9000 kg (19841 lb) free fall bomb, or a large number of small free fall bombs.

Over the years the TU16 has been developed into a myriad of versions to carry enormous early cruise missiles such as the now outdated KS1 (AS1 Kennel). Anti ship versions carried torpedoes or mines, and early in its career the Soviet airforce developed the unusual technique

of wing tip to wing tip inflight refueling with a hose trailed by one TU16 to refuel another.

Of the original 2000 aircraft built 700 remain in service, providing over the horizon, mid-course guidance for Russian Navy anti-ship cruise missiles. Other versions carry the K26 (AS6 Kingfish) anti-ship missile, or have been converted into refueling tankers, and electronic surveillance aircraft.

ARMAMENT

One 23 mm gun in the nose, twin 23 mm turrets in the tail, ventral, and dorsal positions. The TU16 has one large ventral weapons bay for stand off missiles, free fall bombs with nuclear or conventional warheads. Naval versions are equipped to carry long range anti ship missiles, free fall bombs, torpedoes, and mines. Maximum weapons payload is 9000 kg (19800 lb).

TECHNICAL SPECIFICATIONS

Dimensions

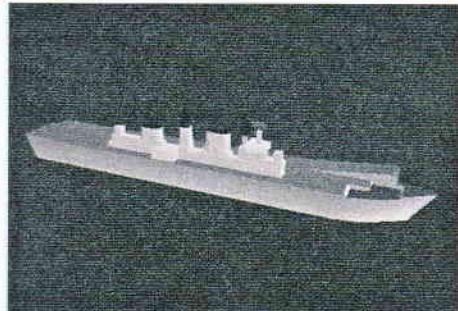
Wingspan	32.99m (108 ft 3 in)
Length	34.8m (114 ft 2 in)
Height	10.36m (34 ft)

TU16	
Max level speed	567 knots 1050 kmh 652 mph
Service ceiling	15000m 49200 ft
Required runway length	NA
Maximum range with internal fuel	3198 n miles 5925 km 3682 miles
Maximum range with drop tanks	not equipped to carry external fuel tanks
Equipment for inflight refueling is fitted	

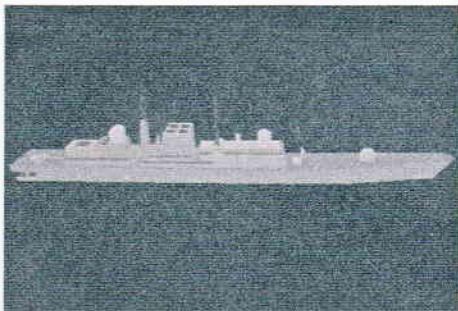
Performance Table

SHIPS

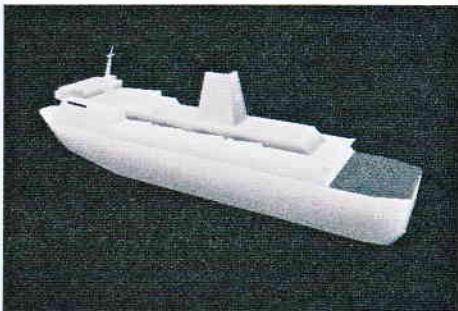
NATO FLEET



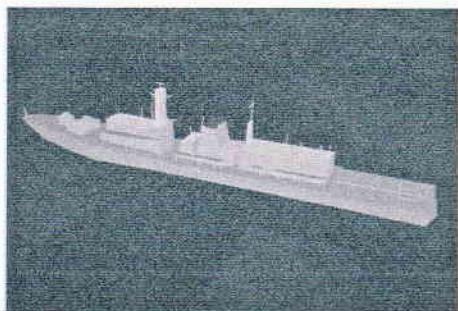
Invincible class carrier



Type 42 destroyer



Hospital ship



Type 23 destroyer



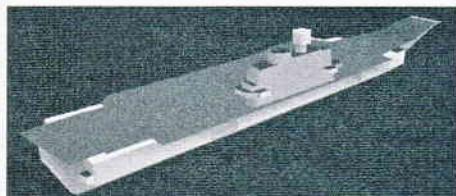
Vanguard submarine



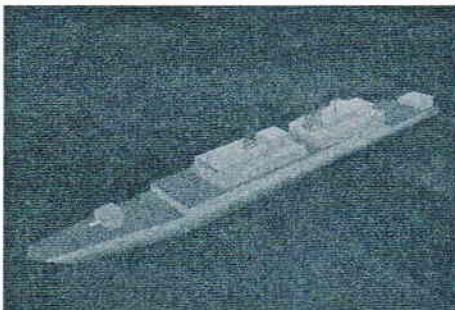
Nimitz aircraft carrier

SHIPS

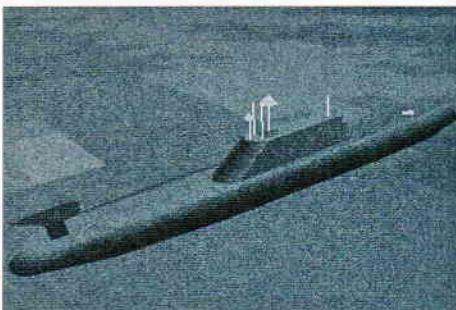
RUSSIAN FLEET



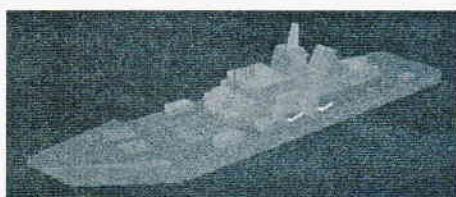
Kuznetsov class carrier



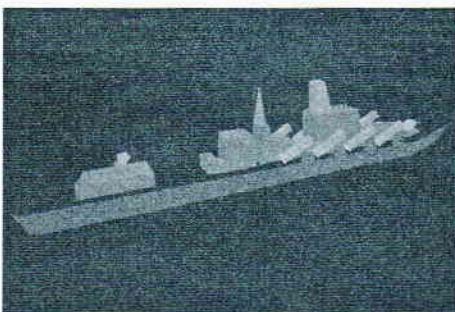
Neustrashimy class frigate



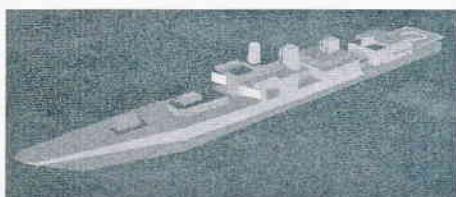
Akula class submarine



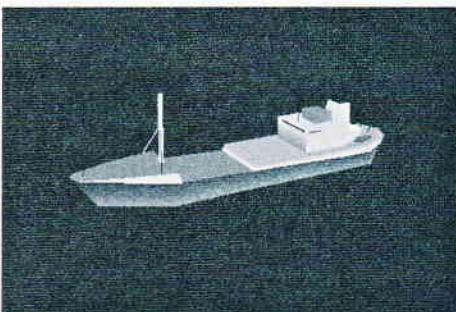
Kirov class battle cruiser



Slava class cruiser



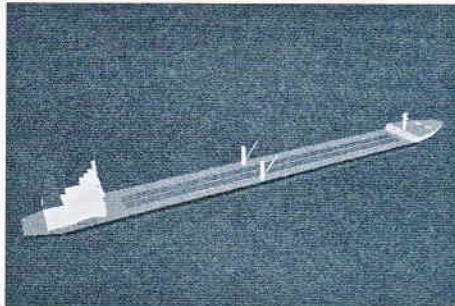
Udaloy class destroyer



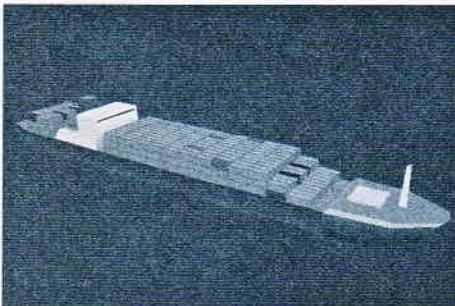
Spy trawler

SHIPS

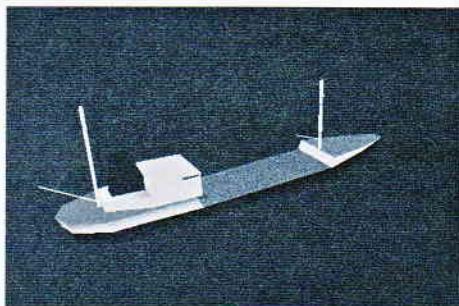
MERCHANT FLEET



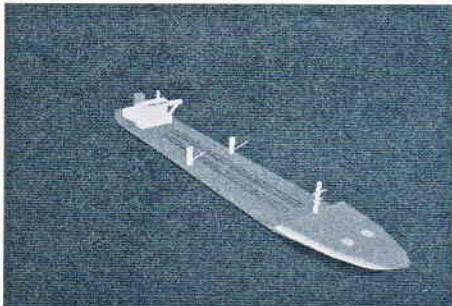
Large oil tanker



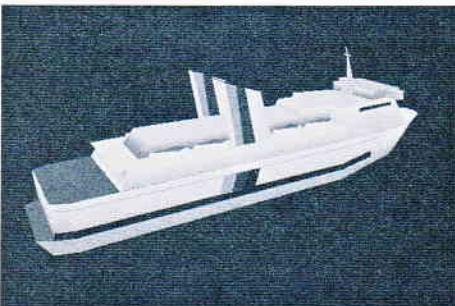
Container ship



Trawler



Small oil tanker



Vehicle ferry

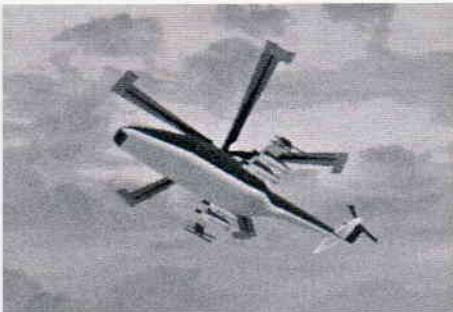
HELICOPTERS

NATO



Boeing Chinook CH-47

RUSSIAN



MiL Mi-24 'Hind'



MiL Mi-26 'Halo'



Bell Cobra AH-1

ARMORED FIGHTING VEHICLES

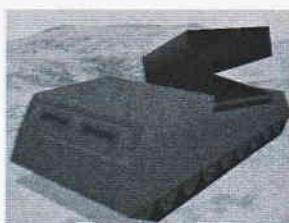
NATO FIGHTING VEHICLES



Challenger 2 MBT. Role: Main Battle Tank.
Armament: 1x120mm, 1x7.62mm CO-AX
Chain-gun 1x7.62mm MG.



M198. Role:
**Towed Field
Gun**
Armament:
1x155mm.
Range: 30km.



MLRS. Role:
**Multiple Rocket
System.**
Armament:
12x227mm
Rockets.
Range: 45km.



Warrior IFV. Role: Infantry Fighting Vehicle.
Armament: 1x30mm, 1x7.62mm CO-AX
Chain-gun.



M110A. Role: Self Propelled Gun.
Armament: 1x203mm Howitzer. Range: 21.3km.



M163 Vulcan.
Role: Anti-
Aircraft Gun.
Armament: 1x6
Barrel 20mm
Cannon.
Range: 1.6km.

ARMORED FIGHTING VEHICLES

NATO FIGHTING VEHICLES



Rapier SAM.

Role: Surface-to-Air Missile.

Armament:

8x133mm SAM

Range: 3.6km.



Patriot SAM & Radar Unit Truck. **Role:** Surface-to-Air Missile System.

Armament: 4x406mm SAMs per launcher unit. Range: 68.5km.



S373 Truck &

Mobile Radar Unit. **Role:**

Radar Tracking.

Armament: Nil.



Roland

Euromissile

SAM. **Role:**

Surface-to-Air

Missile.

Armament:

2xSAM.

Range: 6.3km.



Chieftain AVLB No 8. **Role:** Armored

Bridgelayer. Armament: 2x7.62mm MG.

ARMORED FIGHTING VEHICLES

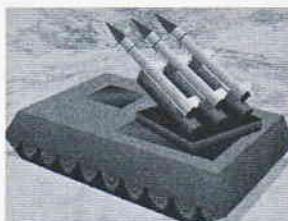
RUSSIAN FIGHTING VEHICLES



BMP 1. Role: Infantry Combat Vehicle.
Armament: 1x 73mm MG CO-AX, Sagger ATGW launcher.



M1973 (2S3). Role: Self-Propelled Gun.
Armament: 1x 152.4mm Howitzer, 1x 7.62mm MG. Range: 24km.



SA-6. Role:
Surface-to -Air
Missile.
Armament:
3x SA-6 SAM.
Range: 24km.



T80 MBT. Role: Main Battle Tank.
Armament: 1x 125mm Gun/Missile launcher,
1x 7.62mm MG CO-AX, 1x 12.7mm MG.



BM-21. Role:
Multiple Rocket
System
Armament:
40x122mm
Rockets.
Range: 20.4km.



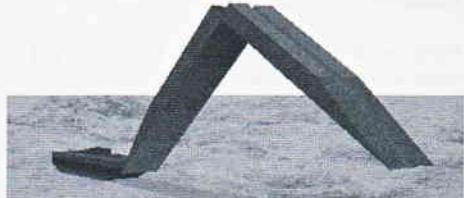
SA-11. Role:
Surface-to-Air
Missile.
Armament:
1x SA-11SAM.
Range: Approx..
100km.



D30. Role: Towed Field Gun.
Armament: 1x 122mm. Range: 21.9km.



ZSU-23-4. Role:
Anti-Aircraft
Gun
Armament:
4x 23mm
Cannon.
Range: Approx.
5km.



MTU-20 (T55). Role: Armored Bridgelayer.
Armament: Nil.

EF2000 CAMPAIGN

PRELUDE TO WAR

It was a tragic parallel: the time that Zrynski Leader of the Russian Ultra Nationalist Party swept to power in the Autumn of 2001 and history began to repeat itself. A great world power had fallen and was set to rise again, as Nazi Germany had in the thirties.

After the dissolution of the USSR, Russia was plunged into an economic crisis that surpassed the great depression of the thirties. Old trade agreements with the former Satellites broke down and high level corruption and chaos in the Government lead to drastic economic reforms. At the same time, territorial arguments erupted across the former Soviet lands, leading to the loss of confidence and dispute with the Western nations. In turn this caused investment in Russia to collapse, sending inflation soaring by thousands of percent.

Boris Yeltsin, the former Soviet Leader, fought hard to keep the nation together, but a menacing opposition was fast growing - a dangerous mix of Communists and the extreme Nationalists of the Communist National movement, who sought to safeguard Russia's military and economic status. The Communist

Party of the Russian Federation, although no longer politically influential, grew to tens of millions. Yeltsin tried to ban them but failed. Eventually, the National Salvation Front, another Communist group banned by Yeltsin, became all-powerful.

By 2000, leaders of the Ultra-Nationalist movement were basking in the majority support of a demoralized populous. Another brief Civil War erupted in Russia for the second time in 10 years. Forces loyal to Yeltsin fled to the former Satellite states of the Ukraine and Belarus. Western leaders showed open support of the Yeltsin Regime, widening the rift between the Western powers and the new Russian Empire of Zrynski. In Russia, the downward spiral continued with the desperate act of a desperate man...

While the Ultra Nationalist's fought to preserve what was left of the Russian Empire, Western powers plotted to bring it to its knees once and for all. Russia feared them no more. It was time for a New World Order.

The powerful, reborn Russian war machine developed a radical new policy to carry out its threats to reclaim and unite the former CIS nations, to conquer the oil fields of the Middle East and to control all that stood between them and the Indian Ocean. First came the swift and decisive moves into Finland and Poland, taking back what it had owned over fifty years earlier.

Compared with the previous ten years, NATO was just a shadow of its former self. The collapse of Communism seduced Western leaders into massive reductions in the armed forces, although the real threat had never gone away. It had merely changed for the worse.

Taking advantage of the NATO situation, knowing that the United Nations would spend months trying to find a diplomatic solution, the Ultra-Nationalists went ahead with their plans to claim territories they believed were theirs. In manoeuvres strikingly similar to the German invasion of Poland, the Russians swept into Finland, then into Kazerberstan and Aberstan. Meanwhile, Russian Naval forces seized control of the powerful Black Sea Fleet.

EF2000 CAMPAIGN

PRELUDE TO WAR

NATO was paralyzed with fear, although no major incursions were made into West European territory. Poland, Slovakia, the Czech Republic, and all the former Warsaw Pact Nations turned to NATO for help. Belarus and the Ukraine, fearing the worst, agreed to a non-aggression pact with Russia. Next to go were the former Baltic states of Latvia, Estonia and Lithuania. Central Europe and the Polish borders were the stage for a massive stand off between the bulk of the Russian War Machine and a NATO force allied with many former Warsaw Pact nations.

With NATO occupied in central Europe, the Russians and their numerically superior airforces could make a daring sweep south from Finland and Norway, cutting off Iceland and gaining control of the sea lanes from America to Europe. If NATO reacted by moving forces from central Europe, they would weaken their defenses. This would allow the Russians to punch a hole through Poland and former Eastern Germany, through the Fielder gap and through the rest of Germany, bringing NATO to its knees. Of course, both sides still held the Nuclear card.

Central Europe became a buffer zone, NATO depending on the huge expanses between Poland and its Eastern flanks. Even with the Atlantic under Russian blockade, Europe could hold out for weeks against a Russian onslaught. This would give time for NATO to reinstate the original logistics plans of the Cold War period. Russian leaders knew that well-supplied NATO forces in Germany would be almost impossible to defeat. They had to take the North and gain control of the Atlantic, and with most of NATO's forces committed in central Europe, it should be just a matter of time.

The future of Central Europe would be decided by the battle of Norway - a battle that was to be fought principally in the air and at sea. The unforgiving topography of the Scandinavian and North Cape areas is unsuitable for ground warfare. Unfortunately for the West, the almost constant daylight of the Nordic summer months rendered squadrons of NATO Stealth Fighters all but useless. An air battle between high-tech super-powers was about to begin, the likes of which had not been seen since the Battle of Britain. For the Russians, capture of intact Norwegian airbases was the primary objective.

THE STATE OF WAR

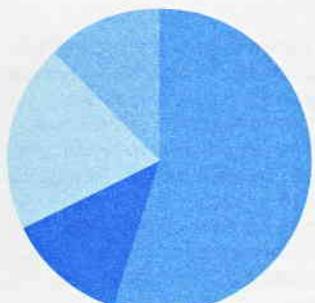
In the Northern Europe theatre of operation, the Russian air army consists of over 2000 front line aircraft. Although many of their aircraft are technically inferior, the Russians still possess large numbers of advanced, modern aircraft that are a match for any Western aircraft. Their pilots are also of the highest calibre. Russia also possesses a formidable fleet of long range bombers able to penetrate deep into the North Atlantic region, casting their shadows on each and every sea lane.

Between them stands Norway and eight front line air bases, two US carrier fleets, a UK carrier group and long range support from Denmark, Scotland and Iceland. Several hundred NATO fighters and bombers stand against a force twice their size.

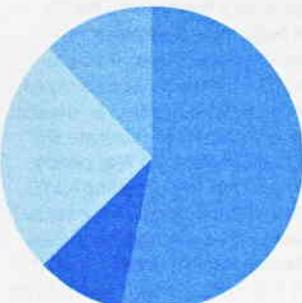
In all, the total number of EuroFighters deployed in Norway is 356 with over 240 in reserve in Scotland.

EF2000 CAMPAIGN

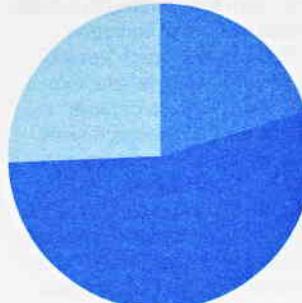
PRELUDE TO WAR



CLASS 1 FIGHTERS	
108 - SU-35	
84 - SU-27	
12 - SU-33	
60 - MIG-29	
GROUND ATTACK	
60 - SU-25	
STRIKE AIRCRAFT	
48 - SU-34	
48 - MIG-27	
SUPPORT AIRCRAFT	
8 - IL-78M	
2 - A50	
36 - TU-26	
12 - TU-16	



CLASS 1 FIGHTERS	
122 - EFA	
48 - F-22	
60 - F-18	
CLASS 2 FIGHTERS	
66 - F-16	
36 - F-15	
24 - F-14	
GROUND ATTACK	
12 - Harrier	
12 - A-10	
STRIKE AIRCRAFT	
36 - Tornado	
12 - F117A's	
SUPPORT AIRCRAFT	
1 - J-767	
6 - R-767	
3 - E-767	
12 - F-111R	



CLASS 2 FIGHTERS	
150 - EFA	
60 - F-15	
36 - F-14	
GROUND ATTACK	
12 - A-10	
24 - Harrier	
STRIKE AIRCRAFT	
48 - Tornado	
12 - F-117A	
SUPPORT AIRCRAFT	
12 - J-767	
7 - R-767	
3 - E-767	
13 - F-111R	

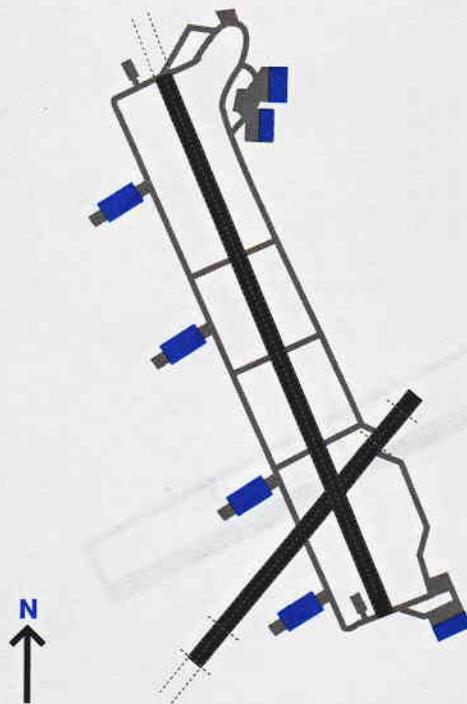
Nato Aircraft - Russian Slight Advantage

Nato Aircraft - Major Russian Advantage

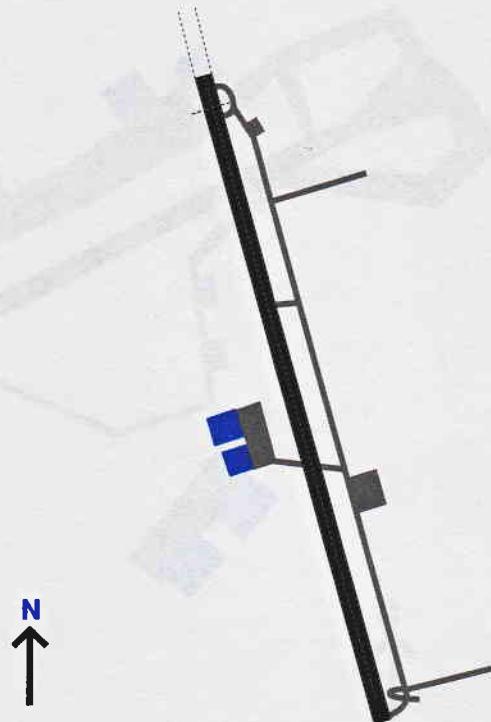
Nato Aircraft - Before Russian Invasion

MILITARY AIRFIELDS

ANDOYA

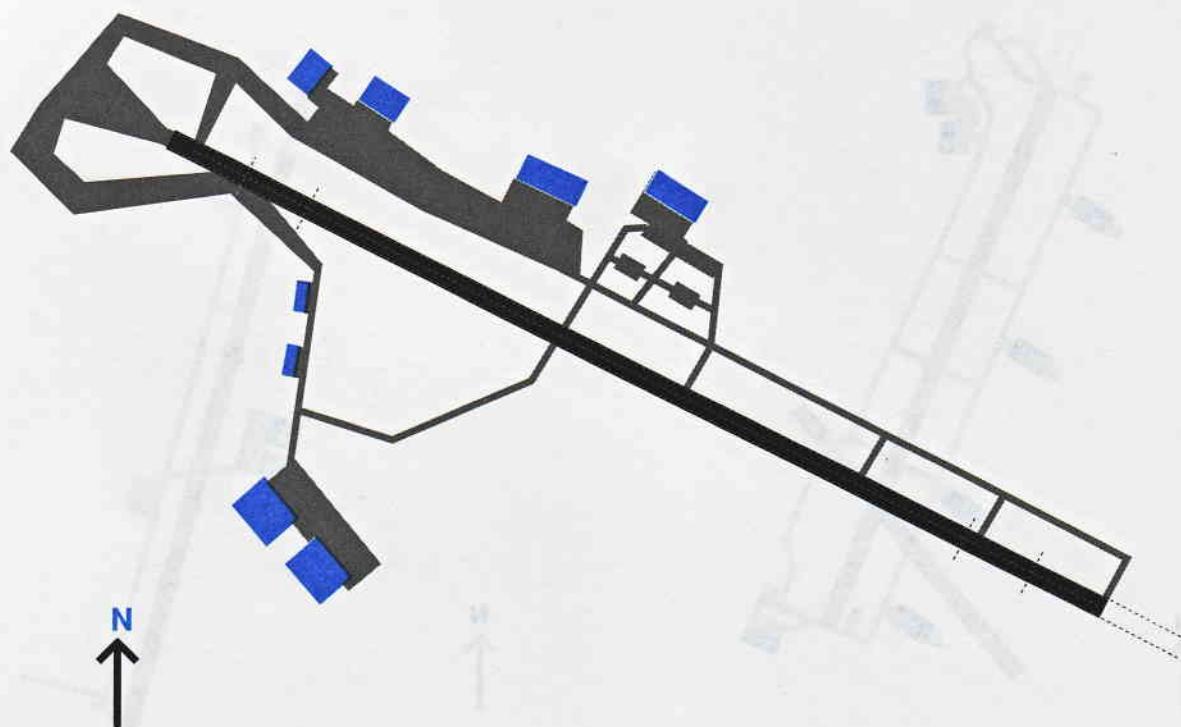


ORLAND



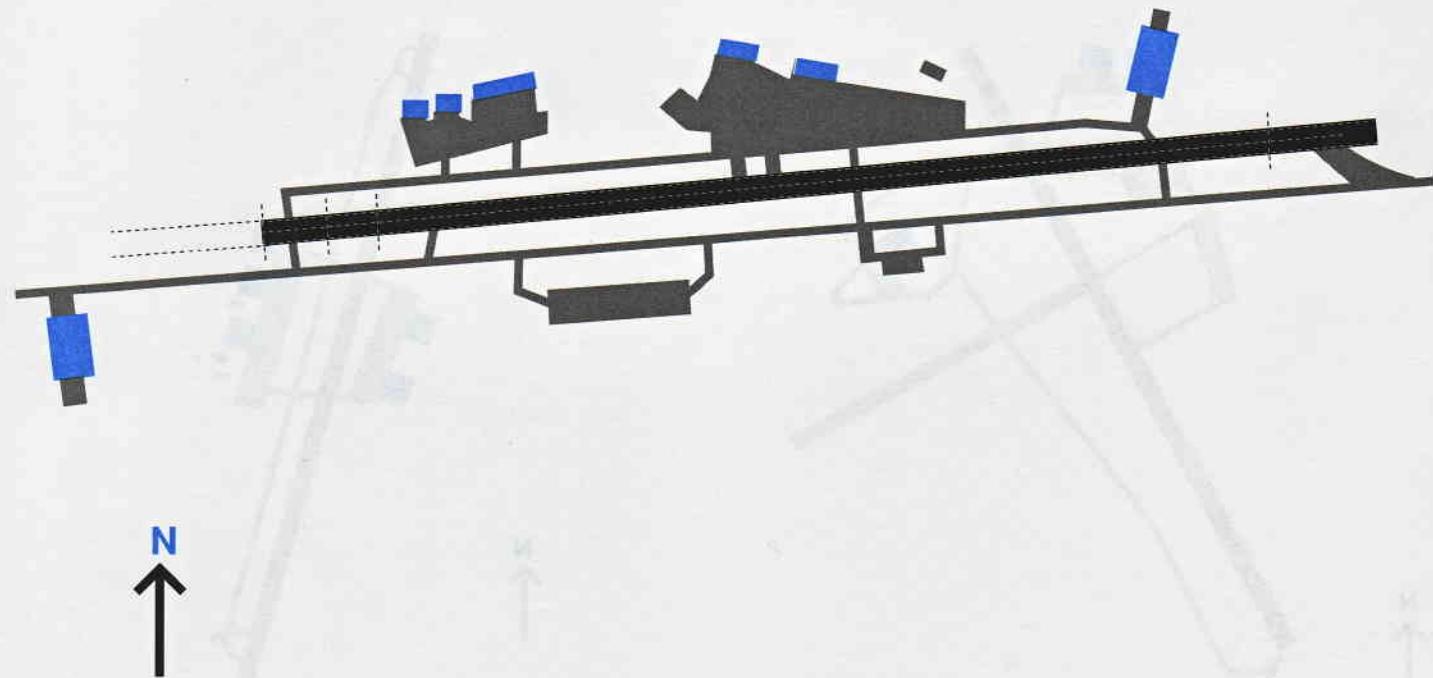
MILITARY AIRFIELDS

BARDUFOSS



MILITARY AIRFIELDS

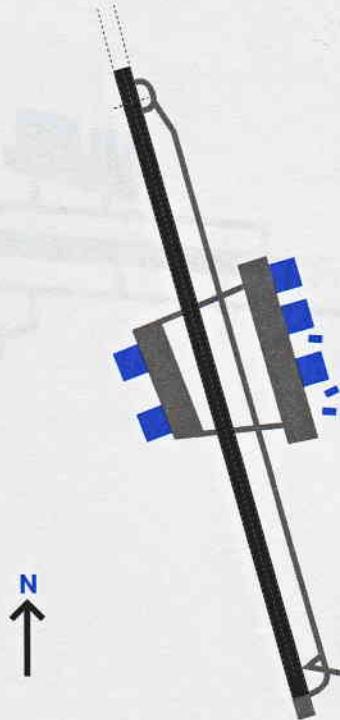
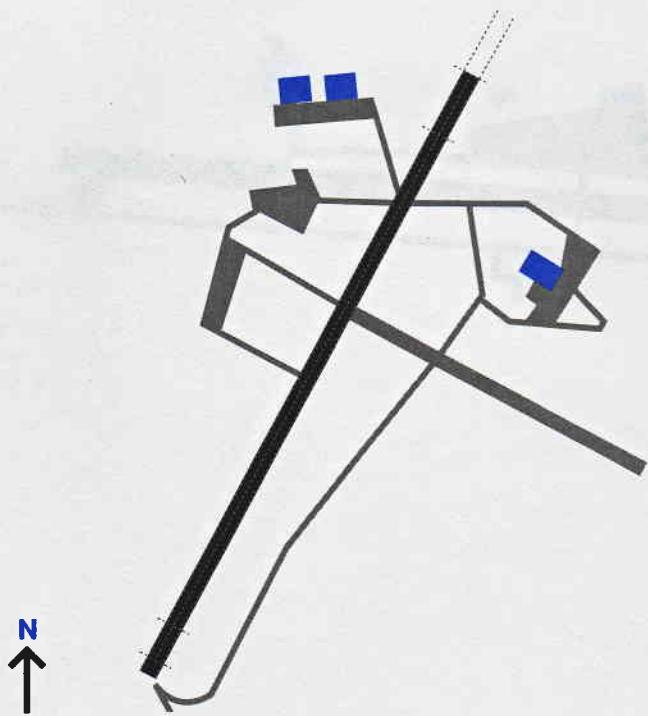
BODO



MILITARY AIRFIELDS

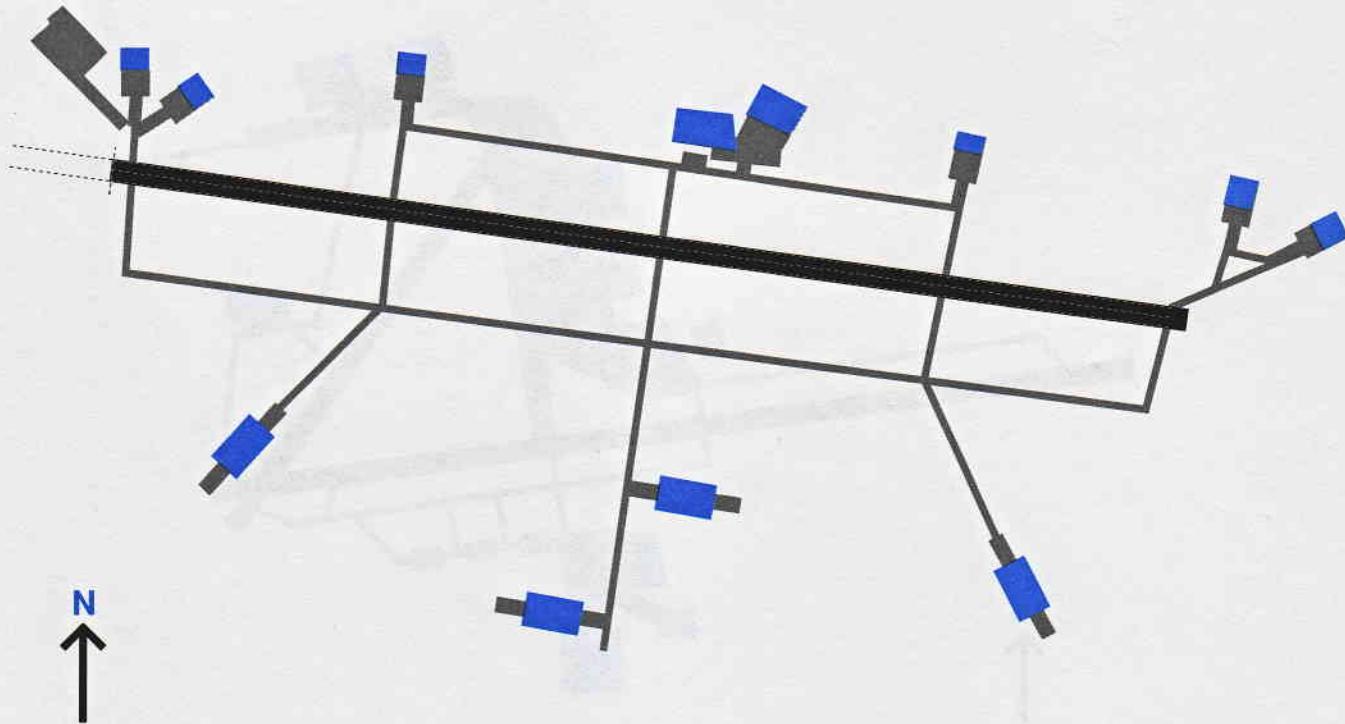
OSLO

PROVINCIAL AIRFIELD



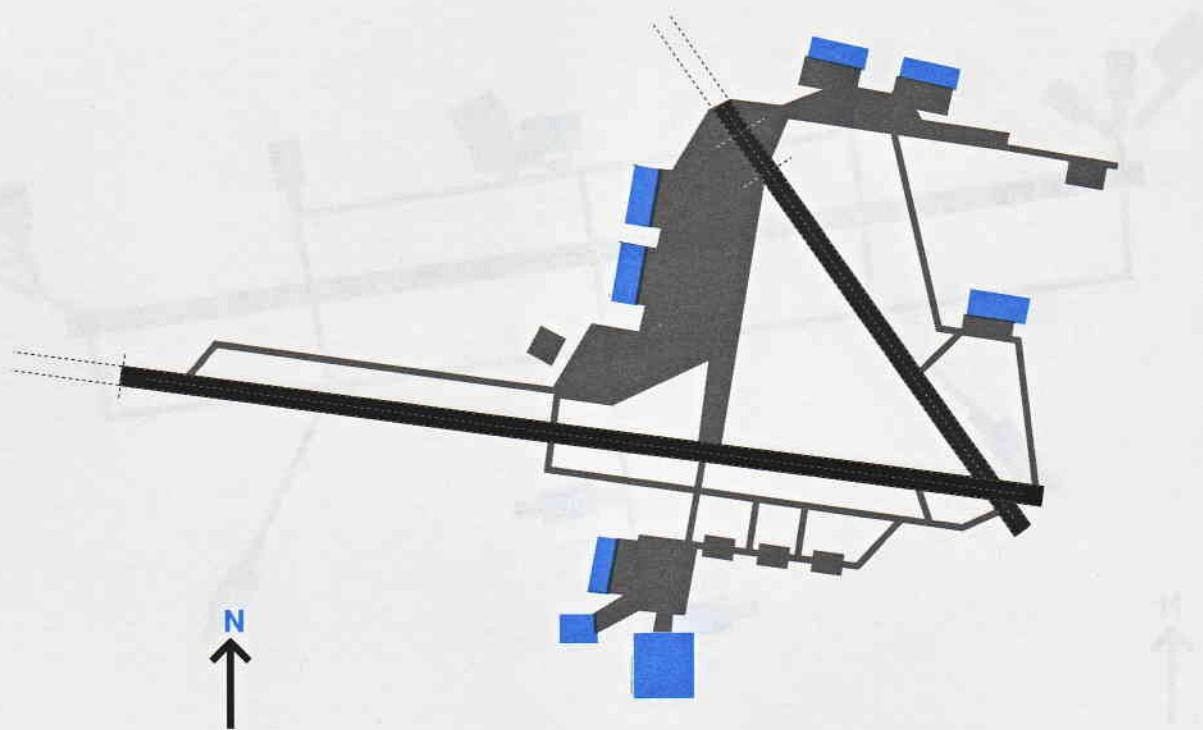
MILITARY AIRFIELDS

RYGGE



MILITARY AIRFIELDS

TRONDHEIM



THE WARGEN SYSTEM™

HOW THE CONFLICTS ARE DRIVEN

The DID War Generator, or WARGEN system, was born from the desire to create a realistic combat environment for the EF2000 simulation. After all, a good flight simulation has to do far more than just mimic real aircraft. Many war simulations suffer from the tedium associated with managing the massive amounts of data used to model a large scale conflict. The aim of the DID War Generator was to fully automate the management of this data to allow the users to concentrate entirely on their role as a pilot.

To produce an AI system capable of controlling all aspects of a future war, from the organization and movements of carrier fleets to the repair of runways and hangars, required a great deal of research. An AI system was designed that would mimic the hierarchical command and control structure of modern Air and Sea forces. The system was tailored towards a Norwegian Limited Theatre Conflict where the emphasis would lie with Sea and Air power (the Norwegian terrain would make a land war difficult).

The DID WARGEN is actually a sophisticated war-gaming engine that underlies the unique 3D world of EF2000. Over 10,000 individual objects in the 3D world are controlled by the WARGEN as you interact with the environment. This is what makes EF2000 a true hybrid of wargaming genres. If the demand is there, we may soon decide to give the player the power to manipulate the AI that drives the WARGEN, enabling you to set-up and play-out scenarios in a way that will astonish military strategists. Let us know what you think!

Some of the theoretical basis for WARGEN came from the ideas presented in Colonel A. Warden's book on the operational theory of a modern airforce. His ideas on the mechanics of the airforce and its relation to the other sectors of the military machine were integrated with the original design of the AI engine to produce the core of the WARGENs AI engine.

TOTAL WAR GAMES

The WARGEN operates at four distinct levels of command based AI. Data in the forms of orders and directives are filtered down through the system to the lowest levels. Field reports and statistical data are then propagated back through the system to update the higher levels of intelligence allowing the WARGEN to accurately manage the overall conflict.

The highest of these levels is The Grand Strategic Level. This level manages the forces from a governmental or military chiefs perspective and is responsible for the overall direction of the war as well as the maintaining of international relations with all other protagonists. It is at this level that a protagonist may decide to surrender, or indeed may decide to bring a neutral country into the conflict by force in order to improve their current situation.

Below this lies the Strategic level AI that is responsible for organizing the forces available in terms of material (all military hardware),

THE WARGEN SYSTEM™

HOW THE CONFLICTS ARE DRIVEN

personnel (pilots and other highly trained military persons) and position (relocating forces to maintain good defensive/offensive locations), to try to meet the demands made at the Grand Strategic level. In addition to this, the Strategic level also maintains force strength and mobility by calling for reserves and additional force where needed. In general this level deals with logistics.

The Operational Command level is by far the most complex. It is responsible for the generation of all Land, Sea and Air missions for all protagonists. Missions are generated to very high levels of detail to ensure an accurate model of the conflict is created. Sea forces are used to resupply the land and air forces, and the carrier fleets are positioned to complement the forward line bases and provide a strong defensive/offensive position. Land forces are used to transport supply from the coast to the bases inland. The limited ground war means that the positioning of the land forces is crucial to the defense of forward line airbases, supply dumps and command centers. Air missions are

generated both to provide defensive air cover and offensive strikes into enemy territory.

The lowest level in the WARGEN hierarchy is the Tactical Combat level. At this level sophisticated combat rules are used to resolve all land, sea and air combat. Detailed battlefield statistics are generated at this level for examination by higher levels of the system.

Using these four hierarchical levels of AI, WARGEN can manage an entire theatre air campaign. In practice WARGEN manages an area of over 4,000,000 square km and controls the operations of over 1000 planes, 2000 ground units, and 500 ships. Of course, you will be just a small cog in a large machine, but as you are flying NATO's most effective air weapon, you are able to make a significant difference to NATO's fortunes in the campaign.

THE IMPORTANCE OF ACCURACY

Great care has been taken in developing the AI routines with the data, statistics and probability tables to ensure that the data used by the system is as accurate to real-life as possible.

GRAND STRATEGIC LEVEL

At this level you will receive signals when an allegiance (protagonist) is defeated or surrenders. The AI continually monitors international relations, which affect actions such as the response of fighters and SAMs in neutral countries; e.g. a fighter from a neutral country is shot down by your flight - the next time you go into this neutral airspace you will be actively tracked down and destroyed without mercy.

In addition, keeping on good terms with non-combatant countries means that you can use their road/rail network and ports to bring in your supplies. If they become angry with you, they will not allow you to use their transport network, thereby cutting your supply network and making life easier for the enemy!

THE WARGEN SYSTEM™

HOW THE CONFLICTS ARE DRIVEN

STRATEGIC LEVEL

Once your friends and enemies are identified it is then necessary to re-distribute your forces to defend your territory, or put yourself in optimal attacking positions (if attacking is the correct response). The strategic level performs all necessary force distribution and resets the primary supply routes. If force sizes are getting dangerously low then reserves will be brought in.

OPERATIONAL LEVEL

This is where it all happens. Your aim is to select the most important enemy targets for your overall campaign. Then for each base these targets are prioritized. The operational level will build a mission for all prioritized targets and decide who is going to do what to whom, where and when.

For the planes: the AI selects the most appropriate plane for this type of mission from a desirability list; then it selects the appropriate size and content of the mission in terms of

flights and number of planes; and finally, it selects the supply requirement for the mission.

For the airbase: the AI assesses the ability of the airbase to cope with this mission given the amount of air traffic already going through the base. An ATC system is used to schedule the launch of all missions.

For the target type: the AI selects exactly the correct weapon package for the target type from over 500 possible combinations

For the waypoints: the AI plots waypoints to and from the target making use of the terrain or using safe (out-to-sea) routes, or routes through neutral countries.

JSTARS and AWACS are positioned to achieve maximum detection range whilst still being in secure friendly airspace, usually only a short sprint away from a base. Refuellers are positioned for maximum accessibility but away from direct enemy threat - although refuellers near to the FEBA will be at considerable risk.

CAP routes are chosen based on information about previous enemy incursions and local topography. Strike routes are chosen to try and get the strike flights to target as safely as possible. From the ingress point onwards, each pilot on a flight is made to follow an individual waypoint route called an attack pattern - each tailored to the weapon type and target type which ensures that the planes release their weapons over the target at the correct time intervals. All this is done not only for the EF2000 but all of the 1000 plus planes in the world.

THE WARGEN SYSTEM™

HOW THE CONFLICTS ARE DRIVEN

SELECTION OF GROUND FORCES AND PLACEMENT OF AIR DEFENSES

For Ground based vehicles the most appropriate trucks and tanks are selected for offensive or supply missions. The choice of the safest supply routes to use that day will allow the required amount of supply through.

Placement for all 500 plus SAM sites, and 100 plus AAA guns is also calculated.

Placement of battle vehicles in the currently disputed areas of the world is carried out as follows...

For Ships: placement of the carrier fleet adjacent to the current area of most offensive operations. Selection of the safest supply routes to use to get ships either to or from ports for supply. Attack-ships are positioned when an attempt is made to capture a base.

BASE REPAIR AND CRITICAL TARGETS

When critical targets such as runways and control towers are damaged the AI system will begin a series of simulated repairs over the course of several hours or days. Some targets such as a heavily damaged control centre can take days to repair if it is possible at all; others such as runways can be mended in under six hours if the damage is not too severe.

THE PILOTS

All pilots are individually modeled; i.e. many pilots all have several attributes describing their behavioral characteristics, skill and experience. After each mission, a pilot is reassessed and his details are updated for the next phase of missions.

TACTICAL LEVEL

When you actually fly your mission, an advanced tactical AI system processes all ground and air combat that occurs around you. All AA combat in which you are directly involved is handled by the

SmartPilots system. All combat more than 100 miles away from the player is dealt with by the WarGen system. The results are plane based and takes into account the ability of each plane to: achieve a lock-on the enemy; the probability of missile hitting if launched, based on military data; the plane combat performance ratings; and the relative plane proximities.

All AG combat is processed in a similar way. The AAA combat uses probabilities of a lock-on coupled with the plane's ability to evade the lock, and a probability of kill to determine the outcome.

THE SMARTPILOTS SYSTEM™

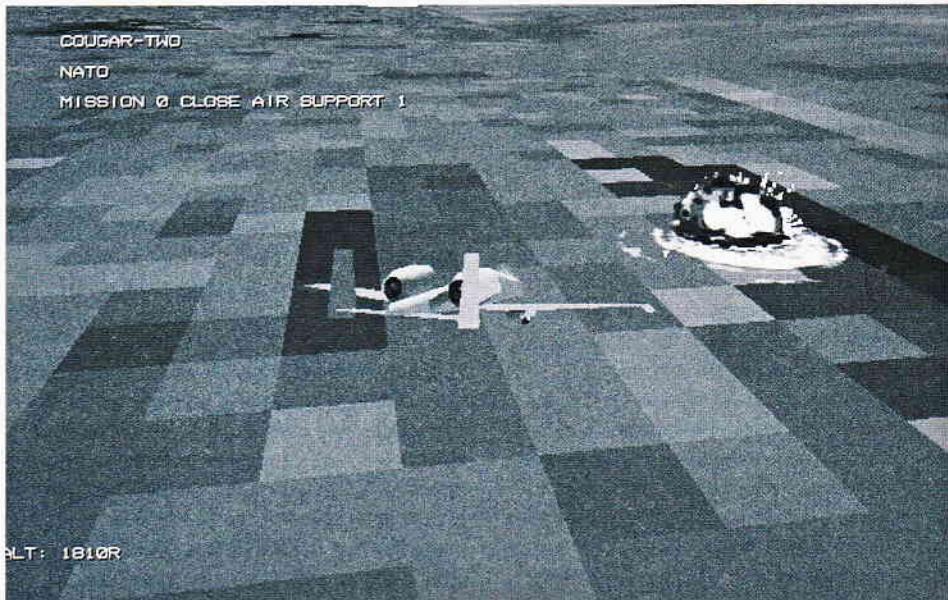
YOUR COMPANIONS IN THE SKY

For the first time ever, a DID simulation features the SmartPilots Artificial Intelligence System. The system combines real-time aerodynamic modeling with behaviour dictated by modern military doctrine to provide an all-round simulation, not only of the aeroplane you are flying, but of the entire battlefield environment. SmartPilots compliments WarGen as an in-game AI system.

DETAILED MISSIONS

As you fly a mission in EF2000, you will follow a waypoint route, stopping to engage the enemy, to refuel, or perform other mission-critical tasks. The computer-controlled planes (CCPs) which you will encounter as an EF2000 pilot all have their own missions just like yours. Some, like CAP, are missions which you can fly yourself. Others, like AWACS, are only available to certain aircraft types.

Each CCP flight is commanded by a wing leader, who will follow his waypoints, and decide what actions the flight should take, responding to the



An A-10 attacks a tank under SmartPilots control

THE SMARTPILOTS SYSTEM™

YOUR COMPANIONS IN THE SKY

situation in hand. Just as you will sometimes be contacted by AWACS, JSTARS, or another flight in your mission, so will the CCP wing leaders. In fact, if a CCP CAP is in a better position to intercept an enemy flight than yours, AWACS will send them instead of you.

AERODYNAMIC MODELS

In flight, CCP motion is determined by a full aerodynamic flight model. Lift, drag, thrust and weight are all taken into account, as are roll and pitch inertia. For this reason, the MiG-21, which lacks a G-limiter, can obtain a higher instantaneous turn rate than the 9 G F-16, but will lose a lot of speed in the process, due to induced drag. The A-10, with its high aspect ratio wing, will maintain an excellent turn rate at low speeds, where either fighter will bleed off speed. The F-15, although fast and powerful, will suffer in close combat against a fighter with a higher roll rate, like the SU-27.

THE DOGFIGHT ALGORITHM

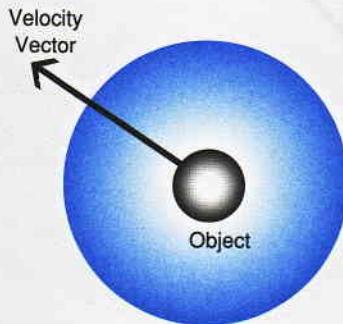
Air-to-air combat with SmartPilots uses a new system, the Dogfight Algorithm. The CCP continually re-calculates its situation in combat, without ever resorting to set manoeuvres. For instance, instead of using a pre-defined high yo-yo manoeuvre to prevent overshoot in a turning fight, the CCPs will incorporate a calculation of energy and turn-rate tactics into their manoeuvring, while still keeping an eye on target position, heading and speed.

Furthermore, the CCPs will act as a team, each flight splitting into two-ship sections which will co-ordinate their attacks using modern air-combat techniques. You may notice the opposing fighters using the double-attack system against you. It can no longer be presumed that Russian forces will use out-dated ground-control tactics and trail formations.

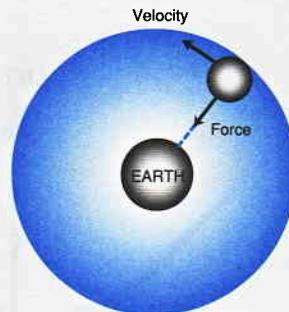
THE FLIGHT MODEL

DYNAMICS

Imagine an object moving in space. It moves in a certain direction at a certain speed. These can be described by its velocity vector. The size of the velocity vector represents the speed, and it points in the direction of motion.



According to Isaac Newton, this object will keep on moving with the same velocity until a force acts on it. A force in the same direction as the force at right angles to the velocity will not



change the speed, but will alter the direction of the object's motion towards the direction of the force. In this way, a satellite moving around the Earth will always be pulled downwards, but will never hit the ground.

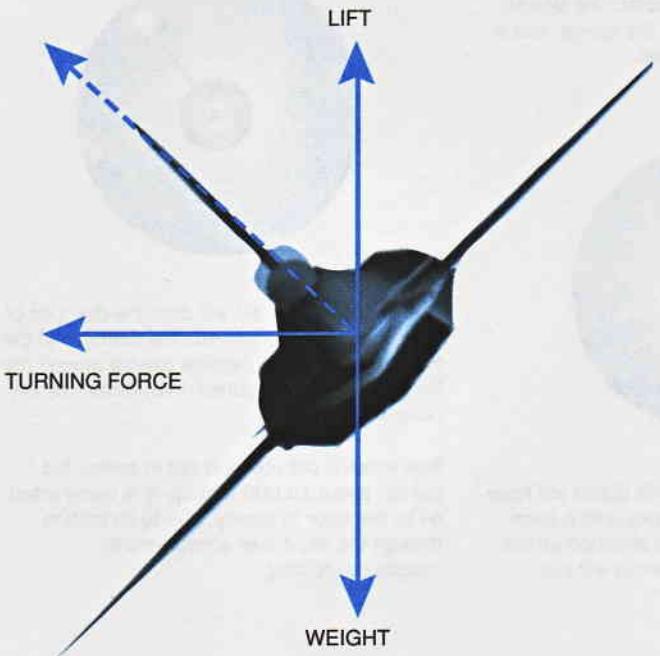
Now imagine our object is not in space, but in the air, about 10,000 feet up. It is being acted on by the force of gravity. Due to its motion through the air, it also encounters air resistance, or drag.

These two forces add together to make the object slow down and fall. If the object is an aeroplane, we can stop this from happening. The engine provides thrust to balance the drag. To counter the effect of gravity, the wings provide lift.

THE FLIGHT MODEL

DYNAMICS

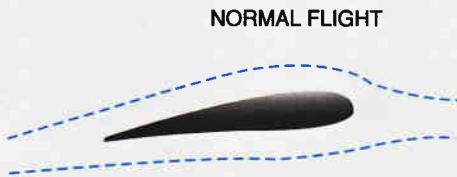
As with the satellite, only a force at right angles to the plane's velocity can turn it around. Viewed from behind, the aeroplane makes a level turn by banking to one side and increasing lift, so that the vertical part of the lift balances weight. Then the horizontal part of the lift is not balanced out, and so turns the aeroplane.



THE FLIGHT MODEL

AERODYNAMICS

A wing produces lift by deflecting the air flowing past it downwards, which pushes the wing in the opposite direction. The shape of the wing can produce this effect, as can its angle of attack. The higher the angle of attack, the greater the lift. If angle of attack is too great, the air can no longer move round the wing from leading to trailing edge, and the area behind the wing becomes a wake. This is called stalling. A stalled wing produces little lift.

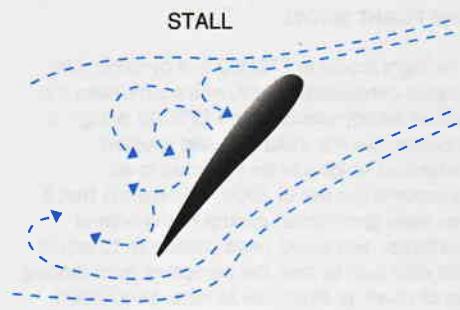


NORMAL FLIGHT

Any object in air flow is pushed back by drag. Lift produces extra drag, which adds to the normal, or profile drag. This means that an aeroplane in a turn needs more thrust to maintain its speed. A conventional aeroplane works by pointing the tailplane down; the lift from the tail rotates the aeroplane nose-up, so the wing has a high angle of attack and produces plenty of lift for turning.

EF 2000 AERODYNAMICS

The EF 2000 has foreplanes instead of a tailplane. Also called canards, these work by pitching up to rotate the aeroplane. At low speeds, the EF2000 is unstable, so the canards are then deflected down again to balance the aeroplane at the higher angle of attack and prevent it from flipping out. This instability is not noticed by the pilot because between the pilot and the aeroplane is a flight control system (FCS) which makes the necessary control inputs to stabilize the aeroplane.



STALL

Unlike the WWI pilots, who moved control surfaces with mechanical linkages, the EF2000 pilot is shielded from the actual business of pitching the canards and ailerons. The joystick position is interpreted by the FCS as a demand for a certain roll rate and pitch rate. This means that when the stick is left alone, the EF2000 will neither pitch nor roll, even if it is highly banked or upside-down.

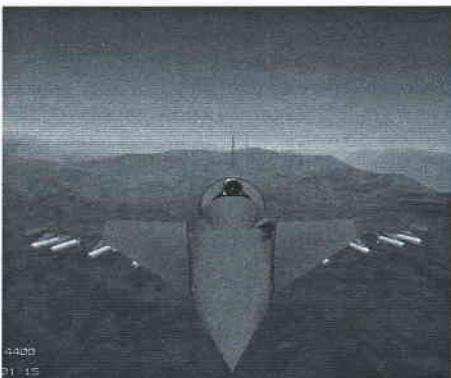
THE FLIGHT MODEL

AERODYNAMICS

THE FLIGHT MODEL

The flight model in EF2000 is a dynamic, six degree-of-freedom model, which simulates the actual aerodynamics of the EF2000 design. It incorporates the instability and coupled behaviour which can be expected in an aeroplane like the EF2000. This means that if you were given direct control of the control surfaces, you would need constantly to adjust the stick just to stop the aeroplane from flipping up or down, or from side to side. So EF2000 also includes a flight control system which shields the player from most of these complexities, just as the real EF2000 does.

As an example, Select the simulator option from the EF2000 menu and choose free flight. Use TimeSkip to set your aeroplane on the runway. Now turn on first your wheelbrakes, then your afterburners. The aeroplane will not move forwards, but will pitch down a little. This is because the brake friction on the wheels counters the engine force, but as it acts below the centre of mass, this pitches the aeroplane down.



Front view of EF2000 in subsonic turn

Now select an outside view of your aeroplane and release your wheelbrakes. As you accelerate along the runway, notice the way the canards pitch up and down. This is because the flight control system senses the oscillation of the aeroplane, and is trying to damp out this motion. At around 120 knots, pull back on the stick to take off. Retract your undercarriage and release the stick.

Now pause the simulator and select the front camera view. Unpause and pull back hard on the stick, holding it in this position. Notice the canards pitch up initially, then pitch downwards. Due to the EF2000's instability at subsonic speeds, it needs to pitch the canards down just to maintain this pitch rate without turning even faster. Keep the aeroplane pitching until the nose is level again. Now release the stick. Note the slight pitch-down on the canards to return to steady flight.

THE FLIGHT MODEL

AERODYNAMICS



EF2000 in supersonic turn

Return to level flight and select a rear view of your aeroplane, then apply some rudder. As the rudder moves, notice also that there is some motion of the flaperons (the combined flaps and ailerons on the wing trailing edge). This is because the rudder, as well as yawing the aeroplane (turning it sideways) will tend to cause roll as well. To counteract this, the FCS applies some aileron deflection automatically. This is a feature which is not in the development EF2000 aeroplanes, but which is expected to be implemented in the production models.



EF2000 with rudder applied

GLOSSARY

AA - Anti-Aircraft.

AA or A-A - Air-to-Air.

AAA - Or 'Triple A' - Anti Aircraft Artillery.

AAM - Air-to-Air Missile.

AA-10 ALAMO - NATO designation for the R-27

AA-8 APHID - NATO designation for the R-60 IR missile.

AA-11 ARCHER - NATO designation for the R-73 IR missile.

AAR - Air-to-Air Refueling.

AAV - Armored Amphibious Assault Vehicle.

AB - AfterBurner.

AC - Aircraft Commander.

ACA - Agile Combat Aircraft.

ACE - Armored Combat Earthmover.

ACM - Air Combat Manoeuvres - dogfighting tactics involving more than two aircraft.

ACRV - Armored Command and Reconnaissance Vehicle.

AD - Air defense.

ADAM - Area Denial Artillery Munition.

ADATS - Air Defense Anti-Tank System.

ADI - Attitude Director Indicator - a cockpit instrument which displays an aircraft's pitch and bank angles relative to an artificial horizon.

AEW - Airborne Early Warning.

AEV - Armored Engineer Vehicle.

AFTERBURNER - Part of a jet engine that increases the power of the engine by mixing fuel with the jet exhaust.

AG or A-G - Air-to-Ground.

AGL - Altitude above ground level.

AGM - Air-to-Ground Missile.

AILERON - Control surface on an aircraft wing that produces aircraft roll.

AIM - Air Intercept Missile.

ALARM - Air-Launched Anti-Radiation Missile (BAe).

ALL-ASPECT - Weapons that are effective at any angle to the target.

ALT - Altitude above sea level.

AMRAAM - Advanced Medium Range Air-to-Air Missile - BVR missile.

AOA - Angle of Attack - the angle between an aircraft's velocity vector and a reference line pointing straight ahead of the fuselage.

AP - Armor Piercing.

APPROACH - Line-up prior to landing.

APC - Armored Personnel Carrier.

APHE - Armor-Piercing High Explosive.

ARM - Anti-Radiation Missile, a missile which targets radio-emitting targets such as radar.

ASARS - Advanced Synthetic Aperture Radar System.

ASPECT ANGLE - The angle formed by a line running directly another aircraft and a line parallel to the other aircraft's longitudinal axis.

ASPJ - Advanced Self-Protection Jammer.

ASW - Anti-Submarine Warfare.

ASRAAM - Advanced Short Range Air-to-Air Missile (BAe).

AS-7 Kerry - NATO designation for the Kh-23 A-G missile.

ATTITUDE - The state of an aircraft in terms of pitch, bank and yaw.

ATC - Air Traffic Control.

ATF - Advanced Tactical Fighter.

ATGW - Anti Tank Guided Weapon.

ATM - Air Tasking Message.

AUTOPILOT - A mode in which the flight control computer takes over the control of the aircraft, leaving the pilot with less to do.

AVIONICS - Electronic systems in the aircraft.

AWACS - Airborne Warning And Control System.

GLOSSARY

BAe - British Aerospace.

BAI - Battlefield Air Interdiction.

BANDIT - A known hostile enemy aircraft.

BANK - The angle of the wings about the longitudinal axis referenced to horizontal.

BANK - To roll the aircraft to one side and induce a turn.

BEAMING - Flying perpendicular to the emissions from a threat radar.

BDA - Bomb Damage Assessment.

BMEWS - Ballistic Missile Early Warning System.

BFM - Basic Flight Maneuvers.

BINGO - "Bingo Fuel" is the amount needed to RTB (return to base).

BLACKOUT - Loss of consciousness due to excessive forces on the pilot.

BLAST-FRAGMENTATION WARHEAD - An explosive charge which creates a large amount of shrapnel.

BLIND - I do not have the friendly aircraft in sight.

BLU - Bomb Live Unit.

BOGEY - An unknown aircraft. Become bandits when identified hostile.

BRACKET - An ACM tactic in which two (or more) aircraft fly opposite sides of a threat formation.

BREAK-THROUGH PRESSURE - pressure needed to overcome the G-limiter on the joystick.

BREAK - To suddenly turn in the hope that any enemy following will lose his tactical advantage.

BUG-OUT - Leave a dogfight.

BVR - Beyond Visual Range

CALLSIGN - A pilot's or controller's codename.

CAP - Combat Air Patrol.

CAS - Close Air Support.

CBU - Cluster-Bomb Unit.

CEP - Circular Error Probability (measure of bombing performance).

CFPD - Command Flight Path Display System.

CHAFF - Packets of foil used to decoy or obscure radar systems.

COMPASS TAPE - Heading indicator at the top of the HUD.

CONCUSSIVE - With violent, if not explosive, force.

CORNER VELOCITY - The velocity at which an aircraft achieves its best turn performance.

CONTINUOUS WAVE RADAR - A system which

emits radio waves continuously, as opposed to pulses (see PULSE DOPPLER RADAR).

COURT MARTIAL - A military trial held when breaches of conduct codes occur.

CTOL - Conventional Take-Off and Landing.

DASA - German AeroSpace Industry.

DASS - Defensive Aids Subsystem.

DEFCON - Defense Condition. A series of alert conditions set which cause world wide forces to establish escalating levels of readiness and security.

DLIR - Downward Looking InfraRed.

DOGFIGHT - Engaging enemy fighters.

DOPPLER RADAR - Airborne radar which makes use of Doppler effect (frequency shift) in signals reflected from ahead and behind aircraft to give measure of speed over the ground and to distinguish moving targets.

DROGUE CHUTE - A parachute released to slow an aircraft, usually when landing.

DRAG FACTOR - A number which indicates how un-aerodynamic external stores on an aircraft are.

DRAG MANEUVER - decoy maneuver to distract fighters away from their targets.

GLOSSARY

DURANDAL - Runway cratering missile.

ECCM - Electronic Counter CounterMeasures.

ECM - Electronic Counter Measures

ELEMENT - Two aircraft working together as a team, possibly as an element of a larger flight.

ELEVATORS - Aircraft control surfaces, located at the back of the horizontal stabilizers, which provide pitching moment.

EO - Electro-Optical.

ERA - Explosive Reactive Armor.

ESM - Electronic Support Measures.

EW - Electronic Warfare.

EW RADAR - Early Warning Radar

FAB - Fugasnaya Aviatsyonna Bomba - Russian designation for 'general purpose bomb'.

FAC - Forward Air Controller.

FARP - Forward Air Refueling Point.

FBW - Fly-by-wire a flight control system which transmits flight commands via wires to servo actuators which drive the ailerons, rudders or other control surfaces. In most FBW systems, pilot input is processed and possibly negated by a flight computer before being sent to the control actuators.

FCC - Fire Command Centre.

FCS - Fire Control System.

FEBA - Forward Edge of Battle Area.

FIRE AND FORGET - A missile that once fired, will guide itself to its target.

FLAK - Shrapnel produced by AAA shells exploding.

FLAME-OUT - Stalling of aircraft engine due to circumstances; e.g. bird-strike.

FLAPS - Control surfaces on aircraft wings which increase lift for a given flight condition and allow a lower airspeed than is normal in flight.

FLAPERONS - A useful control surface that's a cross between ailerons and flaps.

FLARES - Pyrotechnic packages which burn with intense heat designed to confuse InfraRed missiles.

FLASHPOINT - A trouble zone, be it economic, military or otherwise.

FLIR - Forward Looking InfraRed.

FOD - Foreign Object Damage.

FUZE - An adjustable triggering device in a missile, bomb or other weapon.

G - A force acting upon the aircraft and pilot

when manoeuvring, expressed in terms of the earth's gravitational force.

GBU - Guided Bomb Unit.

GLCM - Ground Launched Cruise Missile.

GLLD - Ground Laser Locator Designator.

G-LOC - G-induced Loss Of Consciousness.

GPS - Global Positioning System.

G-SUIT - A suit worn by pilots which reduces the effects of high g numbers.

HARM - High-speed Anti-Radiation Missile.

HARD TARGET - Target which is Armored.

HARD POINTS - weapons pylons for carrying anything except fuel (see WET POINTS).

HAS - Hardened Aircraft Shelter.

HE - High Explosive.

HEAT - High Explosive Anti-Tank.

HE-FRAG - High Explosive Fragmentation.

HOTAS - Hands On Throttle And Stick, which puts all controls at the pilot's fingertips.

HSI - Horizontal Situation Indicator - a cockpit indicator which combines a compass with information from an inertial reference system or navigation beacons to indicate relationship of the aircraft with the planned course.

GLOSSARY

HUD - Head-Up Display.

ICM - Improved Conventional Munition.

IFF - Identification Friend or Foe.

IIR - Imaging Infra-Red.

ILS - Instrument Landing System

INDICATED AIRSPEED - The airspeed shown by an airspeed indicator and not corrected for error due to air density variations caused by altitude and temperature.

INS - Inertial Navigation System.

IR - Infra-Red.

IRD - Infra-Red Decoy.

IRST - Infrared Search and Track - an EF2000 system that tracks aircraft and missiles using the heat generated by their engines and by their friction with the air.

JAMMING - Confusing the enemy radar by using high-energy bursts of a certain frequency.

JOUST - EFA - Tactical simulator for evaluation of aerial combat and plane types.

JSTARS - Joint Services Tactical RADAR System.

JTACMS - Joint Tactical Missile System.

JTIDS - Joint Tactical Information Data System.

KC - Mid-air refueling tanker.

KH-23 - A radio command A-G missile.

KIA - Killed In Action.

KNOCK IT OFF - Slang for 'end the mission'.

KNOTS - nautical miles per hour.

KTS - Abbreviation for Knots.

LANTIRN - Low Altitude Navigation and Target Attack System for Night.

LGB - Laser Guided Bomb.

LIZARD - A term often used to describe the enemy leader.

LOAD FACTOR - The force acting on an aircraft as a multiple of the force of gravity.

LOCK - Acquire a target and fix weapons aiming systems on it.

LOOSE CANNON - A renegade pilot.

LRMTS - Laser Ranger and Marked Target Seeker.

LZ - Landing Zone.

MACH - Unit of speed equal to the speed of sound at your altitude.

MAS - Maneuvering Attack System.

MBT - Main Battle Tank.

MEWS - Mobile Electronic Warfare System.

MFD - Multi-Function Display unit.

MIA - Missing In Action.

MIG - Mikoyan Gurevich - the founders of one of major Russian aircraft design bureaus.

MMD - Moving map display - map used for navigation.

MMS - Missile Management System.

MP - Maritime Patrol.

MRM - Medium Range Missile.

NATO - North Atlantic Treaty organization.

NAUTICAL MILE - 6,076 ft..

NAV - Navigation.

NBC - Nuclear, Biological, Chemical.

NEGATIVE G's - G-force that forces you out of your seat.

NOE - Nap Of the Earth - very low altitude.

NVE - Night Vision Equipment.

ORDNANCE - Bombs, missiles, bullets and other offensive hardware.

OS - Offensive Support.

OTR - Operational Turn-Round. Rapid re-arming and refueling of combat aircraft.

GLOSSARY

OTH-B - Over the Horizon Backscatter (radar).

PGB - Precision Guided Bomb.

PINCER - Same as a Bracket maneuver.

PIO - Pilot Induced Oscillation - oscillation in an aircraft's flight path or attitude caused by a pilot failing to compensate for the lag time between pilot input and aircraft reaction.

PIPPER - A small dot at the centre of the aiming reticule.

PITCH - The angle of an aircraft's nose above or below the horizon.

PITCH LADDER - Pitch indicator in the HUD.

PK - Probability of Kill.

POSITIVE G's - G-force that forces you into your seat.

PREDICTOR SIGHT - A computerized gun sight that predicts the flight of the cannon's shells.

PRESSURE BREATHING - Forced breathing to help cope with high-g manoeuvres.

PULSE DOPPLER RADAR - Radar that emits short bursts of radio waves and detects objects by the returning echo.

RADAR - Radio Detection And Ranging.

RECCE - Reconnaissance.

REDOOT - Effect felt by pilot when pulling negative g's for too long. Caused by blood rushing to the head.

RHWR - Radar Homing Warning Receiver.

RHAW - Radar Homing and Warning.

RMG - Ranging Machine Gun.

ROE - Rules Of Engagement - rules governing the conditions under which a fighter can engage or fire upon a bogey.

ROLL - Rotation around an aircraft's longitudinal axis.

ROOKIE - Inexperienced pilot.

RP - Rocket Propelled.

RPM - Revolutions Per Minute.

RSBN - A radio navigation beacon.

RTB - Return to Base.

RUDDER - Control surface on the tail of an aircraft which affects the yaw of aircraft.

RV - Rendezvous.

RWR - Radar Warning Receiver.

R-27 - An advanced Russian A-A radar-guided missile.

R-60 - A second-generation Russian heat-seeking missile.

R-73 - A third-generation Russian heat-seeking

missile.

SA - Strike/Attack.

SA - Semi-Active. Refers to radar guided missile which requires the radar to illuminate the target all the way to the impact.

SA - Situational Awareness - the amount of awareness a pilot has about the tactical environment around him.

SAM - Surface to Air Missile.

SAR - Search and Rescue.

SARH - Semi-Active Homing.

SEAD - Suppression of Enemy Air Defenses.

SEMI-ACTIVE - Used to describe a missile which must be guided until its own radar can take over.

SIDESLIP - Motion of an aircraft to the right or left perpendicular to its longitudinal axis.

SIX O' CLOCK - Directly behind an aircraft, where it is most vulnerable.

SLAM - Stand-off Land Attack Missile.

SLAR - Side-Looking Airborne Radar.

SLATS - Extendible leading edge high lift devices.

SLIR - Sideways-Looking Infra-Red (system).

SOFT TARGET - Target without any Armor.

GLOSSARY

SRAM - Short Range Attack Missile.
separates from the wing surface.

STALL - Loss of control due to low airspeed or
excessive manoeuvres at high altitude.

STATUTE MILE - 5,280 ft..

STEALTH - Ability to avoid detection.

STUD - Frequency setting on aircraft radio (like
presets in a car radio).

TADS - Target Acquisition and Designator
System.

TERPROM - Terrain following system.

TERRAIN HUGGING - Flying at 500 ft or below,
following the contours of the land.

TFR - Terrain-Following Radar.

THREAT - Any enemy in your vicinity.

THRUST - Power produced by your engines,
usually referred to as a percentage.

THRUST VECTORIZATION - The ability to adjust the
direction of thrust via movable nozzles.

TIALD - Thermal Imaging and Laser Designation
(LGB aiming system).

TID - Tactical Information Display.

TOT - Time-On-Target When you are supposed to
be there.

TOW - Tube-launched, Optically tracked, Wire-
guided.

TRAM - Target Recognition and Attack
Multisensor.

TRANSPOUNDER - A combined radio transmitter
and receiver which transmits a signal when it
receives one. Commonly used for IFF systems.
TRIM - setting aircraft controls or trim devices so
that the aircraft maintains a desired attitude.

TRIM TAB - a small control surface attached to
an aileron or other larger control surface for the
purpose of making small trim corrections to that
surface's position.

TRUE AIRSPEED - indicated airspeed corrected
for installation, compressibility and air density
errors.

TWS - Track While Scan radar mode.

VASI - Visual Approach Slope Indicator system of
lights for landing assistance.

VELOCITY VECTOR - An indicator in the HUD
which shows predicted path of travel.

VERTICAL VELOCITY - the sink or climb rate of an
aircraft.

VIRTUAL COCKPIT - true 3-D scrolling, panning

cockpit.

VSI - Vertical Speed Indicator.

V/STOL - Very Short Take-Off and Landing.

WAYPOINT - A position in the world to which you
have to fly.

WCS - Weapon Control System.

WET POINTS - Places on the plane where
external fuel tanks can be mounted.

WILD WEASEL - Jamming mission, specifically
against enemy air defenses.

WINGMAN - A flying partner.

WIRE - The correct flight path for weapon
delivery.

WP - WayPoint.

YAW - Rotation of aircraft about its vertical axis.

ZERO-ZERO EJECTION - Ejection at zero altitude
and zero speed.

INDEX

3Dfx	7, 31	Avoiding flak and SAM's AWACS	246 114, 276, 311	Creating Campaign missions	7, 65-74, 178-180
A-10	273	BAe	6, 18	CRV-7	207, 250
AA HUD mode	165-167	Bank angle	224	CRV-7 sight	167
AA weapons	184-198	Barometric altitude	162	Custom Air-to-Air	7, 59-60
AA-10 ALAMO	219	Barrel Roll attack	238	Damaged plane, handling	223
AA-11 ARCHER	219	Basic Fighter Manoeuvres (BFM)	232-241	DASS	101, 121, 165, 248
AA-8 APHID	219	Beriev A50	290	DASS code numbers	125
Accelerated video cards	7, 31	BL-755 Cluster Bomb	213, 248	Defensive split	241
Afterburner	39, 149	Bore sight radar view	105	Designating targets	130
AGM 65 Maverick	133-137, 209, 250	Bracket manoeuvre	239	Diamond X	167
AIM-120 medium range missile	185- 186, 192-193	Break manoeuvre	233	Digital Terrain System	173
AIM-120 target tracking	165	Breaking the scissors manoeuvre	234	DirectP	83
AIM-9M target tracking	165	BVR combat	22	Double attack	239
AIM-9X	190	BVR missiles	184	Drop tanks	198
Aiming reticle	166	C-17 Globemaster	277	Durandal anti-runway bomb	201, 211, 251
Air-to-Ground HUD mode	168-170	Campaign	61-64	E767 Sentry	276
Air-to-Ground missiles	201	Cannon, firing	228	E9 JSTARS	274
Air-to-Ground weapons	199-218	CH Flightstick Pro	36	EAP	18
Airbrake	38, 164	Chaff	122	Easy-view keys	40
Airfields - see Military airfields		Check systems	159	ECM	245
Airspeed	162	Chinook helicopter	296	ECR-90 radar	21, 101-112, 125
Akula class submarine	294	Choosing the right weapon	201-202	EF-111 Raven	279
ALARM anti-radiation missile	215-216, 248-249	Cliff-edge (TIALD)	130	EF2000	6-13, 211
ALARM attack pattern	254	Climbing	222	Elevation radar view	105
ALARM sight	169	Closing speed	166	Engine management display	149
Altitude effect on weapons	186	Cluster bomb	201	Engine thrust	162
AN-225	289	Cobra	164	Enhancements	9-14
Analogue navigation instruments	146	Cobra helicopter	296	Evading missiles	125
Angle of Attack (AoA) indicator	164	Command Flight Path Display		External views	87, 92-93
Angle off-tail (AOT)	228	System (CFPD)	171	F-117	271
Approaching ships and flotillas	246	Compass tape	162	F-14	264
Artificial horizon	91	Configuring Joysticks	7, 14	F-15	266
AS-11 Kilter anti-radiation missile	219	Conflicts - see WARGEN system		F-16	267
AS-7 Kerry guided AG missile	219	Conventional bombs	201	F-22	269
Aspect angle caret	166	Counter low Yo-Yo	237	FA-18	245, 268
ASRAAM	21, 184-186, 190	Counter-measures	122	FAB 250 bomb	220
ASRAAM Target tracking	165	Creating Air-to-Air missions	7, 59-60	FAB 500 bomb	220
Auto-leveller - see Recovery Button					
Autopilot	142-145				

INDEX

FEBA	311	Immelmann	238	Merchant Ships	295
Flares	122	Information and status displays	148-153	Message summary	259-261
Flight Assistance Systems	142-148	Instrument Landing System (ILS)	171	Messages - see Sending & receiving messages	
Flight Control System	100, 317-319	Intercept point	228	MICASRAAM	190
Flight model	315-319	Interface	54	MiG-21	284
Forward Air Controllers (FAC)	135	Internal views	87	MiG-27	284
Free-fall bomb sight	169	Invincible carrier	293	MiG-29	20, 22, 283
Frits, Ned	18, 32	IPX	76-77, 83	Military airfields	303-306
FRS-2 Sea Harrier	364	IR Warning Receiver (IRWR)	121	Mission Editor	7, 65-74, 178-180
Fuel management display	150	Iron bombs	203	Missile envelopes	230
G-force	162	IRST	21, 90, 101, 118	Missile flight models	166
G-limit	226	Jaguar	206	Missile Target tracking	165
G-LOC	226	Jamming	108	Missiles, firing	230
GBU-12	205, 206, 251	JAS-39 Gripen	270	MK-82 bomb	203, 204, 247
GBU-16	205, 206, 251	Joystick	32	MK-83 bomb	203, 204, 247
GEC-Marconi	6	JSTARS	114, 311	Modem Link	7, 81-82
Glareshield views	91	JTIDS	10, 104, 113, 249	Moskit anti-ship missile	220
G, onset of	100	KAB 500L Laser Guided Bomb (LGB)	220	Mouse	32
Graphics+	7, 30-31	Key Press	6	Moving Map Display (MMD)	115, 138-141
Gravity	226-227	Keys	41-46	Multiplay	75
Ground attack	242-255	King of the Skies	85	Multiple target tracking	165
HALO helicopter	296	Kirov class battle cruiser	294	NATO fighting vehicles	296-297
HDD	21	Kuznetsov class carrier	294	Night flying	223-224
Helmet Mounted Display (HMD)	164	Lag pursuit	164	Nimitz carrier	293
Help	8, 18	Landing	164	Off-boresight shooting	190-191
Hercules	278	Landing HUD mode	171	Offset track (TIALD)	130
High Yo-Yo manoeuvre	236	Lead pursuit	164, 228	On-line help	8, 18
High-G Barrel Roll manoeuvre	235	Level flight	224	Padlock view	88
HIND helicopter	296	Line of sight (LOS)	228	Pavespike	128
HMD	160-172	Look up/down/ahead radar	106	Paveway GBU	203, 204
HUD	21, 99, 160-172	Low Yo-Yo	237	Pilot AI	15
HUD AA mode	162	Mach number	162	Pitch ladder	164
HUD AG mode	162	Manoeuvring Attack System (MAS)	109	Plan view radar	105
HUD ILS mode	162	Master Arm Indicator	162	Point-attack pattern	253
HUD refuel mode	162	Mauser 27 mm cannon	165, 185, 196, 252	Predictor gun sight	165, 169
IFF	107, 122	Memory	26, 27	Prelude to War	300-302
IL76/78	291				

INDEX

Probability of Kill (PK) values 186, 187, 189
 Pulse Doppler radar 103
 Pure pursuit 164
 R767 Refueler 275
 Radar Altitude (RADALT) 162
 Radar coverage 104
 Radar Cross Section (RCS) 103, 245
 Radar symbology 108
 Radar Warning Receiver (RWR) 121, 122
 Range to target 170
 RBK 500 SPBE cluster bomb 220
 Receiving messages 258
 Recovery Button 91, 143
 Red-out 226
 Refuel HUD mode 226
 Refuelling 171
 Regrouping 225
 Rendition 7, 31
 Rollaway manoeuvre 255
 Royal Aeronautical Society 6
 Royal Air Force 6
 Russian fighting vehicles 299
 S-225 long-range missile 185, 194-195
 S-225 target tracking 165
 SA-6 SAM 216, 217, 218
 SA-N-4 217, 218
 SA-N-9 217
 SAM's 243
 SAM suppression 244
 Sandwich manoeuvre 241
 Scissors manoeuvre 234
 Sea Eagle anti-ship missile 217, 218, 249
 Sea Eagle attack pattern 254
 Sea radar 104
 Section manoeuvres 239-241
 Sending & receiving messages 256-261
 Serial link 7, 78-80
 Set-up 26-31

Short range missiles (dogfighting) 185
 Skip refueling 225
 Slava class cruiser 294
 Slowing forward velocity 233
 Smart bombs 199
 SmartPilots System 256, 312, 313-314
 Smartviews 98-99
 Snapshots 229
 Special bombs 201
 Spy trawler 294
 Stand-off attack pattern 254
 Stealth 245
 Stores management display 151
 Strafing 197, 252
 SU-25/39 286
 SU-27 20, 22, 282
 SU-33 282
 SU-34 287
 SU-35 281
 System Requirements 26
 Take-off 221, 222
 Target heading 166
 Target ingress/egress 243
 Targeting AG weapons 202
 Taxiling 221
 Technical overview 24-25
 Throttle 38
 ThrustMaster F-16 34
 ThrustMaster FCS 32
 ThrustMaster TQS 36
 ThrustMaster WCS 35
 TIARD 128, 132
 Time early/late 168, 170
 Time On Target (TOT) 12, 170
 Time To Go (TTG) 139
 Tornado 272
 Total Entertainment Network 7, 84
 Tracking information 168
 TU-16 292

TU22M 288
 Turning 224
 Two-on-one bracket 239
 Two-on-one drag 240
 Two-on-two bracket 239
 Two-on-two drag 240
 Type 23 destroyer 293
 Type 42 destroyer 293
 Udaloy class destroyer 294
 Undercarriage display 171
 Vanguard submarine 293
 Velocity Vector (VV) 164, 183
 Vertical scissors manoeuvre 235
 Vertical Speed Indicator (VSI) 162
 VESA graphics set-up 26
 Views 45-46, 92-97
 Virtual cockpit 15
 VR headsets 87
 WARGEN system 309-312
 Warning systems display 154-159
 Waypoint 162
 Waypoint indicator 162
 Waypoint number 178
 Waypoint task 178
 Weapon effectiveness 186
 Weapon range bar 162, 186
 Website 16
 Weger, Peter 23
 Who's Who 331-332
 Wide-angle cockpit 88
 Windows 95 7, 28
 Wingmen - Engagement menu 257
 Wingmen - Flight comms menu 258
 Wingmen - Formation menu 257
 Wingmen - Report menu 258
 Wingmen - Tactical menu 257
 www 16

BIBLIOGRAPHY

Air Power T. Mason, Brassey's Ltd., ISBN 1857530691

Aviation, The Story of Flight, B. Gunston, Sundial Ltd., ISBN 0904230562

Avionic Systems, D.H. Middleton, Longman Ltd., ISBN 05802018811

BAe/McDD Harrier, M. Spick, Salamanda Ltd., ISBN 086101569X

Beyond the Horizon, P. Handleman, Airlife Ltd., ISBN 1853103985

Bridges, D. Brown, Reed Publications, ISBN 1857321634

Combat Arms, Modern Fighters, B. Gunston, Salamanda Ltd.

Combat Colours, B. Archer and P.R. Forster, Osprey Ltd., ISBN 1855322056

Combat Missions from the Cockpit, K. Delve, Sterling Pubs., ISBN 085840094

Display Pilot, R. Lea, Osprey/Reed Ltd., ISBN 1855324458

Electronic Warfare, D., Richardson, Salamanda , ISBN 0861012658

Fighter Combat, R.L. Shaw, Pat Stephens Ltd., ISBN 0850598427

Gulf Air War Debrief, S. Morse, Aerospace Pubs. Ltd., ISBN 187402314X

High Tech Warfare, R. Jackson, Headline Ltd., ISBN 0747205094

High Tech Weapons of the Gulf War, T. Smart, Salamanda, ISBN 1856130479

Modern Airborne Missiles, B. Gunston, Salamanda Ltd., ISBN 0861011600

Modern Aircraft Markings, M. Spick and B. Wheeler, Salamanda Ltd., ISBN 0861016955

Modern Attack Aircraft, M. Spick and T. Ripley, Salamanda Ltd., ISBN 0831750545

Modern Fighters and Attack Aircraft, B. Gunston, Salamada Ltd., ISBN 861010558

Modern Fighting Aircraft-F14, Salamanda Ltd, ISBN 0861011945

Modern Fighting Aircraft-F15, Salamanda Ltd., ISBN 0861011821

Modern Land Combat, D. Miller and C.F. Foss, Salamanda Ltd., ISBN 0861013166

Modern Tanks and Fighting Vehicles, R. Bonds, Salamanda Ltd., ISBN 861010574

Norway, H. Hofler, APA Publications, ISBN 1857321634

Philips Atlas of the World, George Philip Ltd., ISBN054005742

Race to the Swift, R. Simpkin, Pergamon/Brassey's Ltd.,

RAF Today, A.W. Hall, Bison Ltd., ISBN 0582082803

Red Storm Rising, Tom Clancy, Fontana, ISBN 0006173624

Rifles and Submachine Guns, F. Myatt, Salamanda, ISBN 0861010779

Soviet Military Power, W. Koenig and P. Scofield, Bison Ltd., ISBN 0861241274

The Air Campaign, J.A. Warden, Pergamon/Brassey's Ltd., ISBN 008367356

The Complete Wargames Handbook, J.F. Dunnington, Quill Ltd., CIP 9226553

The Fighter Pilots Handbook, J. Roberts, Arms and Armor Press, ISBN 184509033

BIBLIOGRAPHY

The Guinness Book of Aircraft, D. Mondey and M. Taylor, Guinness Pubs., ISBN 085123554

The Illustrated History of Helicopters, M. Heatley, Bison Ltd., ISBN 0861242327

The Soviet War Machine, S. Menaul, Salamanda Ltd., ISBN 0861010523

The Student Pilots Flight Manual, W.K. Kershner, Iowa Press, ISBN 0813816106

Thrust for Flight, W. Thompson, Longman Ltd., ISBN 0582082803

Thunder in the Desert, J. Blackwell, Bantam Ltd., CIP 9117173

Top Gun Fighters, G. Hall, Ian Allan Ltd., ISBN 0711018197

Top Gun, C. Chant, New Burlington Ltd., ISBN 1853484210

Tornado Down, J Peters and J Nichol, Penguin Ltd., ISBN 0451174720

U.S. Military Power, S.L. Rys, Bison Ltd., ISBN 0861241290

Warplanes of the 21st Century, B. Yenne, Bison Ltd., ISBN 0861246659

EF2000 CREDITS

WHO'S WHO

The following is a list of the SUPER EF2000 team at DID, in alphabetical order

Andrew Bate - Artist - 3D shape design, mission building.

Andrew Gahan - Artist - 3D shape design and mission building.

Bill Bird - Artist - Manual Compilation.

Carl Jackson - QA - game testing.

Chantelle Thacker - Artist - 3D shape design.

Charlie Wallace - Programmer - 3D World code.

Chris Bell - QA - game testing.

Chris Orton - Director of R&D - 3D techniques and effects.

Colin Bell - Director of Programming - project planning and game integration.

Craig Houston - Artist - world building and design of texture maps.

Damian Edwards - Mission development, testing and manual proofing.

Dave Ambler - Artist - 3D shape design.

Derek Johnson - Programmer - in-game language handling for localization - GUI implementation, statistics and integration.

Don Whiteford - Director of Production - simulation design, project management, manual concept, and manual copy.

Donna Chippendale - Artist - rendered 3D Studio art for the simulation and manual.

Gary Chaffe - QA - game testing.

Geoff Wynne - QA - game testing.

Iain McLeod - R&D Programmer - Network Communications System - Modem & serial code and GUI system development.

Ian Boardman - Head of 3D Design for SUPER EF2000.

- management of 3D modeling and world building.

Ian Tasker - Artist - 3D shape design.

John Bradley - Network Manager.

John Knight - Researcher - background information on Norway, scenario maps, general research and testing.

Jon Spencer - Head tester.

Martin Carter - Artist - world building and design of texture maps.

Martin Kenwright - Managing Director and Producer - original concept, SUPER EF2000 creative direction, publisher relations and manual copy.

Michael Hocking - Head of AI - WarGen design and coding, AA combat AI, neural networks, mission planner, GUI system design and manual copy.

Mike Burrows - R&D Programmer - SUPER EF2000 research and development - Win 95

code - cool F/X.

Neil Ambler - Artist - 3D shape design.

Neil Lecky-Thompson - Aeronautical Engineer and Programmer - Weapons flight models.

Nevil Plura - Software Manager - TIALD simulator development and adaptation for SUPER EF2000.

Nick Clarkson - Press & Media Relations Manager - publisher liaison, press and advertising.

Paul Chaffe - Military Liaisons - assistance with military research, mission building, military liaisons.

Paul Frewin - R&D - programming.

Paul Hollywood - 3D Designer - input into 3D systems, target management, missions and environment building.

Phil Owen - QA - game testing.

Ralph Van Doorn - Mission development and testing.

Ray Purvis - additional manual contributions.

Robert Ball - Artist - texture map design.

Robin Anderson - R&D programmer - sound and music integration.

Rob Openshaw - QA - game testing.

Roderick Kennedy - Head of Aeronautical Engineering and Programmer - Flight models,

EF2000 CREDITS

WHO'S WHO

SmartPilots AI controlled pilot system and manual copy.

Roger Godfrey - Programmer - Avionics and AI - Win 95 installation.

Russell Payne - Director of programming- 3D engine design, R&D.

Shaun Hollywood - Creative Director - graphic design - GUI design.

Simon Kershaw - Artist - 3D shape design, mission building, manual copy.

Simon Livesey - QA - game testing.

Stephen Powell - Programmer - WarGen components, avionics and GUI implementation.

Steve Hunt - Programmer - mission planner - smart views.

Steve Monks - Lead Programmer - Avionics, program module integration.

Steve Tickle - R&D programmer - cool explosions.

Stuart Jennett - Artist - EF2000 Silicon Graphics art.

Tim Johnson - Producer - mission building, 3D world design and manual copy - project management & documentation.

Tony Buckley - Head of Quality Control - quality control - publisher relations - testing, quality evaluation & technical support.

With thanks to . . .

the Advertising Agency Ltd - documentation design.

BAe Publicity Dpt - Information, advice and support.

David Chinn - Royal Aeronautical Society and NEFMA.

DID Administration - All the support staff in the office.

IBM Computers - Hardware.

John Turner - EF2000 Test Pilot.

Key Publishing - Information and aircraft line drawings.

Lockheed Publicity Dpt - Information.

Ned Frith - Head of EF2000 Marketing at British Aerospace.

Ocean QA - a big thankyou for all the hard work and late nights.

Ocean Software - Our publishers and much more.

Orinoco Sound Source - Sound effects and music.

Pete Birch - RAF Advisor. **Polylang Ltd.** - localization.

Robert Lynch - Military contacts and encouragement

Squadron 13 - Enthusiasm and advice.

Squadron Prints - Supply of special EF2000 prints and postcards.

Steve McLaughlin - RAF (retired) Air defense Consultant.

ThrustMaster - Suppliers of flight peripherals.

Many thanks to all of our Beta testers...You know who you are.

And anyone else who we may have forgotten to name, but who has contributed directly to the project.

Special thanks to the partners and children of team members, who have suffered as much if not more than the rest of us. We will make it up somehow!

DIGITAL IMAGE DESIGN LTD.

COMPANY PROFILE

Introduction

DID is a British-based development company specializing in the field of 3D software. The company employs around seventy specialists, each of whom has a background in either science or the arts, including experts in such fields as TV graphics, aeronautical design, computer networks, AI and 3D computer graphics. The DID philosophy is one of innovation, not imitation.

Principal Activity

DID specializes in the development of 3D computer games and military simulations for IBM PC compatible machines and is regarded as one of the major global developers in this field. Digital Image Design's products are renowned world-wide for their quality, and this has been achieved by constant improvements with each product released. There are very few developers that specialize in 3D graphics for PC, because their complex nature makes the effect very difficult to achieve successfully. The company has striven to produce a better class of product with each of its games and this has been rewarded with world-wide acclaim.

DID has collaborated with numerous influential sources including British Aerospace, The R.A.F., The Royal Aeronautical Society, NEFMA and a number of retired and currently serving fighter pilots, in order to make the simulation as accurate as possible. Several major aircraft and avionics manufacturers have since approached DID to investigate the possibilities of adapting the software for marketing and PR purposes.

DID's expertise has led it into the military arena (In 1997 the company achieved BS EN ISO 9001 TickIT accreditation).

The increasing power of the PC combined with the company's sophisticated 3D engine provide a much needed response to ever decreasing military budgets, and has enabled DID to create systems for all three sectors of the armed services. Amongst developments is an extremely cost-effective PC-based simulator for training pilots to use the TIALD system for laser-guided bombing. Its cost is a tiny fraction of its nearest commercial rival, without compromising effectiveness. Projects currently under development include cockpit trainers, AFV gunnery trainers, night vision systems and

various part-task simulators.

For all the latest information on the company and its games make sure you visit the DID web site.

<http://www.did.com>



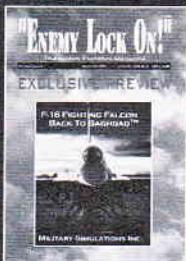
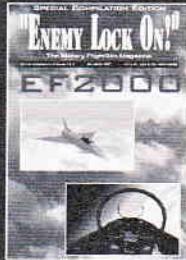
DIGITAL IMAGE DESIGN LTD.

AWARDS

1990	F-29 Retaliator	
	EMAP	Best Fight Simulator
	CVG	Joint Highest Scoring Review/Joint game of the Year
	Computer Game World (USA)	Runner up for Best Flight Simulator
1991	Robocop 3	
	Generation4 (France)	Most Innovative Game and Best Film License Game
1992	Epic	
	Tilt D'Or (France)	Best Computer Game of 1992
	Microkids (France)	TV Award for Best Game of 1992
1993	TFX	
	Tilt D'Or (France)	Best Flight Simulator
	Generation 4 (France)	Best Flight Simulator
	Powerplay (Germany)	Nomination for Best Flight Simulator
	Computer Game World (America)	Nomination for Best Flight Simulator
1994	TFX	
	PC Losirs (France)	Trophée d'Argent
	Golden Joystick	Best Flight Simulator
1994	Inferno	
	PC Losirs (France)	Trophée d'Or.
1995	EF2000	
	PC Losirs (France)	Trophée d'Argent
1996	EF2000	
	Computer Game World (USA)	Best Simulation

"ENEMY LOCK ON!"TM

The Military FlightSim Magazine



HOT OFF THE RAILS

Exclusive colour previews of soon to be released sims.

BETA NEWS

Detailed de-briefs on the latest products as they near completion.

INSIDE STORY

In depth interviews with flightsim developers.

FEATURES

Combat tips: How to get a greaser – the essential guide to landing all the top sims; the Pro's View, real pilots give their impressions of the current sims; soapbox, the forum for readers views.

REVIEWS

No nonsense reviews of software and hardware.

RUMOURS

Read about it here before it reaches the grapevine

SIM-CELEB

The personal side to the flightsim 'celebrities'

For Credit Card Orders call 1-800-477-SIMS



TFX
MILITARY

DIG

ocean

YOU'RE NOT JUST FLYING THE PLANE, YOU'RE COMMANDING THE WAR.

Calling all sim fans! Control an entire air war

With extensive multi-player options, you're never alone in DID's F22. And there's so much more! Escape from the confines of your cockpit into the E-3 Sentry AWACS, or step into the base commander's shoes. With DID's F22 there's more ways to play, more ways to win, more ways to keep the action moving.



WINDOWS 95 SOFTWARE = INTUITIVE FUN

Based on Windows 95, DID's F22 takes drag-and-drop techniques to the max. What's more, there's full on-line help with a graphical interface to make your training intuitive and fun.

A 3-D INTENSIFIED FLYING EXPERIENCE

Support for 3D accelerator cards guarantees workstation quality graphics on your Pentium PC. We've also enhanced the graphics technology and introduced advanced light-sourcing to add dramatic new depth - whatever the time or weather conditions.

NEW 'REAL-TIME' WARGEN SYSTEM

Using version 2.0 of our proven WarGen campaign simulator (first seen in EF2000), DID's F22 now runs real-time scenarios and gives unprecedented control over the battle. You'll find the eight countries and allegiances, which form your world venue, offer conflicts to die for.

UTILIZE THE FINEST IN AIR INTELLIGENCE

An alliance with World Air Power Journal (the aviation reference source) has generated the fantastic DID's F22 full-color flight manual - an in-depth guide to modern air combat.



IN ASSOCIATION WITH



DID'S F22 - COMING SOON

Commander

Programming System for THRUSTMASTER® Flight Controls

The *Commander* for Windows allows you to fully exploit the programming power within your ThrustMaster joysticks. By utilizing a powerful 'point and click' graphic environment, you will be assigning complex functions and key combinations within minutes of installation.

Full boxed CD-ROM version \$29.95 + shipping

Credit Card Orders
(call toll free)
1-800-477-SIMS
(CST 10am - 4pm) sales only or
1-888-296-5007

Email
sales@sim-tech.co.uk



www.sim-tech.co.uk



Digital Image Design Ltd, Tannery Court,
Tanners Lane, Warrington, Cheshire WA2 7NR.
e-mail: e12000@did.com
<http://www.did.com>



Infogrames Entertainment, Inc.
333 West Santa Clara Street, Suite 820
San Jose, CA 95113
Tel: (408) 289 1411
<http://www.oceangames.com>

DID EF 2000 V2.0™, © 1998 Oceans Software Ltd., © 1998 Infogrames Entertainment, Inc.
Oceans and Infogrames are © and ™ of Infogrames Entertainment, Inc.
All rights reserved. Game program: © 1998 Digital Image Design.
Designed and Developed by Digital Image Design Ltd.
All Rights Reserved