REACH FOR THE
SKIES

The Battle for Britain

Instruction and flight manual

Preface

War is a complex human state. It is caused by greed, jealousy and fear. It breeds hatred, cruelty and unspeakable atrocities. Yet the act of war, more than any other human activity, produces examples of bravery, personal sacrifice and invention that show the most admirable aspects of the human character. With such a range of human emotions raised, it is not surprising that war creates so much interest.

At Rowan, we are interested in the use of aircraft in war situations. The science of flight and the art of aerial combat are fascinating subjects. With the advent of more powerful computers it is possible for us to explore the subjects in more depth and produce more interesting simulations. We are now able to present you a battlefield which goes on around you as you participate. In the air, you have a team to manage. On the ground, you can develop strategies to get the best out of the aircraft at your disposal.

It is especially interesting to develop simulations of battles that actually occurred. There is a tremendous amount of material available about the "Battle of Britain" and we spent a long time researching. We found details such as the wing area of the aircraft involved and asked ourselves the big questions like "Why did the RAF win?", "Could the Luftwaffe have won?", "Why did it happen at all?"

In this simulation you will be able to try out strategies and tactics and see how your ideas stand up in battle. But we don't pretend to provide enlightenment about the cause of war. Fifty years ago RAF and Luftwaffe airmen were fighting each other in a deadly battle and BOTH sides considered it a justified war. Recent history suggests that the best weapon devised against war is powerful and well-informed public opinion.

Rod Hyde
Rowan Software Ltd

REACH FOR THE SKIES

Credits

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Contents

Summer 1940. The future of World War II hangs in the balance. The cream of the Luftwaffe and the aces of the R.A.F are locking horns in their most crucial confrontation yet 'The Battle for Britain'. You have the chance to re-live that famous battle, play the role of an R.A.F. pilot or Luftwaffe flying ace and shape the course of history. Your performance determines whether the outcome is a repeat of the R.A.F victory or an unequivocal Luftwaffe success.

'Reach for the Skies' is not a mission based game which can be lost or won on the basis of one mission. Instead it is a simulation of the entire conflict that became known as 'The Battle of Britain'. You will win or loose depending on your long term performance during the conflict. Your aim as an R.A.F. Pilot or Controller is to maintain your reserves of aircraft while also protecting the shores of South East England, while as a Luftwaffe Pilot or Controller you lead the German forces as they cross the English Channel in search of victory. Climb aboard a Spitfire, Hurricane, JU87, JU88, BF-109, BF-110, HE111 or DO17 and engage in dog fighting with only your skill and wits to protect you. You can also plan the battle as a Controller, actually making the strategic decisions that will win or lose the battle.

This manual contains instructions on the use of the software as well as the mechanics of aircraft flight and combat. Air combat during the Battle of Britain did not depend on the monitoring of complex computer systems in a jet powered war horse, but rather the delicate guidance of a graceful but temperamental mount during an airborne joust. While it is possible to enter the game immediately by following the instructions in the 'QUICK START' section it is likely that your first outing will be a short one and we strongly advise that you read all of the instructions as soon as possible in order to discover the finer details of this simulation

All references below are to KEYBOARD control. For corresponding MOUSE or JOYSTICK controls, consult the section `SUMMARY OF CONTROLS'.

Please note that any additional information too recent to be included in this manual can be found on your game disks as an ASCII 'READ.ME' text file. If your version does not have this file, then the manual already contains all of the relevant information you require.

When you need to make a choice within the simulation you will use one of the following methods;

DOT SELECT - A number of option screens (such as SIDE SELECT) present you with a choice in the form of plaques with dots on them. If a dot is flashing then that is the current default option which may be selected by pressing RETURN/ENTER. To change the default option you use the LEFT/RIGHT CURSOR KEYS and then RETURN/ENTER to make your selection.

Dot select is also used on map screens during the game to find out information, where the dots represent features such as airfields, convoys and aircraft. Using the LEFT/RIGHT CURSOR KEYS will highlight each factory shown on a map Pressing RETURN/ENTER will provide information on the factory and allow you to issue orders. Pressing CURSOR UP/DOWN will change from Factories to the next category (aircraft, airfields etc) where you can use LEFT/RIGHT to repeat the process.

NUMBER ENTRY - There are two ways of entering numbers. If the number has a cursor at the end, it is possible to edit the number by using BACKSPACE or DELETE and the NUMBER KEYS. Examples of this are when setting RANGE, HEADING etc. when playing as CONTROLLER.
The second method is when there is no cursor next to the number (as you have a fixed choice of numbers) in which case the CURSOR LEFT key will decrease the number and CURSOR RIGHT will increase it.

MENU BAR - A number of game options, including control device and difficulty, are selected through a MENU BAR at the top of the screen. Should you wish to change any of these options before flying you should refer to the section of the manual 'MENU BAR'.

System Requirements

This manual contains machine specific instructions for the IBM PC version of 'Reach for the Skies'. Some instructions may differ for the Commodore Amiga and Atari ST computers and these will be listed on a separate 'User Guide' included in the packaging.

IBM PC and 100% compatibles

Required: IBM PC (and 100% compatibles) with at least 540K of base memory, Hard disk with at least 3.5 meg of free space, High Density Floppy Disk Drive (3.5" or 5.25"), VGA 256/16 colour or EGA 16 colour graphics.

Supports: Ad-lib, Sound Blaster, Roland MT32/LAPC-1 EMS/KMS, Microsoft compatible mouse and driver, keyboard or joystick

Installation and Loading Instructions

IBM PC and 100% compatibles

To play 'Reach for the Skies' it must first be installed onto your hard disk as follows.

Insert "Disk 1" into your preferred drive (A or B). Select the drive as normal, type INSTALL and press ENTER/RETURN and follow the on-screen prompts.

SOUND SUPPORT: During installation you will be asked to select the sound card to be used for SOUND EFFECTS and then again for MUSIC. 'Reach for the Skies' supports the use of twin sound cards. This means that you may select a Sound Blaster card to play the sound effects and a Roland card to play the music, provided that you have the necessary hardware.

The sound cards supported are Ad-lib, Sound Blaster / pro, Roland LAPC-1/MT32.

Note: If you wish to change the configuration after installation see the section 'CHANGING YOUR CONFIGURATION' later.

Saving Pilot's Progress

Players should note that the program automatically saves your pilot's progress and any photographs you take to hard disk at the end of each game day.

Video footage, which uses more disk space, is not saved automatically but only when you select the save option included on the video playback screen.

War aims – Winning at 'Reach for the Skies'

As an R.A.F officer your fighters must avoid risky and unnecessary contact with Luftwaffe fighters, concentrating instead on turning back, or shooting down, the bombers. Remember that your resources are limited and should never be risked in unnecessary combat with fighters for the purpose of personal glorification. In PILOT mode you will have three pilots with which to complete the campaign. If you lose your life three times then the R.A.F. will quickly become demoralised and the Luftwaffe will win the day. In CONTROLLER mode you must manage your resources and create a strategy to effectively protect against the Luftwaffe threat. Your responsibility will be for all of your fighters and, although lost pilots will be mourned, you will continue the conflict, regardless of the number of pilots lost. Should you allow the British Air Strength to fall below 50% the Luftwaffe will gain the advantage they need to sweep your defences aside and launch the invasion of Britain. Maintain British Air Superiority until the end of September 15th and the invasion will be cancelled and you will have won the day.

As a Luftwaffe officer you must clear the airs of R.A.F. fighters to gain air superiority. Only then will the way be clear for Operation Sealion - The invasion of Britain.

In PILOT mode you have three lives with which to bomb and strafe your assigned targets to weaken the British defences. At the controls of your deadly fighters you must hunt down the British defenders and destroy them in aerial combat. Reduce the British Air Strength below 50% and the Luftwaffe will be successful. In CONTROLLER mode you must select the targets your bombers will strike at as you strive to break the will of the R.A.F. Your responsibility will be for all of your fighters and bombers as you set up the bombing raids and assign fighter cover in your quest to attain air superiority. Succeed in reducing the British Air Strength below 50% and you will be eating dinner at the Ritz. Fail and you will have to make your excuses to the German High Command.

Hard drive tidy - The PC version of Reach for the Skies includes a utility called 'tidy' which will remove unwanted files from your hard drive. Video, photographs, high scores and game introduction files can all be removed to free hard drive space. To use this utility select the directory that you have installed Reach for the Skies into and then type "Tidy" followed by the first letter of the file type you wish to remove (listed below).

V - Video files
P - Photograph files
H - High scores and player records
D - Demo/intro files
A - All of the above.

Actual R.A.F. strength during the Battle

The R.A.F. started with about 700 fighters: 430 Hurricanes and 270 Spitfires. Fighter production during the period was about 100 fighters per week: 60 Hurricanes and 40 Spitfires.

The simulation starts with 60 aircraft (although not all may be in serviceable condition on the first day) and the production rate is one fighter per day. The ratio with reality in both cases is just below 10%. The ratio of Spitfires to Hurricanes for both stock and production in the simulation is 50/50.

Getting Started

After loading of the simulation you will see an introduction sequence (256 colour ONLY) followed by the title/credit screen. Pressing ESC at any time will terminate the intro or credits and take you to the first game screen.

SIDE SELECT:
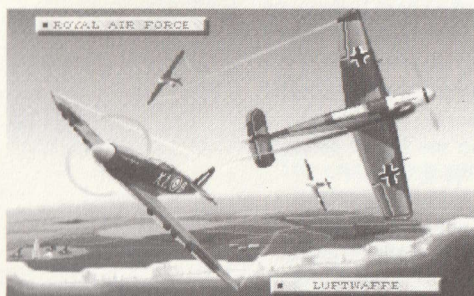
This is the first screen you will see once 'Reach' has loaded successfully. It allows you to decide which side you will control during the battle. It shows two plaques - one for the R.A.F and one for the Luftwaffe. Next to their names you will see a small square. If it is flashing it means that the plaque is currently selected. You can change the selection by pressing one of the CURSOR LEFT/RIGHT keys. When the flashing square is next to the name you want, press ENTER/RETURN on the keyboard to confirm.

The Royal Air Force (R.A.F.)

If you choose the R.A.F., you will be moved to the pilot's Ready Room screen. This is where you select a log book into which to save your progress. If this is your first game all the log books will be blank (marked 'Sprog')

The R.A.F. Ready room

A dark highlight bar will show which logbook is currently selected. Use the keyboard arrow keys to move the bar up and down the stack of books to choose which log book you will use then press ENTER/RETURN.

(If you choose a logbook other than Sprog's, then you will move to the Orders Screen and continue from the point after that pilot's most recently completed mission. This can only happen if you have played this simulation before and have a previously created pilot). If you have not played before you will be presented with the following screen.

LOGBOOK:

Having selected a logbook, you will be presented with a top down view of the book lying on the table. You now have the opportunity to enter your name. Type in your name (a maximum of 10 characters is allowed) then press the down arrow key on your keyboard to move the cursor down to the callsign box. Delete the callsign and add in your own if you wish. When you are satisfied with both your name and callsign, press ENTER/RETURN or press the down arrow key and highlight NEW PLAYER then select as normal.
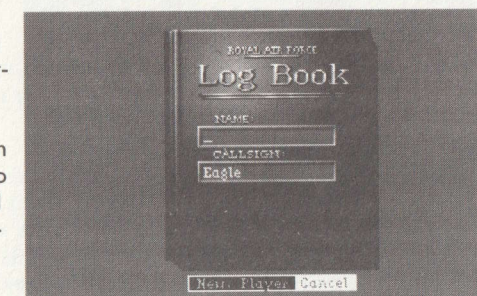
(Note that if you have chosen a log book that has previously been used, you will have a different option at the bottom of the screen. Select OK to use the character and his callsign. Selecting RECONFIG allows you to re-configure the role that character plays. CANCEL takes you back to the initial R.A.F/Luftwaffe selection screen.)

ROLE SELECT:

There are three options to choose from. PRACTICE, CONTROLLER and PILOT. press RETURN/ENTER to select or use CURSOR LEFT/RIGHT to change the highlighted selection.

PHASE SELECT/ORDERS BOARD

Following your selection of ROLE you will see the PHASE SELECT screen and the ORDERS BOARD which will be discussed before giving details of the PRACTICE, CONTROLLER and PILOT options
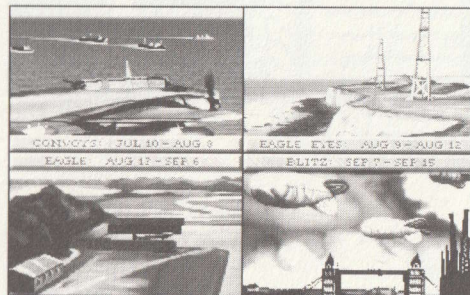
This screen allows you to choose which phase (characterised by the Luftwaffe's varying tactics) of the Battle of Britain you enter. Details of the phases are given in FOUR PHASES OF THE BATTLE and depending on which phase you select you will need to adjust your tactics to match the Luftwaffe.
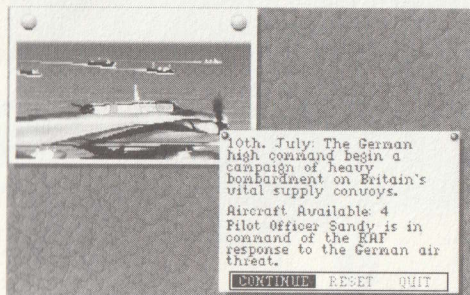
This screen provides a summary of the options you have selected, as well as detailing the number of aircraft that Fighter Command have made available to you. Select CONTINUE to enter the main game, RESET to return to the first option screen or QUIT to exit the simulation.

CONVOYS: JUL 10 - AUG 9   EAGLE EYES AUG 9 - AUG 12
EAGLE AUG 12 - SEP 6   BLITZ: SEP 7 - SEP 15

10th. July: The German high command begin a campaign of heavy bombardment on Britain's vital supply convoys.

Aircraft Available: 4
Pilot Officer Sandy is in command of the RAF response to the German air threat.

CONTINUE RESET QUIT

Practice

When you select the practice option you will be presented with a SUMMARY SCREEN.

This screen shows the various groups of aircraft (referred to as 'flights') which your computerised CONTROLLER has ordered to respond to an incoming threat. By using the CURSOR UP/DOWN keys you can check the orders given to each of the flights and decide which aircraft you wish to fly in. With your chosen aircraft highlighted press CURSOR LEFT/RIGHT to highlight one of the options TAKEOFF, INTERCEPT, LAND or CANCEL listed at the bottom of the screen.

No TYPE   LOCATION   MOVE STATUS
4 HURRICANE CROYDON AIRFIE

Return to control room

4 Hurricane aircraft scrambled from Croydon Airfield to intercept Raid Q which consists of 6 Ju87 and escorts.

Practising allows you to play one day of the simulation, without risking your status in the overall conflict. If you select this option the first time you play the simulation you will be able to practice the first day of the first phase you have chosen. Should you be shot down it will have no effect on the overall conflict. The difficulty level will be that of a beginner and VULNERABLE will be selected. If you wish to practice while invulnerable (you can not be shot down and will 'bounce' if you hit the sea or ground) or in 'REAL FLIGHT' (less powerful, more realistic flight), you should refer to the section 'MENU BAR' for information on how make such a change. You will also need to refer to the sections of the manual listed under FLYING WITH THE R.A.F.

Controller

CONTROLLER - For those players who prefer a bit more strategic involvement in the battle, you can assume the role of a controller in the R.A.F. You must decide what the R.A.F's response will be to the Luftwaffe's inbound raids each day. Your orders will have a strong effect on the outcome.

As an R.A.F controller you will decide on the movement of aircraft from factory to airfield and airfield to airfield, as well as which aircraft to deploy against the enemy. The ultimate aim of a controller is to maintain the number of R.A.F aircraft so that it remains above the critical level needed to prevent the Luftwaffe from gaining aerial supremacy during the battle. If the British Air Strength falls below 50%, then the threat of an invasion will become a reality.

We recommend that you assume the role of a Controller only after you have become a successful Pilot, because when playing as a Controller you will have to fly as a Pilot once you have set up each day's response to the Luftwaffe.

The Luftwaffe will attempt to reduce the R.A.F strength in a number of ways:

Shoot down R.A.F aircraft in combat.
Shoot R.A.F aircraft whilst still on the ground.
Bomb R.A.F repair facilities located at airfields.
Bomb the R.A.F aircraft factories.
Bomb shipping convoys carrying aircraft spares coming from America.
Bomb radar facilities to reduce the R.A.F's early warning capability.
Deny the R.A.F the use of their airfields.

To maintain the R.A.F's air strength above the critical level, you must ensure that the loss rate does not significantly rise above the aircraft production rate.

Providing that the four factories remain undamaged, each will produce a new aircraft once every 2 days.

(a) Currently highlighted group
(b) Current date
(c) Number of available aircraft today
(d) Name of current Airfield/location
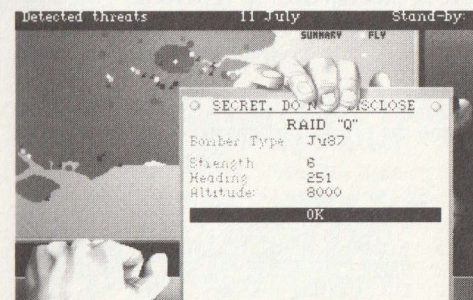(e) Detected threat
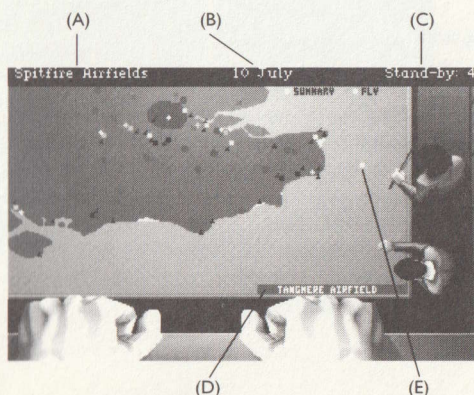
R.A.F Control Room screen showing map with icons

You are now in the Control Room, looking down over the map of the South East of England. The text on the top line gives the name of the location that is currently highlighted (the flashing dot), the day/date and also the number of aircraft made available to you for today by Fighter Command.
On the map you will see several small dots which mark the following areas of interest:

Marker	Group type
Red square	Spitfire airfield
Blue square	Hurricane airfield
Light grey square	Aircraft Factory
White square	Detected threat
Blue cross	Other airfield
Dark grey area	Conurbation
White cross	Barrage balloon
Red marker	Anti Aircraft Artillery (AAA) site
Black marker	Radar site

As CONTROLLER you can interact with those locations marked with a coloured dot. (Detected threats, Aircraft factories, Spitfire and Hurricane airfields). Use the CURSOR UP/DOWN keys to move between groups and CURSOR LEFT/RIGHT to move between individual members of a group. The top left of the screen gives the name of the location that is currently highlighted and pressing RETURN/ENTER will bring up a clipboard giving more information.

1 - Detected Threats

There will always be at least one or more white 'Detected Threat' squares over the channel at the start of each day. These show the position of the Luftwaffe aircraft as they approach England. One important point to note is that Radar was in its infancy during the Battle of Britain. For this reason the information given on your charts will be estimated and will often change in some respect each time you check on a Detected Threat.

The clipboard gives each raid a letter to avoid confusion. If there are bombers in the group, then the type is displayed. The number of aircraft, their heading and altitude is also shown. This information has been collated from various radar stations and is therefore considered to be reasonably accurate. The type of bomber has been calculated from the speed of the aircraft. As a result, it is not possible to predict exactly how many of the aircraft in the raid are bombers and how many are fighters. It is possible to calculate the target of the raid from their heading, but this isn't always reliable as the enemy often doesn't turn towards its final target until the last possible moment.

It is wise to get information about ALL of the Detected Threats before developing a response.

2 - Aircraft factories

Throughout the battle, new aircraft were being manufactured to increase the number available or replace those that were destroyed in combat. A stock of aircraft can build up at factories if left unattended. They must be moved to airfields before they can be employed in the war effort.

If an aircraft factory is successfully attacked, all of the aircraft in stock will be destroyed and the production capability will be severely impaired in the future.
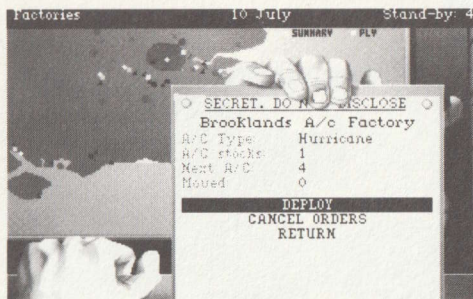
There are four factories manufacturing aircraft in the South East of England. Two make Hurricanes and two make Spitfires. On selecting a factory on the map, a clipboard is displayed.

This clipboard tells you the type of aircraft (a/c) manufactured at the factory and how many completed ones are in stock. The 'next a/c' shows how many days it will be before a new aircraft will be finished. When it is ready it will automatically be added to the ones in stock. The 'moved' figure indicates how many aircraft you have moved from the factory on that particular day.

Below this information are three options: DEPLOY, CANCEL ORDERS, RETURN.

DEPLOY - If there are a/c in stock at the factory you will be prompted to select a new base (airfield) to which the a/c will be moved. Use the CURSOR LEFT/RIGHT as normal to highlight the required airfield and press RETURN/ENTER. A clipboard will be displayed and you should use the CURSOR LEFT/RIGHT KEYS to increase or decrease the number of a/c to be deployed at this airfield. Pressing RETURN/ENTER will confirm the move and ESC will cancel it.

If you now select the same aircraft factory again on the map, you will see that the aircraft stocks are at 0 and the moved total is at 1. The moved a/c is now in transit to the selected airfield, but it won't be available there until the next day. If you want to cancel the move, select CANCEL ORDERS . To leave the clipboard without cancelling the order, select RETURN instead.

Note: Aircraft en route to airfields will not be attacked by Luftwaffe raids.

3 - Airfields

This is where the CONTROLLER'S job really starts. With the limited number of a/c stationed at these airfields you must defend England against attack, issuing intercept orders to your fighters, while also keeping an eye on pilot morale, the state of the airfields and the repair facilities. Selecting an airfield will provide you with a clipboard showing the following information and options.
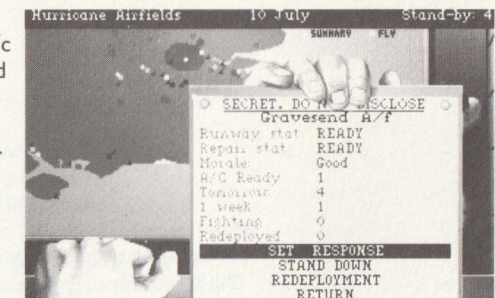
Runway Status

The Luftwaffe will try and bomb the runway to prevent use of the airfield. If the runway is READY, then all is well and your aircraft can be scrambled.

Damaged airfields can take up to 5 days to be repaired.

Repair Status

This shows the status of the a/c repair facilities at this airfield, where damaged (but not destroyed) a/c can be repaired. If the status is READY, then this facility is functioning normally. Repairs will be performed quickly unless the facilities have been affected by bomb damage.

Morale

The current state of the battle will have an effect on morale. It can range from Poor, Fair, Fine, Good up to High. At the start of the battle morale will be FINE. Your actions as Controller will have the biggest influence on the state of morale. (Each R.A.F airfield has its own morale level as does each Luftwaffe Rendez-vous point.)

(i) What affects Morale?

It goes up if:

(a) the Controller gives an airfield a rest day the day after its a/c were scrambled.

(b) any aircraft from the airfield are involved in a successful mission against the enemy.

(c) all a/c scrambled from an airfield return undamaged.

It goes down if:

(a) you use airfields every day over a long period.

(b) any of the airfield's aircraft are shot down.

(Moved aircraft affect the morale of the airfield they are moved to. The morale level becomes an average of the aircraft already present and the new arrivals)

(ii) What effect does Morale have?

Morale affects the way the computer controlled pilots behave. A high morale level means they will be more successful in engaging the enemy. They will be more effective in combat and more likely to spot an enemy on their six (behind them) and manoeuvre more effectively.

Aircraft ready

The number displayed here shows the total number of operational (undamaged) a/c at this airfield. However you should note that the controller's job was made harder by the strict limits placed on the use of fighter resources by Fighter Command. Each day you will have a only a small number of a/c you are allowed to scramble to meet all incoming threats. The number available is listed in the top right of the map screen and will vary during the campaign.

Tomorrow

This is the total number of a/c ready for the next day. This figure includes repaired a/c and a/c en route from factories.

One Week

Unfortunately some a/c might take up to a week to repair. The number that fall into this category are included in this figure.

Fighting

This number tells you how many a/c from this airfield are currently involved in combat with the Luftwaffe.

Redeployed

This indicates how many a/c from here are being moved to another airfield today.

Four options are also available on the Airfield Clipboard:

SET RESPONSE

Selecting this option will allow you to scramble aircraft to meet an attack. This is described in more detail in PLANNING YOUR RESPONSE .

STAND DOWN

This will cancel any responses that you have set up for this airfield.

REDEPLOYMENT

This option allows you to move a/c to another airfield in the same way that you move a/c from factories. It is useful when you need to reinforce an airfield that has lost a lot of a/c or you want to move a/c with a low morale from a front line airfield and replace them with a/c with a high morale. You should note that as with a/c travelling from factories, a/c redeployed in this way are unavailable for one day.

RETURN

This takes you back to the map.
If you have not already done so, select each of the Detected Threats

Planning your Response

and note down the number and type of a/c as well as their altitude speed and heading. If there is more than one threat you will need to decide upon your tactics as CONTROLLER. Do you spread your forces and attempt to counter all the threats or attack in strength, hoping to defeat one attack quickly and then turn to face another. You will rarely have enough a/c to meet all attacks, so you will have to formulate your own strategy and see how well it works. Once you have decided on the Detected Threat you will counter first you should select the closest airfield with operational aircraft. When the clipboard is shown, select SET RESPONSE from the options and the board will be removed to show one of the 'Detected Threats' on the map flashing. . Using the CURSOR LEFT/RIGHT keys move the highlight to the threat you wish to deal with and then select it. A new clipboard will be displayed, allowing you to set up your response.
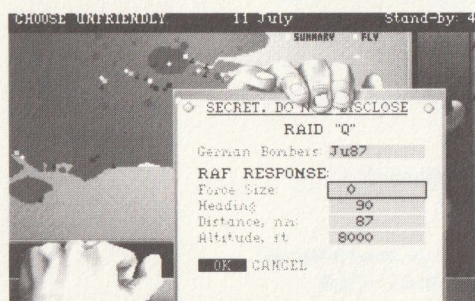
The type of German bomber is displayed. Beneath this are the values that define the R.A.F's response to the threat.

The 'Force Size' box is highlighted and using CURSOR LEFT/RIGHT will increase or decrease the number of a/c to be scrambled, up to the maximum allowed by Fighter Command. When you are satisfied use CURSOR DOWN to move to the next field.

Your control room staff automatically insert default heading, altitude and distance values onto the clipboard, based on the information received from the Radar network. These figures are used by the a/c to navigate to their 'Circle Point' (where they await updated headings from the CONTROLLER to guide them to their target). It is important to note, however, that these default figures will often result in your a/c meeting the enemy head-on. As discussed later in IMPROVED FLIGHT AND COMBAT TACTICS a head on confrontation is far from desirable and ideally you should alter these figures to position your a/c in a better 'attack position'.

Select 'OK' to close the clipboard and initiate the response.

EDIT RESPONSE
If you wish to change your orders select your chosen airfield again and you will notice that you have the opportunity to edit the response you have just set. It behaves in exactly the same way as for when you set the original response.

Prepare to Scramble

Having set up your response (or responses) it's time to check the last two options available on the R.A.F Map Screen. Using the CURSOR UP/DOWN KEYS move the highlighter until either SUMMARY or FLY are highlighted. LEFT/RIGHT CURSOR will then move between the two.

(1) SUMMARY

The Summary screen lists all of the flights that you have set up for that day. One flight is highlighted and extra information for it is displayed in the panel at the bottom of the list. You can select whichever flight you wish out of those available using the CURSOR UP/DOWN KEYS. The highlighted flight will be the one you will fly in.
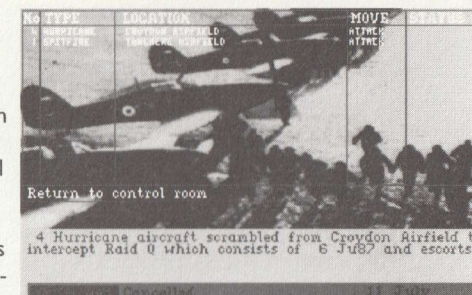
At the bottom of the screen are the options that allow you to confirm or cancel the relevant flight. If the orders are cancelled then that will be shown in the status column next to the flight orders and that flight will stand down. You can reverse the cancellation by re-selecting 'confirmed'.

Use CURSOR DOWN to select 'Return to Control Room' and then RETURN/ENTER. You will be asked to accept the changes you have made to the orders or forget them. If you forget them, any changes you have made to the orders will be cancelled.

Whichever option you choose, you will return to the Control Room.

(2) FLY
You are now ready to switch to being a Pilot in the R.A.F, helping to execute the orders you have made as a Controller. Selecting 'Fly' will take you to the Pilot's summary screen. Once there selecting 'TAKE OFF' or 'FLY' will put you in the cockpit of the a/c.

See PILOT for details on how to fly the aircraft. At the start of each new day you will return to the Control Room to formulate new orders.

Pilot

Whichever role you select (PRACTICE, CONTROLLER or PILOT) you will eventually end up at the pilots summary screen, preparing to take to the air.

This screen shows your a/c and the others which are to be scrambled with you and shows where they are flying from and which raid they are going to attack.

At the bottom of this screen will be a number of options. They will vary depending on whether you are flying as a trainee in PRACTICE, or as a proper PILOT.

Practice
Trainees will have the options to Takeoff, Intercept, Land or Cancel.

Pilot
Pilots will have the options to Takeoff, Fly or Cancel.

TAKEOFF (Practice or Pilot)
This option will place you in the cockpit, on the runway, ready for takeoff.

INTERCEPT (Practice)
Trainees can go straight into a fight with the enemy by selecting this option.

LAND (Practice)
This option will position your a/c on an approach to your home airfield. You will need to practice landing when you have limited fuel as this may result in you needing to return to an airfield to refuel or to rearm

FLY (Pilot)
This option skips takeoff and puts you in the air en route to intercepting the Luftwaffe raid.

CANCEL (ALL roles)
This will cancel the summary screen and take you back to the previous screens.

Selecting any option other than CANCEL will put you into the cockpit of your aircraft, ready for the battle ahead. To learn how to fly, see the section FLYING WITH THE R.A.F.

Flying with the Royal Air Force (R.A.F.)

Whatever route you took to get this far, you will now be sitting in the cockpit of either an R.A.F Spitfire or Hurricane aircraft. We will assume that you are at the rank of Pilot Officer (the default rank and the easiest level). For details on changing Rank and Difficulty see 'THE MENU BAR'.
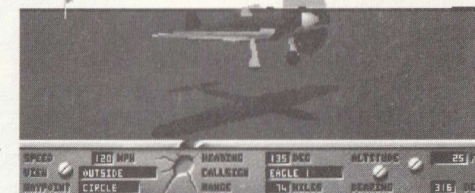
TAKEOFF

If you chose TAKEOFF you will enter the cockpit of your aircraft as it taxis down the runway for takeoff. At the easiest level (Real Flight NOT selected) this will provide enough speed to take off. (For details on taking off with the 'Real Flight' menu option selected see the section 'Real Flight' later in the manual). Once the aircraft is in the air, it is time for you to take control. You might like to press Function key 5 (F5) to see your a/c from an outside view. You should notice the landing gear underneath. Press G to raise the undercarriage then press F5 again to return to the cockpit.

(You can discover much more about the variety of different views available by turning to the section 'DIFFERENT VIEWS')

Press P to pause the simulation whenever you want the chance to read the following instructions on how to fly.

Because of the excessive power available to you in the beginners mode (Pilot Officer rank with REAL FLIGHT switched off), there is no reason why you can't throw the aircraft around the sky to get a feel for how it responds. Try using your control device (which at the moment will be set for keyboard by default unless you have altered it via the Menu Bar).

This section of the manual is conveniently separated into two parts. FLYING THE SPITFIRE/HURRICANE tells you all you need to know about the controls in the cockpit and how to fly the aircraft. MAKING AN INTERCEPT takes you through combat with the Luftwaffe and explains the best tactics to use when in the air.

What is in a name?

The name "Spitfire" was given very early on in the development of the early prototypes. However, Mitchell didn't like it. The name "Shrew" was seriously proposed at one point. Obviously the "Shrew" supporters were not marketing men. It is certainly not a name to capture the imagination of the public. "Spitfire" seemed to fit, even though it was rather "earthy" when compared to the beautiful lines of the aeroplane.
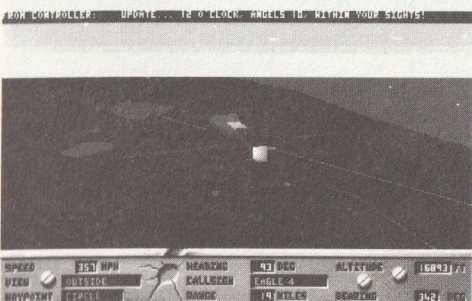
The Spitfire became a legend, a symbol of the success of the British people. All over the country, Spitfire funds were started in nearly every city, town and village.
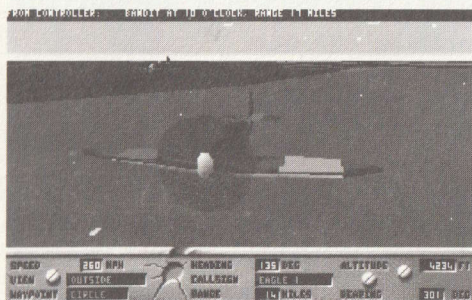
"R.A.F Spitfire aircraft."

Spitfire

Despite the impression that it made on the public, the Spitfire only accounted for 20% of the enemy aircraft destroyed during the Battle of Britain. It had a long service life and it was a very photogenic aircraft. It handled superbly and was the "sports car" of the aircraft industry. Its speed and manoeuvrability made it more than a match for the Luftwaffe's best fighter, the BF-109. Unfortunately, the guns they had were painfully inadequate in comparison to those fitted in the Luftwaffe aircraft.

Hurricane

The Hurricane was responsible for 80% of the destroyed enemy aircraft but was not as popular as the Spitfire in the eyes of the public. Its success was due in part to the fact that the R.A.F had greater numbers of Hurricanes than Spitfires, but also because the Hurricane's wooden frame and panels (compared to the Spitfires metal) could take more damage in battle as enemy bullets often passed straight through, missing vital components, rather than ricocheting around inside.

"R.A.F Hurricane aircraft."

The cockpits for the Spitfire and Hurricane are so similar that we use the same cockpit design for both aircraft in this simulation. You can easily tell which aircraft you are in by pressing 'I' on the keyboard. An Information Readout panel in the cockpit will tell you which one you are in. You could also switch to an external view of the a/c instead as the Spitfire and Hurricanes were visually quite different. If you are a real expert, you should also be able to tell the difference by the way each aircraft type handles when in the air. Both Spitfire and Hurricane aerodynamics are accurately represented, as far as is possible, in this simulation.
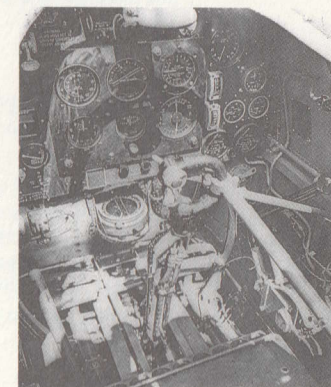
The cockpit shown below should be studied along with the keyboard control card enclosed in your package.

Dials

The dials on both the R.A.F. and Luftwaffe aircraft were calibrated in imperial units (ft, miles etc.) rather than metric units. This step from reality was taken for your benefit. We decided that having to get familiar with two different sets of units in the same simulator was taking the desire for "accuracy" beyond a reasonable limit.

However you will probably have noticed that, for the sake of accuracy, speeds are calibrated in miles per hour rather than the more normal modern (for aircraft) unit of knots.
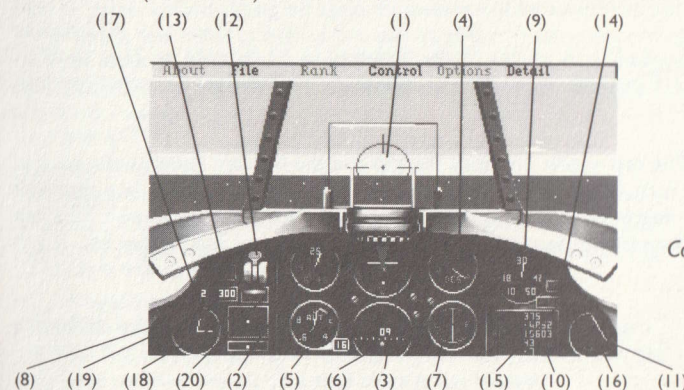
Cockpit of Spit/Hurr

(1) Sights

This allows you to line up your shots when firing on the enemy. The distance between aircraft will obviously have an influence on whether you hit it or not, as will the angle of your approach to the target. This is explained in more detail in the section 'MAKING AN INTERCEPT'.

(2) MPH

This shows you the current speed of your aircraft. The range is from 0 to 460. The numbers on the dial are in units of ten, so 14 is really 140 M.P.H. The red area from 0 to 60 is a danger zone. If the needle enters the zone, you will be in danger of stalling. Note that neither aircraft can actually fly at the maximum speed shown on the dial as the manufacturers were forced to use any gauges that they could get there hands on at the time.

(3) Artificial Horizon

The white line indicates the pitch and bank of the aircraft. The numbers 6, 3 and 0 on the left and right are in units of ten degrees, so 6 is 60 degrees, 3 is 30 degrees and so on.

(4) Rate of climb indicator

This shows the rate that the aircraft is climbing or descending in feet per minute. The gauge only shows up to 4,000 feet climbing or 4,000 feet descending. For more detailed information you will need to 'cheat' by referring to the V.S.I readout on the Information Panel.

(5) Altimeter

This gauge shows your altitude above sea level. It works in the same way as a clock, having two needles and the figures represent units of ten feet or one hundred feet. If the long needle is pointing at the 2 it indicates twenty feet and if the small needle points at the 2 it indicates 200 feet. The number in the bottom right hand corner next to the gauge shows the altitude in one thousand foot units only. For each 360 degree turn that the large needle makes, a change of 100 feet has been registered. For each 360 degrees that the small needle turns, a change of one thousand feet has been registered.

(6) Heading

Each unit on this readout is equal to 10 degrees, so 21 is equal to 210 degrees. From this you can easily calculate your current heading.

(7) Slip and turn

The top needle indicates the slip and the bottom needle indicates the turn. Each graduation on the turn needle represents a turn rate of 3 degrees per second. When an aircraft turns, it slips as well. This can be compensated by use of the rudder. Z turns the rudder left, X will turn it right. To re-centre it press C.

(8) 12 hour clock - can be used for dead reckoning

The clock shows you the correct time of day in hours and minutes.

(9) R.P.M.

The R.P.M. (Revolutions per Minute) gauge reflects the percentage of power being applied to your aircraft's engine. As with the M.P.H. dial this does not give a true indication of the maximum R.P.M. of your a/c as the dials were not originally designed for use in these aircraft.

(10) Information Readout (I)

For those pilots who find it difficult reading all of the gauges and taking the information in, a digital readout has been provided giving you most of the information you require in an easier, but less realistic, format. Of course, if you want to fly as the real pilots did then you should only rely on the original instruments. Press I on your keyboard to toggle between the digital information and your callsign and aircraft type.

(i)   Speed
      The speed of the aircraft is registered in miles per hour (M.P.H)

(ii) VSI - Vertical Speed Indicator
      This shows the vertical speed of the aircraft in feet per minute. A positive or negative number indicates whether the aircraft is climbing or diving.

(iii) Altitude
      This show the height of the aircraft in feet above sea level.

(iv) Heading
      The current heading of the aircraft is shown here in degrees.

(v)   Pitch
      The pitch axis of the velocity vector (not the aircraft) is measured in degrees.

(11) Fuel

This gauge shows your current fuel levels. If the needle reaches the red zone, then you are low on fuel and should land back at your airfield to refuel before taking off again. Refuelling will be automatic but it will take a few minutes before you can be airborne again depending on your distance from the nearest airfield. If your aircraft is damaged the mission will be over for you as the ground crew will take your aircraft for repair.

(12) Flap switch (F)

The flaps are down when the switch is down. Flaps are only used when you are bringing the aircraft into land. Pressing F on the keyboard will toggle them up or down. During flight they should be up.

(13) Wheel brake light (W)

When the wheel brakes are applied this light will come on. Toggle them on and off by pressing W on the keyboard. Wheel brakes are only used to bring the a/c to a stop once it has landed.

(14) Video light (V)

When the light is on, it means that video film is currently being recorded. Pressing V will toggle this on and off. Pressing O will rewind and restart the tape if you wish to overwrite the footage already in memory and start again.

(15) Auto-pilot light (A)
When this light is on, the auto-pilot is engaged.

(16) Auto-gun light (T)
When the guns are switched into auto mode (press T) then this light comes on. If an enemy a/c flies through your sights and is within range, the guns will automatically fire as long as you have enough ammunition left and your guns haven't jammed or been damaged in battle.

(17) Control device sensitivity
This number represents the current setting for the control device. This can be adjusted by using the F3 and F4 keys. Only keyboard control is affected by any changes made. Mouse and joystick sensitivity are adjusted by their own software or setting up procedures.

(18) Control surface indicator
This shows the position of the ailerons, elevators and rudder. Move the aircraft with your control device to note the changes registered here.

The ailerons cause the aircraft to roll, the elevators cause the a/c to climb and the Rudder is used when the aircraft slips.

(19) Ammo counter

(20) Gear (G)
These lights indicate the gear status. When the red light is illuminated the gear is raised, when the green is illuminated the gear is lowered. The gear can only be lowered when the aircraft's speed is below 200 mph.
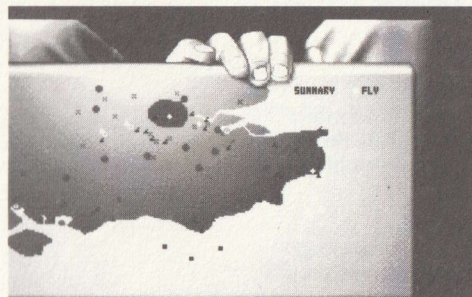
The Pilot's Map (M)
Every pilot carries a map with him in the cockpit of his Spitfire or Hurricane which shows the location of each wing leader. To look at your map, press the M key on your keyboard.

This map is almost exactly the same as the one available to the Controller in the Control room back at the R.A.F base. You can select any of the squares on the map that represent the R.A.F's aircraft (including your own) or the enemy bandits (inbound detected threats). A page will appear giving you additional information on each aircraft. To exit this screen select FLY or press ESC.

Different Views

There are many different views available, both inside and outside your aircraft.

Outside view (F5)
When in the cockpit, try pressing function key F5. You will be shown your aircraft as viewed from the outside. There is an additional panel of information at the bottom of the screen but you don't have to worry about that for now. It is described in detail at the end of this section. When you wish to return to the cockpit view, press F5 again to toggle the view.

Rotating the outside view (1 and 2)
You can change the position that you view your aircraft from when using the outside view (F5). Try pressing the number 1 key on the main keyboard and holding it down. The view will rotate in the X axis (in the horizontal) around the outside of your aircraft. Now let go of key 1 and try holding down key 2 instead. This moves the view in the Y axis (vertically). If you want to reverse the direction that the view moves around in, try holding down the ALT key first then either the 1 or 2 key.

Zoom in/Zoom out (F1/F2)
From the outside view you can get a closer look at the aircraft by zooming in with function key F1. You can zoom out by pressing F2.

Track view (F6)
Function key F6 toggles between the cockpit and the track view. Track view differs from the normal outside view. It views the aircraft from the rear and tries to keep the same view no matter what manoeuvres the aircraft might make. It is just like the view you would get if another aircraft was tracking you from behind.

Home base view (F7)
F7 will show the view from your home base. In the R.A.F's case this will be an airfield.

Satellite view (F8)
This view will show your aircraft from above.

Bomb view (F9)
Pressing F9 when you are bombing will give a view from the bomb as it descends.

Bandit views (Shift 0)

You aren't restricted to outside views of your own aircraft. You can also have a look at the enemy under certain circumstances. When in combat, try pressing the SHIFT key and the number key 0. You should see the outside view of an enemy aircraft. If you don't, then an enemy isn't in range or hasn't yet been assigned to you.

External view panel

When viewing your aircraft from outside you can still keep track of the speed, heading etc using the external view panel (shown below).

SPEED	357 MPH	HEADING	93 DEG	ALTITUDE	16893 FT
VIEW	OUTSIDE	CALLSIGN	EAGLE 4		
WAYPOINT	CIRCLE	RANGE	14 MILES	BEARING	342 DEG

The 'SPEED', 'HEADING', 'ALTITUDE' and 'CALLSIGN' shown on the panel are those of your own aircraft.
'VIEW' depends on which external view you selected, e.g. F5 = "Outside" view and F8 = Satellite view.
'RANGE' and 'BEARING' are the range and bearing from your current position to the current waypoint.
'WAYPOINT' shows the navigation waypoint currently selected. If you wish to change a waypoint press ' (inverted comma) to increment the waypoint and ; (semi-colon) to decrement the waypoint. A waypoint is a point or an area where the aircraft should perform an action such as bombing a target. Each R.A.F. flight has three main waypoints.

TAKEOFF - This waypoint is over the home airfield.
CIRCLE - This is the area the aircraft patrols, ready to intercept the inbound threats. After a successful engagement an R.A.F fighter will return to its CIRCLE waypoint until it is assigned a new target.
LAND - This is also over the home airfield. If during combat an a/c is low on fuel it will return to its home base to refuel and then return to the circle waypoint. If it is out of ammunition it will continue to fly, acting as Wingman for its partner until both aircraft are out of ammunition, at which time they will return to base to re-arm. Damaged aircraft will return to base for repair

Waypoint note - Aircraft will always attempt to reach their currently selected waypoint. However, these are a 'standing order' and will be overruled if an enemy comes within range. If this happens the aircraft will attempt to engage or evade the enemy before returning to its original course.

Internal views

As well as external views the Spitfire and Hurricane have a number of internal views. These allow the player to scan the skies for enemy a/c from within the cockpit. The internal views available are;

Key	Internal view
3	Left back 45 degrees.
4	Left.
5	Left front 45 degrees.
6	Front (normal cockpit view).
7	Right front 45 degrees.
8	Right.
9	Right back 45 degrees.

Pressing [in any of these views will move to a 'look up view' which will allow you to see a larger part of the sky, but less of the cockpit and controls. To exit 'look up view' press].
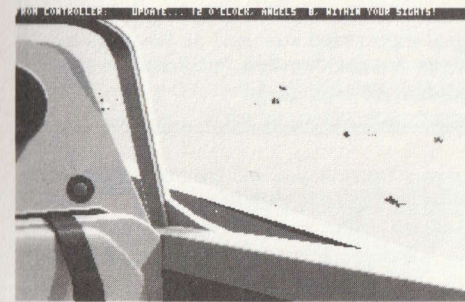
Left back 45 degree view (6 key)

Behind you!

Unfortunately you cannot look directly behind you, mainly because it wasn't physically possible because all you would see is your own pilot's chair! To see what is directly behind you either use the look up view and check your mirror or try the 3 or 9 key views and weave the aircraft left and right to get a brief glimpse of anything on your tail.

Switching Between Aircraft

'Reach for the Skies' allows you to switch between the aircraft of any flight in the air (as long as they are on your side!). This gives you an even stronger influence on the outcome of each day's mission.

To switch, hold down the SHIFT key and press number 9 to jump to the cockpit of your wing man (if you have one) or a number from shift 1 to shift 8 to jump to the cockpit of another wing leader then SHIFT 9 to get to their wing man. You will see the callsign in the Information panel change to show that you are now in a different aircraft.

Making an Intercept

Radio Messages

In those days, a radio was referred to as a wireless.

The RAF aircraft were fitted with an AM set which could be picked up by domestic wireless. This meant that people on the ground could listen in to the excitement, drama and tragedy of air warfare.

The RAF aircraft were also fitted with something called pip-squeak. The signal transmitted was used on the ground to track friendly aircraft. It was an obvious "ancestor" to the modern IFF technology.

Shortly after the start of your mission, you will start to receive radio messages about the bandits (enemy aircraft) nearby. The messages appear at the top of the screen preceded by the callsign of the sender, and are colour - coded as follows: (another pilot or your controller).

If the message is in WHITE then it has been sent specifically to you, by another pilot or your controller. You should take note of it and act accordingly.

DARK BLUE messages are radio chatter being sent to another pilot and provide information on how the battle is going.

If the message is GREEN then you have sent the message as a comment on your immediate situation. These messages are the simulations way of warning you about enemy aircraft that you would normally be aware of in a real situation. You should act on these warnings immediately.

For example - FROM RED 2: BANDIT AT 11 O'CLOCK. RANGE 6 MILES.

This is a message from a fellow pilot. If the message was displayed in WHITE then the message was specifically for you. BANDIT AT 11 O'CLOCK means that there is an enemy aircraft at the 11 O'clock position ahead of you, 6 miles away.

To reach the enemy and engage, you may fly manually (in-real time) or turn on the Auto-pilot by pressing the A key. If you want to get to the enemy quickly, you can also turn on Accelerated Mode.

Accelerated Mode

Pressing the TAB key on the keyboard will put the simulation into accelerated time mode. This will speed up time for everybody, allowing you to get to the interception point in seconds rather than minutes. It affects the enemy in the same way. Note: If you activate Accelerated Mode while in manual, with a negative pitch, you may quickly end up crashing.

A message at the top of the screen will inform you that Accelerated Mode has been activated.

If you come under threat or come within 6 miles of the enemy, then Accelerated mode turns off automatically.

In addition SHIFT and TAB will lock the game into accelerated mode (as will holding the TAB key) but these are dangerous as your a/c may be destroyed while not under your control.
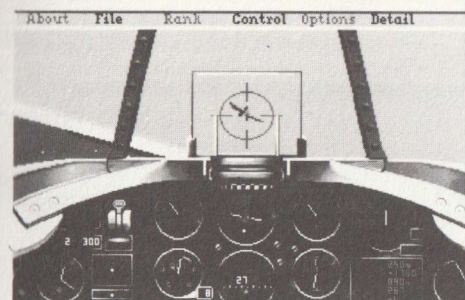
You should soon see the aircraft ahead. If it is far away (6 miles or more) then it will only be visible as a small moving dot in the sky. As you get closer you will begin to see more detail. If all goes well, you should eventually see it at close range.

(You might receive updates from you controller if the aircraft makes a change in heading. Respond to the new information accordingly).

Speech
Some machines will have a digitised speech option. When turned on, you will hear radio messages from other pilots. A few examples and their significance are given below:

"Some trade for you." - An enemy aircraft is close by your position.
"Okay, let's engage." - I have seen the bandit (message to Wingman).
"Tally Ho." - I have seen the bandit and am engaging (message to controller).

Shooting

If this was a modern day fighter, you would probably just launch a couple of AIM9R sidewinders and sit back and watch as they chased the enemy aircraft. However, in the 1940's combat was totally dependant on the pilot's own skill and reactions which is why combat is so much more exciting as a result. You must be within 250 yards of the enemy target before you can start shooting (SPACE BAR), and the only weapons you have at your disposal are your machine guns.

Deflection

The problem with bullets is that they do not arrive at their target point instantaneously. They take time to reach their target which could mean that the enemy has moved out of the way. To compensate for this, you will have to anticipate where the target will be and aim for that area so that your bullets hit it as it arrives.

The ability to defeat the enemy in air combat means the difference between success and failure. You should refer to the section 'IMPROVING YOUR SHOOTING' for further details of the best tactics to employ.
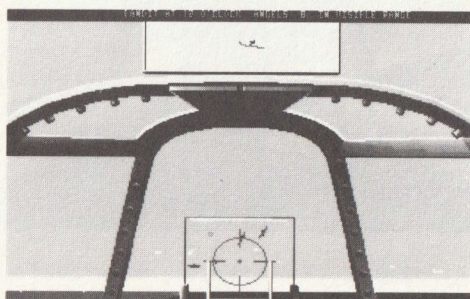
Look up front view ([and])

There are many different views available to you when in the cockpit of your R.A.F aircraft. However, one of the most useful during combat is the 'look up' front view.

Press the [key on your keyboard. You will see a new view of the sky from within your cockpit. This is the view you would get if you were to look up a little from your normal cockpit view. You get a much clearer view of the sky here so you can track enemy aircraft more easily. You also have the added bonus of a rear view mirror so you can see when an enemy bandit is behind you (on your 'six').

You might think that side views are more important when trying to follow an enemy plane, but they aren't! When you turn to follow an aircraft you will bank steeply, so your side views will only show a very high shot of the sky (too high to be of any use) or the ground or sea will fill the view on the other side as you turn. Without the 'look up' view, it would difficult to follow the enemy accurately and give chase.)

Whenever you want to go back to the normal cockpit view from the 'look up' view, press the] key.

Combat View (RETURN/ENTER)

Only possible when an enemy is within 6 miles of your a/c, this is probably the most useful view available. It is an outside view where the camera moves so that, regardless of which manoeuvres you and the enemy perform, both aircraft will remain in view. (Draw a line from the camera to the enemy aircraft and it will always go through your aircraft). In this way you can work out the best manoeuvre to perform in order to get the enemy into your sights.

Locking on (L)

You can lock the combat view onto the currently displayed bandit by pressing the L key. This key will toggle the lock on and off. When unlocked, the view will automatically change to the nearest bandit. You will notice the bandits callsign (as displayed on the panel in the outside view) will change colour to indicate that the combat view is locked onto it.

The locked bandits will always remain in the centre of the screen so you can see exactly where they are at all times. If you put your aircraft into auto-pilot and auto-guns then you might be able to watch the dog fighting unfold before you from the outside view.

Note that the rotational keys (1 and 2) do not have any effect during combat view. However, zooming in and out again with F1 and F2 does operate as normal. (See 'Different views' for more details).

Winning the Day

As an R.A.F officer you must hunt down the Luftwaffe's bombers while evading their deadly fighters. Destroy the bombers before they reach their targets, or inflict such heavy damage that they will be forced to turn back, while minimising the loss of R.A.F's precious aircraft. You will know that your mission is over when your CONTROLLER informs you that the "Luftwaffe are returning home", but you will not know how well you have done until you return to base. For this you should:

(i) Find an airfield (preferably your own) and land.
(ii) Turn on the auto-pilot (press key A) and Accelerated mode (TAB) to land automatically.
(iii) Press F10 to bring up the Menu Bar and select 'End Mission'. (only available when the R.A.F. have destroyed all Luftwaffe bombers or the Luftwaffe bombers have attacked their target).

On ending a mission you are usually taken directly to the Debriefing Screen

Losing the Day

There are a number of ways in which to end the day in failure.
i) Crash/get shot shot down
In practice mode you will be taken to the debriefing screen (described later) before returning to the side select screen. In Pilot mode you will be taken to the ready room when your first or second pilots are killed, in order to enter a name for your new pilot. On the death of your third pilot you will go directly to the debriefing screen, before restarting the campaign. In Controller mode the loss1 of a pilot will not affect you directly except that the number of aircraft available will be reduced and your task will become harder.

ii) Select abort mission
Aborting the first mission will return you to the side select screen as no player record will have been saved. After the first day your character record will be active and so you will return to the beginning of the day in order to restart.

iii) Ejecting (Ctrl & E)
RAF pilots who eject over England will usually survive to fly the following day, while those who eject over the channel are often drowned.
Luftwaffe pilots ejecting over England are likely to be captured and sit out the remainder of the war, while those bailing out over the channel will often survive, due to the superior 'search and rescue' facilities provided by the German U-boat fleet.

Debriefing

To get to the debriefing screen you must have ended a mission either by selecting 'End Mission' from the Menu Bar, or by landing safely at your home airfield. (See 'Real flight' for more details) or by ejecting (Ctrl and E) or being shot down.

A Debriefing Clipboard is displayed with a number of options available.

(i) PHOTOGRAPHS
If you took any photographs during the mission, select this option to review them.
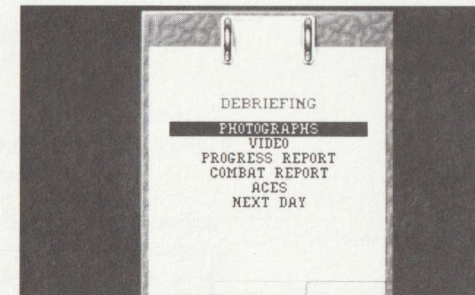
If you have taken any photographs the first one, photograph A, will be put up on the projection screen automatically. The slide projector has three options on it. NEXT takes you to the next photograph. DELETE will destroy a photograph if you don't want to keep it on disk. PREVIOUS will take you back one to the previously viewed photograph.

To leave this room and return to the Debriefing, select the EXIT door.
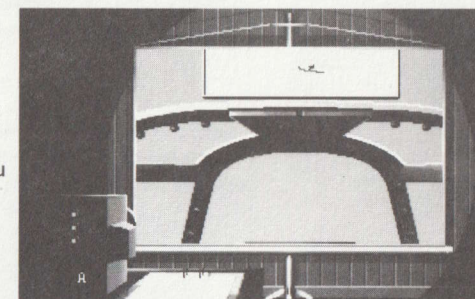
(ii) VIDEO
This allows you to view any recorded video film that you shot during a mission. Until it is saved, video is held in the computer's memory (R.A.M). You should ensure that you save any video you wish to keep so that you can use the memory for recording new footage on your next missions. (The O key rewinds and restarts the video, thus overwriting old recordings).

The available options give you the chance to look at the recorded footage.
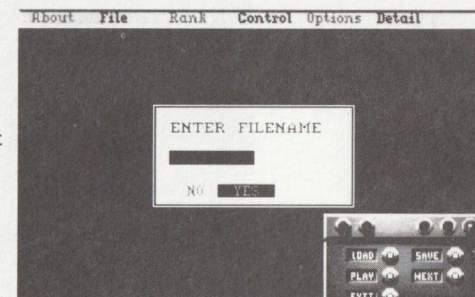
(a) Load

To load in a previously saved film you will have to type in the name of the footage you previously saved and select OK. You must then select PLAY to view it.

(b) Play

To play the footage in memory select this option.

(c) Exit

To leave this room and return to Debriefing, select this option.

(d) Save

To save the video in memory, select this option and give the file a name before selecting OK. The footage will be saved to floppy or hard disk.

(e) Next

If you recorded more than one piece of footage in a mission without using up all of the available film then you can proceed to the next film and then PLAY it with this option. The length of film available depends on the amount of available memory. (On the PC this feature takes advantage of expanded memory if any is available).

(iii) PROGRESS REPORT

On selecting the Progress Report option, you will first see the data for your individual pilot covering the last mission and also giving the grand total since you began. The information tells you how many aircraft you have lost, how many you have shot down, the number of ground targets hit by the Luftwaffe whilst you were in the air, how long you have been in combat for and your kill rating.

The same information is available for the entire squadron by selecting the squadron option at the bottom of the clipboard.

The Kill rating is a score which is calculated from the number of enemy bandits you shot down and your current rank. The higher the rank, the higher your rating will be for each bandit.

The current British Air Strength is also displayed at the bottom of this clipboard. This is a very important figure and shows you how well you are doing. If it falls below 50% then the R.A.F will lose the whole battle and the simulation will end.

To leave the Progress report and return to the Debriefing clipboard, select EXIT.

(iv) COMBAT REPORT

The Combat report gives a detailed breakdown of the day's combat, including the date, the home airfield, the type of Luftwaffe bombers encountered, the time of the attack, the height of the attack, and the number of casualties on either side.

To leave the Combat report and return to Debriefing, press any key.

(v) ACES

The Aces list gives you the top ten R.A.F pilots in terms of their total confirmed kill rating. Your name will only appear on the list if you manage to get more than the lowest entrant. How high up you appear depends on your total. If a pilot on the list is killed, this will be entered next to his name.

(vi) NEXT DAY

The final option in Debriefing will end the day and take you to the next one. What happens next depends on the role you chose earlier.

Practice

Trainees in practice cannot go to the next day. You are only allowed to practice on the first day of any phase. Selecting 'Next Day' will return you to the orders board for additional training.

You will advance to the next day of the conflict to plan out your tactics in the Control room.

Pilot
You will advance to the next day in the phase.

At the very bottom of the Debriefing clipboard you will find any comments from your superior officers on how the battle is going. The messages can only change once a day depending on the events that have occurred. If you are in PRACTICE you will be informed how well or how badly you did in that day's training exercise instead.

For further information on controlling the simulation you should refer to the section 'THE MENU BAR'. For details on how to improve your flying and combat refer to the sections 'REAL FLIGHT' and 'IMPROVED FLIGHT AND COMBAT TACTICS' (Improving your shooting, Fighter combat and Notes on the theory of flight).

The Luftwaffe
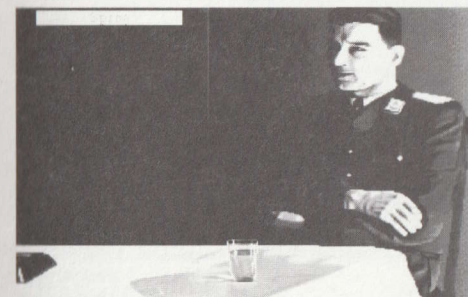
Having chosen the role of the Luftwaffe from the selection screen, you will be moved to the Squadron Meeting Room where you will see Obersteleutnant Werner Molders sitting pensively at a table. On the blackboard behind him are a list of available pilots (default settings at start). You should select one of these and then proceed through the option screens in the same way as for the R.A.F.
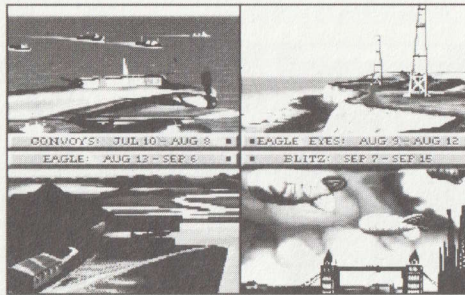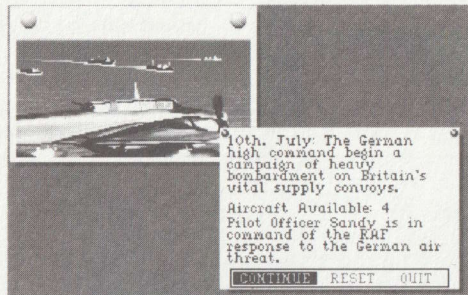
Logbook,

Role select,
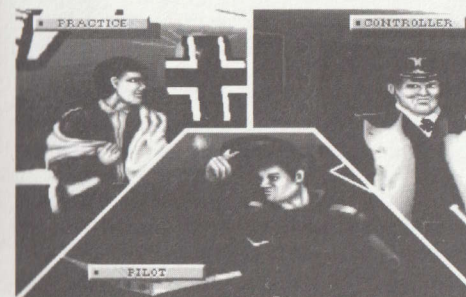
Phase select,

Orders board

Depending on which ROLE you selected there will be some slight differences from the R.A.F. These are listed below.

Practice

The Luftwaffe PRACTICE mode features different options to the R.A.F. as you will be taking an attacking role, rather than a defensive one. The option you can select are:

COAST

This option will take you in your aircraft and place you immediately at the edge of the SE coast of England, ready to execute your orders.

INTERCEPT

This will take you immediately into an interception with the R.A.F. Be ready for a dogfight.

BOMB JU87

This option takes you in your aircraft to a position just before a bombing run. This is the perfect opportunity to practice bombing and straffing.

CANCEL

This will take you back to choose another role if you change your mind.

To learn how to fly and what tactics to use in the air once you are in your cockpit, please refer to the R.A.F. PILOT section and 'IMPROVED FLIGHT AND COMBAT TACTICS'.

Controller

Once you are adept in the role of a Pilot, you should try taking on the role of Controller. You will make decisions about which targets to attack. Each day the German High Command will present you with a selection of strategic targets (one of which was actually bombed on that day during the battle) and it is up to you which target, or targets, you will attack and the number of your available aircraft to use.

As Controller, your aim is to reduce the effectiveness of the R.A.F by lowering the British Air Strength to less than the critical level of 50%. If the strength drops below this level then the final preparations for the invasion can be started.

There are a number of ways of reducing the air strength:

Shoot down R.A.F aircraft in the air.
Shoot R.A.F aircraft whilst still on the ground.
Bomb R.A.F repair facilities located at airfields.
Bomb the R.A.F aircraft factories.
Bomb shipping convoys carrying aircraft spares coming from America.
Bomb radar facilities to reduce the R.A.F's early warning capability.
Deny the R.A.F the use of their airfields.

Having selected the phase you wish to start the battle in, select CONTINUE on the next screen to confirm your choice. You will then move into the Luftwaffe's Control Room. Here you will see a large map of the SE corner of England.

(a) Currently highlighted group
(b) Current date
(c) Number of available aircraft flights today (each flight is two a/c)
(d) Name of current Airfield/location
(e) Available targets
(f) Rendez-vouz points
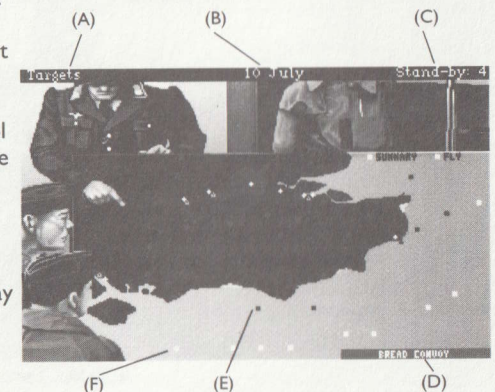
Luftwaffe Control Room

The general layout is very similar to the R.A.F Control Room. However, the ultimate objective of the Luftwaffe is obviously very different!

All Luftwaffe aircraft are organised in flights of two aircraft. As you progress through the campaign High Command will provide you with varying numbers and types of aircraft, depending on how well the campaign is going.

The map in the Control room shows similar items to that of the R.A.F. CONTROLLER.

Marker	Group type
Blue Cross	Airfield
Light grey marker	Aircraft factory
Dark Grey area	Conurbation
White cross	Barrage balloon
Red marker	Site
Black marker	Radar site
White dots	Rendez-vous point
Red dots	Target

However, the groups that you can interact with (red and white dots) are different. The white dots show your Rendez-vous point, where groups of bombers and fighters join in formation for the journey to the target. The red dots are the targets and these will vary in type from day to day, and phase to phase, depending on the plans of the German High Command.

One of the targets will be highlighted (flashing) and you should now check the identity of each target in turn by highlighting then pressing RETURN/ENTER.
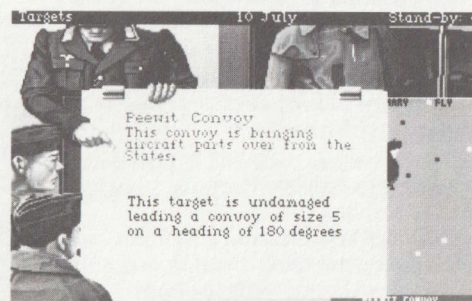
In this example, the target in question is a Convoy, carrying cargo to the shores of England from the United States of America. The state of the convoy (whether it is damaged or not), the size (number of ships) and the current heading is also revealed.

Press any key to make the clipboard disappear.

Now select a Rendez-vous point and press RETURN/ENTER to select it.

The Rendez-vous point will be assigned an identification letter (to distinguish it from other points). It also shows the aircraft type and the current morale level.

(Morale can range from Poor, Fair, Fine, Good up to High. At the start of phase one it will be at FINE).

You will also notice a number of selectable options underneath.
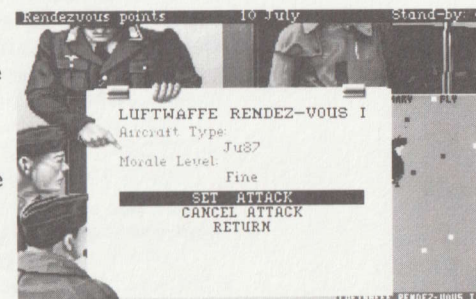
SET ATTACK
This allows you to set an attack on a Target of your choice. Press RETURN/ENTER to select this option and you will return to the map. One of the available targets will be highlighted (flashing) and you should now use CURSOR LEFT/RIGHT keys to highlight the target you wish to attack. Press RETURN/ENTER to select the target and display the 'ATTACK AGAINST:' clipboard.

Target
The name of the target is shown first. In this example, it is a shipping convoy in the channel on approach to England with vital supplies.

Bomber Type
This shows the currently available Bomber Type for this day. All bomber types are available during the entire conflict but the following list shows those most likely to be used in each phase.

Phase	Type
1	Ju87
2	Ju88
3	He111
4	DO17

Flights
Below this is the number of flights assigned to this target. Press the down arrow key to highlight this then use the CURSOR LEFT/RIGHT keys to change the number of flights until you are happy. Remember a flight is two a/c so selecting two flights will launch two wing leaders, each accompanied by one wing man.
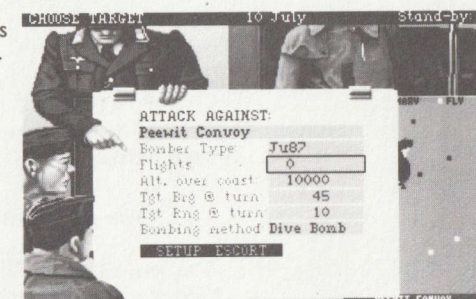
Altitude over coast

You can manually alter the altitude by typing in a new number from the keyboard. The lower the altitude, the closer the aircraft will get to the target before detection. Keep in mind that you might want to set up a few aircraft at higher altitudes to act as decoys. In this situation you want them to be detected early so that the R.A.F concentrate on them instead of the real threat from the aircraft coming in undetected at the lower altitude.

Target bearing at turn/Target range at turn

These two values dictate where the assigned aircraft will make its final turn towards its ultimate target. You include a sudden turn to disguise your ultimate target.

Bombing method

The penultimate option on the clipboard is the bombing method. This can be set at one of three settings:

(i) Dive Bomb

This begins at an altitude of 10,000 feet. (See 'Combat' for more information on 'Bombing' manually)

(ii) Low Level

This is at an altitude of only 2,000 feet.

(iii) High Level

This is at an altitude of 10,000 feet.

When the bombers are setup to your satisfaction, select Setup Escort. Another clipboard is displayed:

You can choose between Bf109 and Bf110 for fighter type.

The formations available are Close, High and Free. See 'Fighter Tactics' in the section IMPROVED FLIGHT AND COMBAT TACTICS for an explanation of these.

CANCEL ATTACK

This will cancel any responses you have set up for this Rendez-vous point.

RETURN

This option returns you to the map without setting an attack.

EDIT ATTACK

Once you have set an attack from a Rendez-vous point, selecting it again will give the option to EDIT ATTACK. Selecting this will take you back to the map where you can choose an attack to edit. An attack clipboard will be displayed and you can alter the attack in the same way that you set an attack.

SUMMARY

When you have set up all you want for that day, you should select 'Summary'. This will summarise the orders you have given for the day. If you want to cancel any of them, select CANCELLED from the bottom of the screen. This will appear in the status column next to the relevant aircraft's orders. To change it back, select CONFIRMED and the status column will be empty again. When you are happy with the orders use CURSOR DOWN key to highlight 'Return to the Control Room'. You will be asked to ACCEPT or FORGET anything you have changed on the Summary screen.

ACCEPT will return you to the Control room and accept the orders on the summary screen, including any changes you have made. FORGET will also return you to the Control room, but it will forget any changes you made and leave the orders as they were before you selected the Summary screen.

FLY

This will take you from the Control Room and into the Cockpit of your aircraft. From here on you will assume the role of a PILOT until the next day, when you return back to the Control room ready to set up the new days orders.

Pilot

Each of the three roles (PRACTICE, CONTROLLER or PILOT) will eventually lead you to climbing into the cockpit of the aircraft assigned to you. You will first have to select an option from the bottom of the Summary screen.

Fl	TYPE	Rendezvous	TARGET	STATUS
3	Ju88	"C"	Pevensey Radar Station	
1	Bf109	"C"	ESCORT	

3 flights of Ju88 receive orders to rendezvous at position C to Dive Bomb the Pevensey Radar Station. A free escort of 2 Bf109 has also been provided.

This screen shows you your aircraft and the others which are to be scrambled with you on that day. You can highlight a different aircraft by using the CURSOR UP/DOWN keys. Whichever aircraft is highlighted will be the one you will fly in. At the very bottom of the screen there will be a number of options depending on your role.

You can either select Coast, Intercept, Bomb or Cancel. To learn to fly the aircraft you should select Coast. This gives you a chance to familiarise yourself with the controls before you have to enter combat or bombing runs.
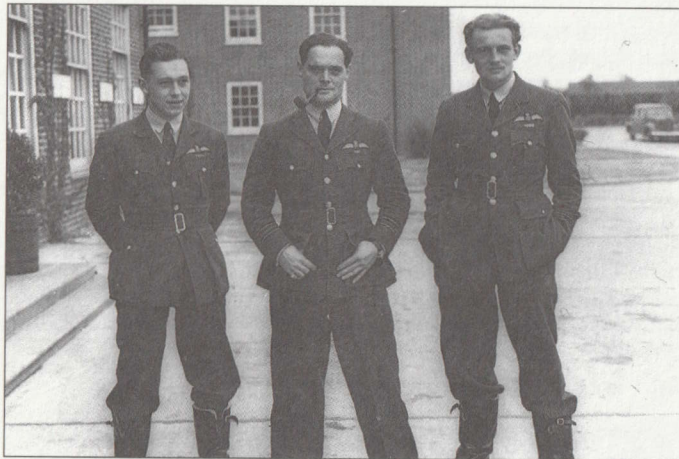
Controller

Controllers can select Begin or Cancel.

Pilot

Pilots can also select Begin or Cancel.

Having made your choice, you will be taken into the cockpit of your aircraft.

Success or Failure

If you select PILOT mode you will have three pilots to use in the campaign. You will win if your pilots can survive until the end of the campaign and reduce the British Air Strength to below 50%. You will lose the campaign when you lose your third pilot.

As a CONTROLLER you will win upon reducing the British Air Superiority or lose when the simulation reaches the 15th of September with the R.A.F maintaining their superiority.

Flying with the Luftwaffe

We will assume that you are at the rank of Leutnant (the default rank and the easiest and most unrealistic level).

All of the dials and gauges displayed in the cockpits of the various Luftwaffe aircraft are calibrated in imperial units (feet, miles etc.). This step from reality was taken for your benefit. Having to familiarise yourself with two different units of measurement in the same simulator was taking the desire for accuracy beyond a reasonable limit.

Now you are in the cockpit, it is time to look at the controls before you. Press P to pause the simulation. You can now study the controls at your leisure. Whenever you wish to see them in action, unpause (press P again). There are six different aircraft to fly in as a Luftwaffe pilot, (four bombers and two fighters). The type you are allocated depends on the phase and the mission orders.

Flying the JU87 Bomber

The Ju87 or Stuka bomber was a great success in the spring of 1940 where it played a major part of the German BlitzKreig. It proved to be a remarkably accurate bomber and with its high pitched wailing siren it instilled panic into the enemy. So much so that the German High Command developed tunnel vision when it came to making bombing strategy. In fact much time and effort was wasted in trying to modify the Big Bombers to allow them to dive bomb. The Stuka's stable mate, the Ju88, was actually used in a dive bombing role as well as the more normal level bombing approach.
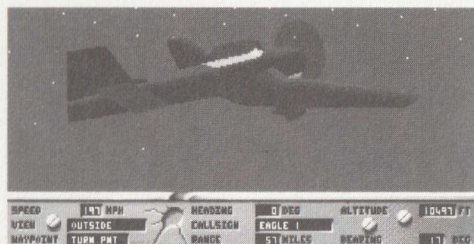

"The JU87 bomber"

However, the Stuka's success in Europe was due to the fact that the Luftwaffe had air superiority. During the "Battle of Britain", the RAF found the Ju87 to be easy pickings. When the Stuka pulls out of its dive it is very slow and so very vulnerable. During the course of the battle, the Stuka squadrons were allocated more and more escort fighters. In the end though the Stuka had to be withdrawn.

In this simulation you can fly the Stuka. It is also possible to dive-bomb and strafe targets. You can move to the rear gunner position to defend the aircraft. The forward guns that are used for strafing can be used in air combat. However, unless you are playing at the easy levels, you will be either very lucky or very skillful to get an RAF aircraft in your sights long enough for a shot.

"JU87 cockpit"
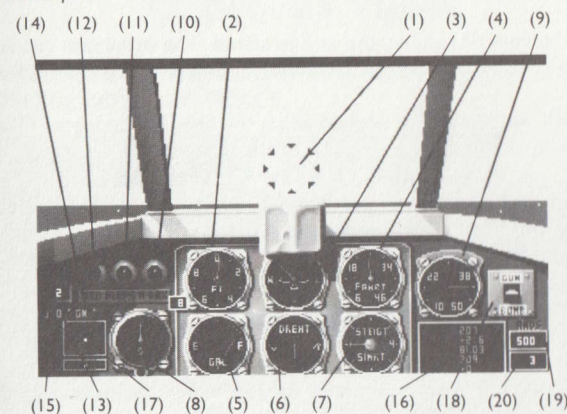
Interior cockpit of Luftwaffe JU87 aircraft

Dials

(1) Sights
This allows you to line up your shots when shooting or bombing the enemy. When shooting, the distance that the aircraft is away from you will obviously have an influence on whether you hit it or not, as will the angle of your approach to the target. This is explained in more detail in the section 'IMPROVED FLIGHT AND COMBAT TACTICS'.

(2) Altimeter: This instrument measures the height above sea level. The zero position is at 12 o'clock. The large needle rotates 360 degrees for every 100 feet. The small needle rotates 360 degrees for every 1000 feet. The digits display the altitude in 1000's feet.

(3) Direction Indicator: This dial displays the aircraft heading. No corrections for deviation or variation are required. North is at the 12 o'clock position.

(4) Air Speed indicator: This shows the indicated speed calibrated in tens of miles per hour. The indicated air speed does not always show the speed that you are flying at (true air speed). In fact the true air speed and the indicated air speed only coincide at sea level.

(5) Fuel dial (Fuel capacities are shown in Aircraft Comparison Table)

(6) Turn indicator: Each graduation on the dial represents a turn rate of 3 degrees per second.

(7) Rate of Climb indicator: This displays the vertical speed of the aircraft in 1000s of feet per minute. The zero position is at 9 o'clock. Climb is represented by a clockwise movement. The instrument is limited to show a maximum reading of 4000 feet per minute.

(8) 12 hour clock - This can be used for dead reckoning.

(9) The rpm dial shows the engine speed. The maximum reading in straight and level flight is 5000 rpm.

(10) Air brakes are applied when the light is illuminated. The air brakes are used to slow down the dive.

(11) Flaps are down when the light is illuminated. The flaps are either up or down. There is no intermediate position and they are normally only used for landing. Flaps are toggled up and down using the F key.

(12) When the light marked "VID" is illuminated a video of the action is being recorded. The video can be played back at the debriefing. On second world war aircraft, gun cameras were used to produce motion pictures of the action when the guns were fired.

(13) When the light marked "AUTO" is illuminated the autopilot is engaged.

(14) When the light marked "GN" is illuminated then the autopilot will fire automatically. Please note though that the autopilot must be on before auto firing can occur.

(15) This number indicates the sensitivity of the keyboard and digital joystick controls.

(16) Press I to toggle between the two types of information presented on the aircraft data panel.

(17) The control surface indicator shows the position of the ailerons, elevators and rudder.

(18) The weapon instruments and controls are to the right of the cockpit. There is a switch to toggle between guns and bombs using the backspace key. The rounds remaining are shown below.

(19) Gun rounds remaining

(20) Bombs remaining
The Stuka is fitted with 3 bombs at the beginning of each mission. One bomb is released for each press of the trigger.

Pilot's Map (M)
Pressing M when in the cockpit will display the pilot's map. This shows the wing leader of each flight of aircraft.

You can select any of the squares on the map that represent the wing leaders of your flights or those of the enemy or the assigned targets for that day. A clipboard will appear giving you additional information.

Different Views

For details of the various views available see the section 'FLYING WITH THE ROYAL AIR FORCE.

Waypoints

As with the R.A.F. the Luftwaffe have three different types of Waypoint:

TURN POINT - This is where the bomber turns to make the final approach to the target. If you are playing as a controller, you can choose where to set the turning point. This is important because you can disguise your intentions until the last minute.

ATTACK - This is the point where the bombs get dropped on the target.

Dive-bombing with the Ju87 "Stuka"
Dive-bombing, as developed by the Luftwaffe, is a very
accurate bombing technique which requires no
instrumentation. Select bombs using the backspace key.
First attain a height of 15000 feet and a speed of 150 mph.
Then bunt (stick forward) the aircraft to start the dive.
Dive at the target at a pitch of about 80 degrees with air
brakes extended. At 4000-6000 feet pull back on the stick,
as the target moves through the gun sight press the trigger.

RETURN   - This is where the aircraft heads for after the mission.
In reality it will be the same as the rendez-vous point where the
mission began.

Internal views
The JU87 aircraft has all the same internal views as the Spitfire or
Hurricane, as well as an additional 'rear gunner view'. The Ju87's
internal views are;

Key	Inside view
3	Left back 45 degrees.
4	Left.
5	Left front 45 degrees.
6	Front (normal cockpit view).
7	Right front 45 degrees.
8	Right.
9	Right back 45 degrees.
0	Rear Gunner (also the Y key).

Pressing [in any of these views will move to a 'look up view' which
will allow you to see a larger part of the sky, but less of the cockpit
and controls. To exit 'look up view' press].

Switching Between Aircraft

When playing the Luftwaffe you can switch between aircraft in
exactly the same way as for the R.A.F. by pressing Shift and a
numeric key from 1 through to 4. From each of these wing leaders
you can jump to a wing man by pressing Shift and 9.

Flying the Heavy Bombers (JU88, DO17, HE111).

When on the Luftwaffe side, if you are using the Big Bombers, then
the objective is to defend them against the RAF fighters. The actual
flying, bombing and subsequent strafing is done automatically. You
can defend the Big Bombers by escorting them with Bf109 or Bf110
fighters or you can take control of the gunner positions inside the
bomber. There are three gunner positions each with a small control
panel:

Forward gunner (press 6)

(1)   (2)   (3)
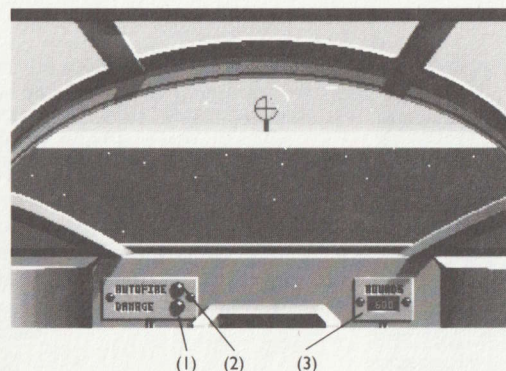
1. When this light is illuminated then the gun is damaged and will not
work.

2. When this light is illuminated, then the gun will fire automatically.
Guns will fire automatically anyway if you move to another cockpit
view.

3. This number indicates the rounds remaining.

rear look up (press Y)

rear look down(press H)

JU88

External (F5) view of JU88

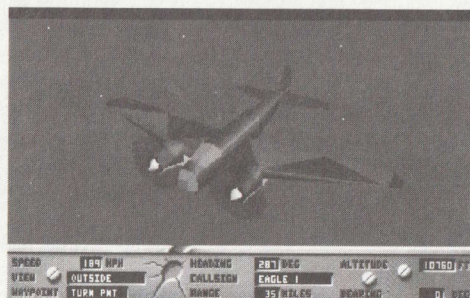A stable mate of the JU87, the JU88 was used in both normal level bombing and dive-bombing raids.

Shooting

When you aren't the pilot, you take the job of gunner. Instead of steering the nose of the aircraft to point at the enemy, you wait until the enemy appears in view and then you can move the gun sight around the screen with the CURSOR keys to track it. Fire when the enemy is in your sights using the SPACE BAR. You can also use CONTROL and CURSOR KEYS to move the sights quickly around the screen.

Auto-fire (T)

This will put your gun into auto-fire mode. However, when an enemy a/c comes within range, the cursor will track it automatically and attempt to shoot it down.

Damage light

If your gun is damaged or jammed, then this light will come on to warn you. During a mission your crew may manage to repair the gun at which time the light will go out.

Rounds

This tells you how many rounds of ammunition you have left on board and ready for use.

These three features are present on all three internal views (6, Y and H keys). Each gunner position behaves in the same way. If an R.A.F aircraft ducks under your front gunner (6) then switch to the gunner underneath (H) to track it. If it passes you then it might end up behind. Press Y and keep your eyes peeled!

DO17.

The Dornier 17 (DO17) bomber was a new bomber design that the Luftwaffe introduced during the course of the battle.

External (F5) view of DO17 bomber

He111.

The Heinkel 111 (HE111) bomber was another new bomber design that the Luftwaffe introduced during the course of the battle

"The HE111 bomber"

Luftwaffe Fighters (Bf109 and Bf110)

The Luftwaffe used two fighters during the "Battle of Britain" to escort their bombers. Both aircraft were designed by Willy Messerschmitt's Bayerische Flugzeugwerke design team. The single engined Bf109 was an outstanding success and was well matched against the Spitfire. The two engined Bf110 was an outright failure. The Bf110's shortcomings were recognised during the battle and at times the Luftwaffe were forced to adopt the absurd tactic of using Bf109 squadrons to escort the Bf110 so called fighters. When there were no Bf109s to protect them, Bf110 pilots would, if attacked, sometimes fly in a defensive circle. This tactic has been used many times during the history of air combat, notably during the Vietnam war and The First World war.
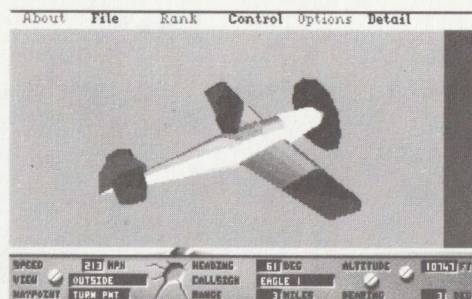
The Messerschmidt Bf109

Both the Bf109 and the Bf110 are present in this simulation. You will find that Bf109s are not always available and so you will have to make do. This could be quite a problem if you are flying at Wing Commander level.
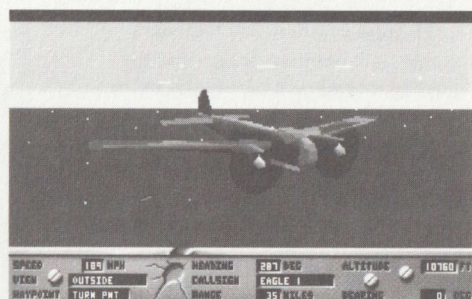
The Messerschmidt Bf110

Cockpits

In this simulation there are six different Luftwaffe aircraft (four bombers and two fighters) from which to choose. During any one mission it is possible to move between one of the bombers and either of the fighters. As it is not possible to fit three setsx of cock-pits into memory we have compromised by using the same set of cockpit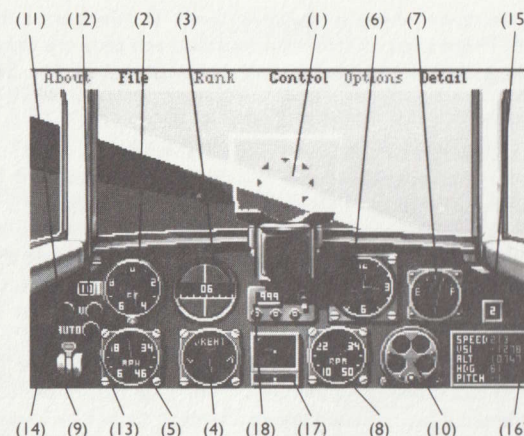s for the two fighters. There is one difference though. In the single seater Bf109 there is no rear view because in practice a pilot could not look directly behind him. To see behind, follow the proce-dure outlines for the RAF Fighters. The Bf110 does have a rear view, in fact which is manned by a rear gunner.

(1) Sights
This allows you to line up your shots when shooting or bombing the enemy. When shooting the distance that the aircraft is away from you will obviously have an influence on whether you hit it or not, as will the angle of your approach to the target. This is explained in more detail in the section 'IMPROVED FLIGHT AND COMBAT TACTICS'

(2) Altimeter: This instrument measures the height above sea level. The zero position is at 12 o'clock. The large needle rotates 360 degrees for every 100 feet. The small needle rotates 360 degrees for every 1000 feet. The digits display the altitude in 1000's of feet.

(3) Direction Indicator: This instrument displays the aircraft heading. No corrections for deviation or variation are required.

(4) Turn indicator: Each graduation on the dial represents a turnrate of 3 degrees per second.

(5) Air Speed indicator: This shows the indicated speed calibrated in tens of miles per hour. The indicated air speed does not always show the speed that you are flying at (true air speed). In fact the true air speed and the indicated air speed only coincide at sea level.

(6) 12 hour Clock - can be used for dead reckoning.

(7) Fuel dial (Fuel capacities are shown in the Aircraft Comparison Table)

(8) The rpm dial shows the engine speed. The maximum reading in straight and level flight is 5000rpm.

(9) Flaps are down when the switch is down. The flaps are either up or down. There is no intermediate position and they are only used for landing. Flaps are toggled up and down using the F key. See the section 'Landing in Training' for more information.

In reality, on the Bf109, flaps were used for takeoff as well. For this purpose, it was possible to vary the degree of flaps applied. In this simulation, Luftwaffe aircraft always start in the air and so it is not necessary to simulate variable flaps. It is possible to defect by landing a Bf109 in England so landing flaps have been provided. It is not possible to defect in the Bf110, the rear gunner will not let you. You will find it impossible to lower the gear on the Bf110.

(10) When the lights are illuminated, the gear is down. The gear is toggled up and down using the G key. The gear cannot be lowered above 200mph. Also, as noted above, the gear cannot be lowered at all on the Bf110.

(11) The wheel brake light is illuminated when the brakes are applied. The wheel brakes are toggled on and off using the W key.

(12) When the light marked "VID" is illuminated a video of the action is being recorded. The video can be played back at the debriefing. On second world war aircraft, gun cameras were used to produce motion pictures of the action when the guns were fired.

(13) When the light marked "AUTO" is illuminated then autopilot is engaged.

(14) When the light marked "GN" is illuminated then the autopilot will fire automatically. Please note though that the autopilot must be on before autofiring can occur.

(15) This number indicates the sensitivity of the keyboard and digital joystick controls.

(16) Press I to toggle between the two types of information presented on the aircraft data panel.

(17) The control surface indicator shows the position of the ailerons, elevators and rudder.

(18) Remaining Ammunition

The BF-110 has a rear gunner position. Press Y key to switch to the rear gunner. This position is controlled in exactly the same manner as any of the gunner positions found on the JU88 bomber aircraft.

Combat

As a gunner on a heavy bomber the enemy will come to you. When the R.A.F. fighters suddenly swoop to attack, you will need to be fast and accurate with your shooting to send them spiralling downwards.

As a fighter pilot in either the BF109 or BF110 you will have to hunt down the R.A.F's intercepting fighters in order to protect your bombers.

Speech
Some machines will have a digitised speech option. When turned on, you will hear radio messages from other pilots. A few examples and their significance are given below:

" We are under attack!" - The bombers you are assigned to protect are under attack from the R.A.F.
"Spitfire attacking" - A Spitfire aircraft is attacking.

Bombing

Luftwaffe bomber aircraft must destroy specific targets. In the JU87 you can accomplish this by bombing or staffing your target.

The other bomber aircraft available (the JU88, DO17 and HE111) perform their bombing runs automatically. (You are positioned as a gunner and so have no influence on piloting the aircraft).

Ending the Day

You mission with the Luftwaffe will end when you either,

(i)   Complete your mission and return to Luftwaffe airspace.
(ii)   Get shotdown/crash or eject.
(iii) Defect by landing at an enemy airfield.
(iv)   You select Abort Mission from the file menu in order to start again.
(v)   End mission option on menus.

In the above situations you will follow the procedure covered by the sections "Winning the Day", "Losing the Day" and "Debriefing".

Real Flight

With 'Real flight' selected on the Menu Bar (which is discussed in a moment) your aircraft's power will be set at a more realistic level meaning that you have less power available and thus need to be more skillful.

Take off

In Real Flight takeoff is not automatic. Instead you should press the / key to increase the engines R.P.M. to maximum. At just over 40mph, gently push the stick forward. This brings the nose down and it is possible to see more of the ground. As well as being important for safety, this manoeuvre reduces drag and hence increases acceleration. At a speed of over 80 mph, gently pull back on the stick until you are airborne. Also as soon as possible after takeoff lift the gear (G key). The easiest way to see if you are airborne is to watch the altimeter on the digital readout.

Takeoff speed is not sufficient to allow adequate climbrate. So fly with little or no climb until the speed has reached 180 mph. It is safe to climb at speeds of over 140mph. Climbrate of between 2500 feet/min and 3000 feet/min can be sustained. The actual value depends on altitude and aircraft type.

First Production Spitfire

Height feet	Top Speed mph	Rate of Climb ft/min
2000	295	2195
5000	307	2295
10000	328	2490
15000	348	2065
18500	362	1700
20000	360	1480
25000	349	900
30000	315	325

Landing

Press G to lower the landing gear. Check that the light comes on. If it has been damaged and the light fails then you will have to perform an emergency landing without them!

Press F to bring the flaps down. Check that the flap lever is down on the cockpit. If you cannot get the flaps down (due to damage) then you will have to approach at about 10 m.p.h. faster than normal.

The correct speed for landing is either 85 m.p.h. (with everything working) or 90 m.p.h. if you are gliding in (due to lack of any fuel).

Mislandings

If you fail to land increase speed to 120 m.p.h. before attempting to climb.

After landing

Bring the R.P.M. down to 0 by pressing the - key then wait. The ground crew will re-arm and re-fuel your aircraft. If your aircraft is damaged then you will be moved to Debriefing.

You will find that you have to power right down to get the speed to below 100 m.p.h. when descending on the glide path. You should aim for a glide path which is at about 5 or 10 degrees below the horizontal, ideally aiming for 7-8 degrees.

Try the following:

(i) Reduce speed to 90 m.p.h.
(ii) Set glide path to 7 degrees.
(iii) Pull back to bring the nose up. The aircraft should lose speed and after a few seconds it will continue but on a steeper descent.
(iv) Increase the R.P.M. by pressing the + key to change to a shallower descent.

The Four Phases of the Battle
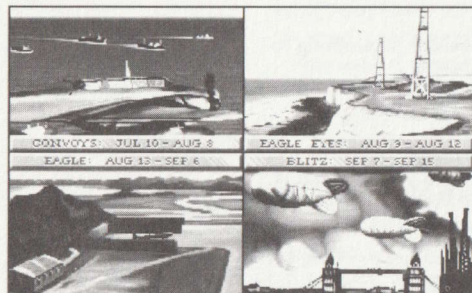
Phase 1: Convoys

Start: July 10th 1940

In this phase, the Luftwaffe are attacking the convoys in the channel. The main aim is to entice R.A.F aircraft to fight over neutral waters. The R.A.F did not oblige in large numbers. Their response was limited to preserve strength for the battle to come.

Phase 2: Eagle Eyes

Start: August 9th 1940

The Luftwaffe changed tactics and decided to attack the R.A.F in its home territory. Before attacking the airfields, it was decided to disable the R.A.F's eye, i.e. destroy the radar. This would make it possible to mount more surprise attacks. However, it proved difficult to permanently damage the radar stations and the phase was short lived.

Phase 3: Eagle

Start: August 13th 1940

This was the Luftwaffe's attack on the R.A.F airfields. This attack was devastating. When the R.A.F was at the point of collapse, the phase ended. If it had continued, the Luftwaffe would surely have been victorious.

Phase 4: Blitz

Start: September 7th 1940

The attack moved to the city of London. Goring hoped to crush the morale of the R.A.F and also force the R.A.F into the air to protect the capital.

Comparing The Killing Machines

In the few weeks of the "Battle of Britain", the courage of the pilots from both sides were tested to the ultimate limit. The aircraft were also severely tested. The aircraft had similarities but many differences some more subtle than others. Knowing the strengths and weaknesses of friendly and unfriendly aircraft is an important part of the job of being a fighter pilot.

This section contains information about the aircraft used during the battle. Mixed in among this general background information, there are some facts that you can put to use in the cockpit.

Aircraft Comparisons

RAF

	Spitfire	Hurricane
Wing span	36ft 11in	40ft 0in
Length	29ft 11in	31ft 4in
Height	12ft 3in	13ft 1in
Wing area	242sq ft	258sq ft
Engine	Merlin III	Merlin III
	1030hp	1030hp
Armament	eight .303 machine guns wing 300 rpg crankcase	.303 machine guns wing 1000 rpg
Max. speed	362mph at 19000ft	328mph at 20000ft
Max. range	395 miles	505 miles
Ceiling	31900feet	34200feet

LUFTWAFFE

	Bf110	Ju87	bf109
Wing span	53ft 5in	45ft 3in	32ft 4in
Length	39ft 9in	36ft 1in	28ft 8in
Height	11ft 6in	13ft 10in	11ft 2in
Wing area	413sq ft	343sq ft	174sq ft
Engine	2 x DB601A	Ju 211A-1	DB601A
	2 x 1150hp	1100hp	1150hp
Armament	Four 7.9mm machine guns 1000 rpg	Two 7.9mm machine guns 500rpg	two 7.9mm machine guns engine
	Two 20mm machine guns 180rpg		two 20mm cannon in wings 60 rpg
	One rear firing 7.9mm MG 750rpg	One rear firing 7.9 MG 900rpg	
Max. speed	349mph at 23000ft	232mph at 23000ft	357mph at 12000ft
Max. range	530 miles	370 miles	412 miles
Ceiling	32000feet	26500feet	36000 feet

LUFTWAFFE BOMBERS

	He111	Ju88	Do17
Wing span	74ft 1in	59ft 10in	59ft 1in
Length	53ft 10in	47ft 1in	52ft 0in
Height	13ft 2in	15ft 5in	14ft 11in
Wing area	943sq ft	540sq ft	592sq ft
Powerplant	2 x DB601A	2 x Ju211B-1	2 x Bramo 323P
	2 x 1100hp	2 x 1200hp	2 x 1000hp
Armament	three 7.9mm	three 7.9mm	four 7.9mm
	machine guns	machine guns	machine guns
	nose	nose	nose
	dorsal	dorsal	dorsal
	ventral	ventral	ventral beam
	750rpg	750rpg	750rpg
Max. speed	247mph	286mph	265mph
	at 16000ft	at 16000ft	at 16400ft
Max. range	1224 miles	1553 miles	745 miles
Ceiling	26000feet	26500feet	26400feet
Bomb Load	4410lb	3968lb	2200lb

The performance figures here are only indicative. In the simulation, with "Real Flight" selected on the menus it will be possible to obtain performances similar to those in the table. However there will be differences as no two aircraft are exactly the same and the total weight of the aircraft is affected by fuel carried.

Performance is also affected by the quality of the fuel. Just before the battle, RAF pilots were to receive a very welcome boost from an American petroleum company. Up to the battle, the standard fuel was a 87 octane mixture. However, under a veil of secrecy a deal was agreed to obtain a 100 octane fuel that had been used by the US Army Air Corps since 1938. The British Air Ministry managed to finalise the contract for the supply of the fuel just before the outbreak of the "Battle of Britain".

The Do17 had extra machine guns fitted, these are not used in the simulator.

Mitchell's Spitfire

	Kills claimed	Actual losses
Luftwaffe	2698	1733
Raf	3058	915

Fighter command overstated by just over fifty per cent while the Luftwaffe overstated by more than 200 per cent.

Many people expect the enemy to exaggerate their successes and dismiss the claims with something like..."well they would say that though wouldn't they".

Then there is the feeling of being let down when you find that your side's claims are shown to be exaggerated too.

How can this happen? Well, propaganda is a powerful weapon and it is likely that wishful thinking did colour peoples judgement. However the distortion is not as great as that seen in some Arab newspapers during the 1967 war where for the first five days the Arabs were said to be experiencing spectacular success followed on the sixth day by an announcement that the Israelis had won!

"The most important weapon that Britain has ever produced."
"..had we not had it we would have been in big trouble"

Reginald Mitchell was Chief designer of the Supermarine Company Woolston Southampton. During the 20's, the Supermarine Company were concerned with the production of sea planes. They were also heavily engaged in producing aircraft to break the absolute speed record and win outright the "Schneider Trophy".

The experience gained by Mitchell in designing these metal mono-planes was used in the production of a series of fighter aircraft designs in the early thirties. Gradually the design was improved and finally with the introduction of the 1000hp Merlin engine, the design was sufficiently impressive for the Air Ministry to place a small order.

The prototypes were a success and a large order was placed.

The Spitfire was a thoroughbred but as production got under way its "roots" started to show. In the design there were no compromises to production techniques. In fact the only compromises were to aerodynamics. It was like a rich man's hand built sports car.

Production proved to be difficult, slow and expensive. Delivery was late and behind budget. However the British did get there act together and managed to produce aircraft in sufficient numbers throughout the Battle and the Spitfire caught the public imagination. Now, after so many years, the impression is that the "Battle of Britain" was won because of the Spitfire. It is surprising, then, to find that the Hurricane accounted for 80% of the enemy aircraft destroyed.

How did the Spitfire manage to win such admiration when the facts clearly show that the accolades should have gone to the Hurricane? Why has history has been unkind to the Hurricane?

The Spitfire had a number of advantages. Its very long service life kept it in the public eye. Its elegant lines made it a very photogenic aeroplane; some say it is the most beautiful fighter aircraft ever to be built. The aeroplane handled superbly. For the young pilots, it was like being given a very fast and desirable sports car and being paid to operate it. It was fast and manoeuvrable.

The Hurricanes advantages were more mundane. Its was a very stable gun platform and could take more damage than a Spitfire. It could also out turn any of its contemporaries. Finally, the RAF had more Hurricanes than Spitfires.

In fact, the Spitfire and Hurricane complemented each other and the RAF needed both. The fact that the Hurricane achieved more kills is mostly attributed to tactics used by the RAF.

The Spitfire's speed and manoeuvrability meant that it was a match for the Luftwaffe best fighter, the Bf109. These fighters were sent over to escort the relatively vulnerable bombers. When inbound aircraft were detected by the RAF, they would send Hurricanes to attack the bombers and Spitfires were used to keep the fighters busy.

The Hurricane had the easier targets and took advantage of the situation. It is obvious though that they could not have achieved so much if the Spitfire had not been so successful.

War is not so neat and tidy as the above summary would suggest. Hurricanes did sometimes engage Bf109s and sometimes they got the better of their enemy. Spitfires sometimes failed to counter the enemy fighter force. So many factors are involved not least of which are pilot skill, experience and luck.

Of all the RAF aircraft available at the onset to the battle, only the Spitfire and the Hurricane made a significant impact. So in this simulation we feature on the RAF side, the Spitfire and Hurricane.

Armament

Spitfire and Hurricane were fitted with eight .303 Browning machine guns. Each gun was fitted with 300 rounds of ammunition belted and fed from boxes for quick rearming. In fact an efficient ground crew could rearm and refuel in eight minutes.

When compared with the cannons on the Luftwaffe, it is obvious that these guns were painfully inadequate. During the pre-war days, the RAF were starved of funds and little was available for gun development.

Some aircraft were fitted with 20mm cannon in the early days of the Battle. These aircraft could be distinguished by the bulges on the wings to accommodate the cannon magazines. Unfortunately, these cannon frequently jammed and were not fitted generally.

Messerschmidt Bf109

The Bf109 was the Spitfire's main rival. In some areas the Spitfire excelled and in others the Bf109 was supreme. Overall the aircraft were well matched and a lot depended on luck, pilot skill and tactics. However considering the end results were so similar, it is surprising how different the aircraft designs were.

The Bf109 was designed for mass production and ease of maintenance. It had no difficult-to-manufacture elliptical wings, in fact no double curved panels. Consequently, it took only one third of the time to build a Bf109 compared with the time taken to build a Spitfire. For field maintenance, the spark plugs, oil pump etc. were easily accessible. All this didn't effect the pilot much. But the fuel injection system did. Luftwaffe pilots could bunt (stick forward) with no loss of engine power. RAF pilots whose aircraft were fitted with gravity fed carbs could not. In RAF aircraft it was necessary to do a half roll before diving. This was to maintain positive g on the fuel system.

Just before the war, the Bf109 broke the land plane record by flying at 379mph.

Visibility

Visibility was poor on all the fighters. A lot of nastiness could be going on under the nose and the wings and behind you. The provision of the tiny make-up mirror was certainly an afterthought on the Spitfire and the situation for the Bf109 was no better. In fact because the cockpit was so much more cramped on the Bf109, it was more difficult to turn to look behind.

Landing

The Bf109 was very difficult to land and the canopy was such that inversion during landing was generally fatal. As a consequence, over 1500 student pilots were killed in the first two years of the war.
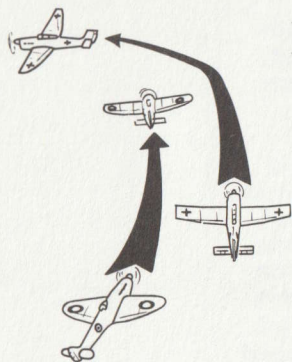
Improved Flight and Combat Tactics

AIR COMBAT MANOEUVRES

Break - This is a traditional defensive move use when an enemy is attacking from the rear. By turning hard into the line of attack you can make the enemy overshoot
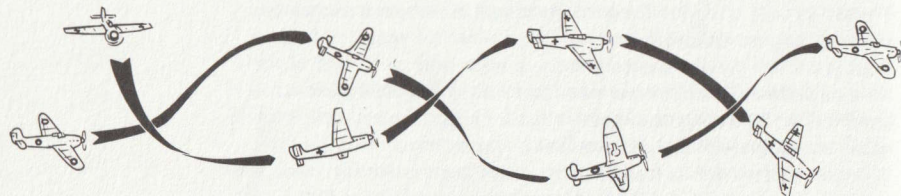
Scissors - This is a counter attacking manoeuvre which can be performed after a successful break. After evading an attack you can attempt to move in behind the enemy aircraft. The aircraft criss-cross each others paths as each attempts to gain and maintain an attacking position behind the other.
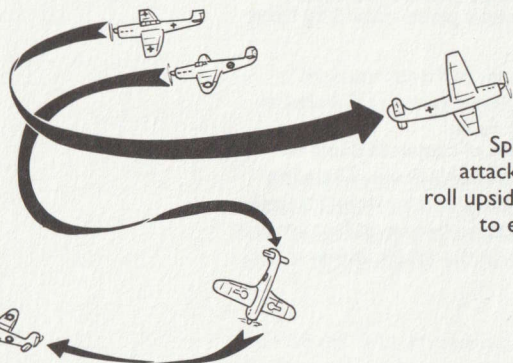
Split S - This is a move that results from an attacking enemy getting too close. You should roll upside down and pull into an accelerated dive to evade the attacker before they can react.
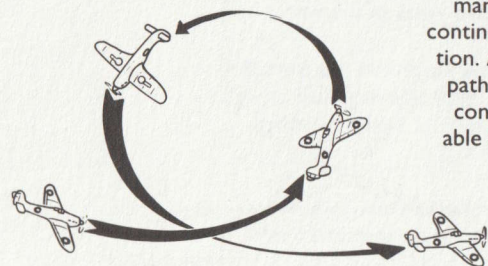
Vertical Loop - This is an evasive move which may be transformed into a counter attack manoeuvre. You should pull into a steep climb, continuing up and over the top in the same direction. As you come down back onto your original path you may find that the attacking aircraft has continued on its attack course and you may be able to position yourself in an attacking position on its tail.

Lag Pursuit - When the enemy you are attacking performs a break you may be able to prevent over shooting and maintain an attacking position by performing the Lag Pursuit. This entails holding a path below and behind that of the enemy aircraft and occasionally pulling into a slight climb to reduce speed and remain behind the enemy.
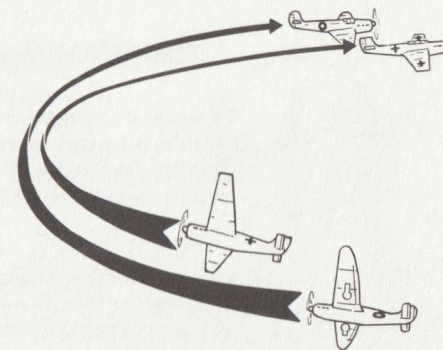
Immelmann Turn - This move was pioneered by the German World War I Ace Max Immelmann, nick-named the "Eagle of Lille". It can be used to change direction in the least amount of horizontal space by pulling into a near vertical climb and rolling to face in the desired direction when you reach the top of the climb. By applying hard rudder and performing a stall turn at the top of his climb, Immelmann used this manoeuvre to position his Fokker for a dive on his enemy with devastating results. The manoeuvre was adopted and used well into World War I and was only abandoned when the introduction of more powerful Allied fighters rendered the stalling Fokkers vulnerable to counter attack.
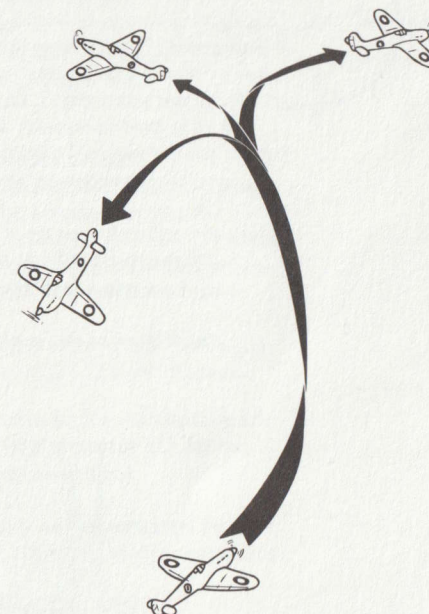
Head on - As mentioned earlier, the head on encounter is not recommended as it amounts to a game of chicken with bullets. If you fail to score a hit on your enemy during this initial encounter the aircraft with the tightest turn arc is likely to end up in the best position. By looping back and across your original flight path in a tight turn you may be able to gain an advantageous position against a slower turning enemy.
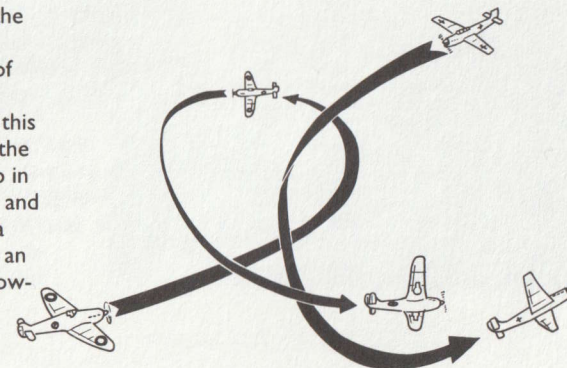
Improving your Shooting

To succeed in this simulation, you have to be or become a pretty good shot. It is much more difficult to down an aircraft with gun or cannon fire than with a missile. For one thing you have to get much closer, also bullets/shells don't guide like missiles. Finally, one hit from a bullet/shell is not necessarily fatal.

These perceived advantages of the missiles led airforces in the fifties to equip fighter aircraft with missiles only. The justification was that the day of the dogfight was over and that fighter aircraft were to become missile platforms for the interception of big bombers. All this doctrine was thrown out of the window during the Vietnam war. Dog fighting was back in and American fighter pilots at the beginning of the conflict "would have killed to get a gun fitted to their aircraft". It is true to say that some American aircraft started the conflict with guns fitted but most didn't. During the conflict most aircraft were fitted with guns to various degrees of success. However, American Fighter pilots have said that if they had guns, the number of kills they could have achieved would have been twice their actual score.

Guns are still in favour on modern fighters even though the gun kill is still the most difficult to achieve. The modern pilot does have some advantages over his second world war colleague:

the calliper of the gun/cannon is greater and so fewer hits are needed

the gun/cannon will be mounted more centrally rather than on the wings. On second world war fighters, guns were harmonised to focus on an area a set distance in front of the fighter

head up instrumentation gives the range of the target as well as the predicted path of the shells. The guess work is largely taken out of the process.

But there is one crucial advantage for the second world war pilot: speed. The aircraft were much slower and this meant that there was more time to set up and prosecute an attack.
Also there was more chance to "catch your breath". Many times in the literature, you will read of pilots saying that they were engaged in a hellish dogfight with scores of aircraft milling around and within seconds the sky was empty. Modern day radar ensures that it is not as easy to escape notice to recover.
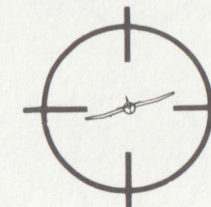
Gun Sights for range finding.
All the fighters are fitted with multiple guns and these guns are focused to a point which is 250 yards in front of the fighter. To be effective then you need to close to a range of 250 yards or closer. The gun sight can be used to help you judge range. For instance, if a small fighter (wingspan, say 35 feet) fills the ring of the gun sight then it is 100 yards away.
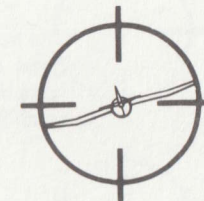
If the fighter's wingspan is only half the diameter of the ring then it is 200 yards away.

It is possible to estimate the range of other aircraft by reference to the Aircraft Comparison Table which contains wingspan information. For instance a He-111 with a wingspan of about twice a small fighter will be at a range of 200 yards when it fills the gun sight circle.

In reality, the pilot could make modifications to the gun sight to help in range finding. For instance on the RAF gunsight the horizontal and vertical lines could be adjusted so that the gap between the lines could be varied. When the target filled the gap, it was at the optimum range. During the development of this simulation, it was shown that this extra sophistication was not useful.

Some aircraft, in the simulation, are fitted with an alternative gun sight design. For this sight, the display consists of eight diamond shaped dots arranged in a ring:
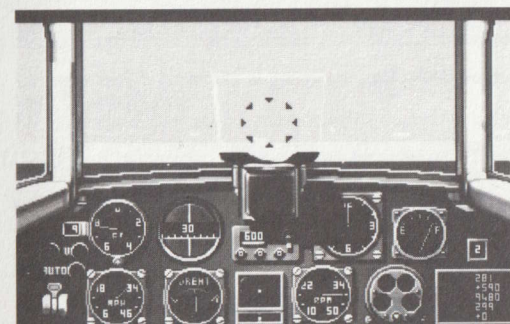
The diameter of the ring was controlled by the pilot until it encircled the target. The sight then automatically calculated the range of the target. However for the purposes of this simulation, the sight should be used in the same way as the previously discussed ring sight.

Gun sight for deflection

The bullets and shells leave the aircraft at over twice the speed of sound. An enemy fighter, at a range of 250 yards, flying at 300mph, travels a distance of 70 yards in the time it takes for the bullets/shells to reach it. In a beam attack (from the side), the pilot must aim at 70 yards in front of the target to get a hit.

Aircraft at Range
250 yds Flying
at 300 mph

70 yds

Aim 70 yds
in Front of Bandit
and Fire
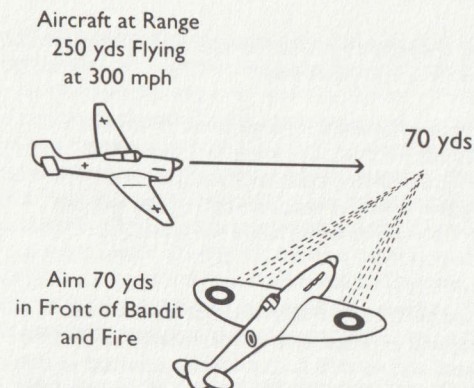
Normally the angle between the two aircraft is much less than the 90 degrees of a beam attack. As the angle is reduced then the "lead" required is reduced from the 70 yards mentioned above. In a stern attack (directly behind) no "lead" is required at all. A stern attack is only usually likely when the target is taken completely by surprise. Normally you will be faced with a deflection shot, that is one where you have to fire where the target will be, not where he is on firing.

Becoming an expert on deflection shooting is essential if you want to become an Ace.

The gun sight can be used when setting up a deflection shot.

First of all it is necessary to estimate the angle between your aircraft and the target. For instance a target is twenty degrees off, if lines extending along the length of yours and his aircraft meet at an angle of twenty degrees.
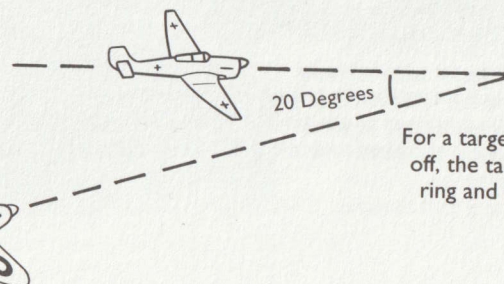
20 Degrees

For a target which is 20 degrees off, the target should touch the ring and point at the centre of the ring:

Targets that are 10 degrees off, should be half way between the ring and its centre. The target should still point at the centre of the ring:
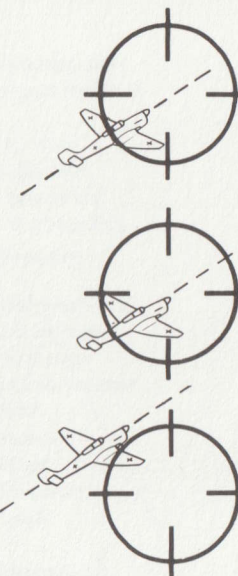
Here is an example of a 5 degrees off setting

This setup will result in a miss. Although the twenty degree off target is touching the ring, it is not pointing at the centre of the ring.

Range Tables

Target a/c	RAF	Bf109	Bf110	Ju87	Ju88	He111	Do17
Range (yards)	100	100	150	130	170	210	170

The figures in the table shows the range in yards when the target fills the circle. The range will be double when the target's wingspan is only half the diameter of the ring.

Gun Harmonising

Neither the Hurricane or the Spitfire had guns on their fuselage. In fact both were fitted with eight relatively smallbore (0.303 in) machine guns, four on each wing. The combination of the wing mounting and the small bore meant that the issue of harmonisation was vital for the RAF.

Harmonisation is the name given to the process of focusing all the guns so that their fire will converge at a chosen point in front of the aircraft. This harmonisation is done on the ground by a member of the ground crew and should be regularly checked.

Cone of Fire
Converging

As the guns fire they vibrate causing the bullets to spread out into a cone shaped pattern.
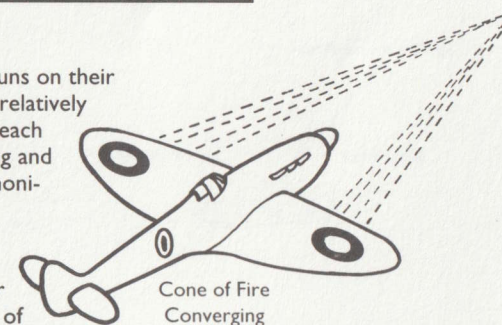
The harmonisation point is a compromise between safety (the further away the better) and the desire to concentrate your fire (the closer the smaller the cones of fire due to vibration).

RAF pilots found that the regulation harmonisation point of 400 yards was too far. During the battle the distance was reduced to 250 yards. In fact it was found beneficial to press home attacks even closer than 250 yards.

It is reported that many pilots modified their gun settings unofficially because the change was not sanctioned by Fighter Command. The squadrons did not see eye to eye with Fighter Command over a number of issues. Many myths developed after the battle and it is difficult to extract the truth. It does appear that some stories "improved" with the telling and some myths seem to have been developed intentionally. It is a fact though that Dowding was removed from office within weeks of his Command's successful defence of Britain. Goring didn't suffer that fate and he lost!

So something as seemingly technically-based as gun harmonisation has its political side.

Fighter Combat

About 80 % of "kills" are the result of surprise attacks. That is the target is hit and going down before he knows that he was even under attack. You should try to maintain the element of surprise as long as possible. By referring to the Map it is possible to fly a course which keeps you out of visible range until you are on the target's six. If you can come out of the sun then your position is even better.

Spitfire Visible Area

Blind Area   Visible Area
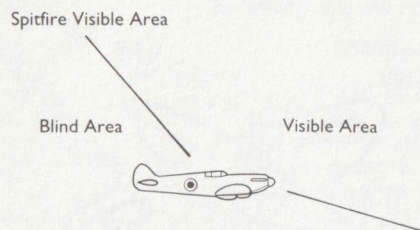
In this simulation, if you are flying an RAF fighter, Luftwaffe pilots only become aware of you when you come into their visible range. However whenever a Luftwaffe pilot can see you, then a Luftwaffe Fighter Leader will be informed of your presence. If you are flying a Luftwaffe fighter, you will find that generally RAF fighters are sent to engage bombers and will only engage you if they see you.

Once the element of surprise is lost, you will be mixed up in a dogfight. You can either try to turn harder or smarter. This section gives you some ideas on how to turn smarter.
Being smart involves attempting manoeuvres that use the third dimension. But also being smart means making fewer mistakes.

Blind Area   Blind Area

Rotte Formation

Leader   Wingman

Scharm Formation
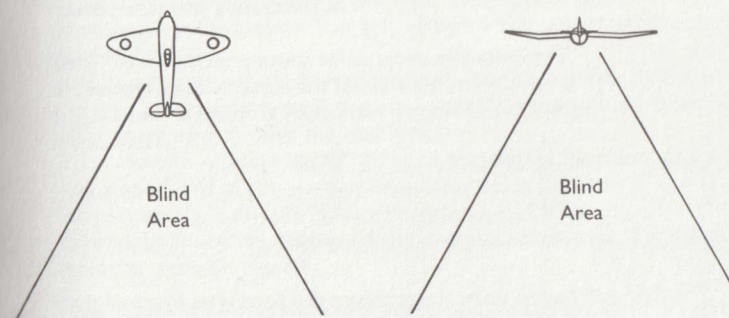
Wingman   Leader   Leader   Wingman

Flying in pairs

It is generally accepted that in air warfare, a single fighter is a liability. A pair is an asset. When paired, aircraft can watch each other's blind spots and tasks such as navigation can be shared. As well as providing mutual support, pairing is also in-line with the well established doctrine of concentrating your fire power.

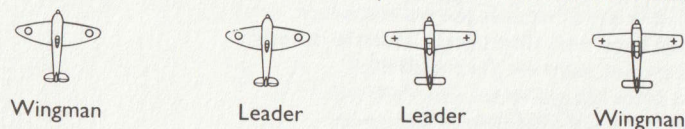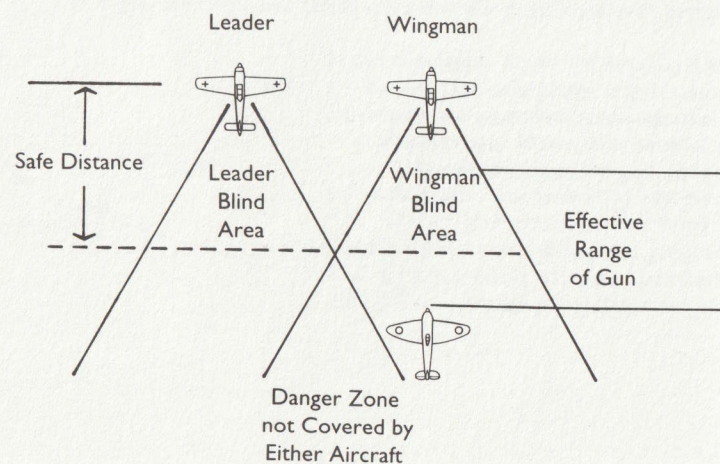The Luftwaffe understood these principals well. Their aircraft, from the start of the battle, were organised in pairs. Pairs of aircraft were then grouped to form bigger formations.

The RAF still had to learn about tactics the hard way. Much of their training was based on the assumption that they would be faced with unescorted bombers. Squadrons would fly in tight V formations. Pilots concentrated on not hitting each other and so the squadron as a whole did not keep an adequate look out. The aircraft at the "end of the V" was called "tail end Charlie", he was the most vulnerable. His job was to maintain a rear guard. In fact he was worse off than a singleton because he had to avoid colliding with aircraft in front. Essentially the V system did not provide mutual support.

RAF pilots did change tactics and for the purposes of this simulation RAF pilots will fly in pairs wherever possible. They were outnumbered and so on occasions RAF aircraft will be sent up as singletons.

Leader   Wingman

Safe Distance

Leader Blind Area

Wingman Blind Area

Effective Range of Gun

Danger Zone not Covered by Either Aircraft

A fighter aircraft spends most of its time in its most vulnerable state: on the ground. It is not surprising then that the bombing of airfields was the Luftwaffe's most successful tactic. In fact on September 5th, Parks reported that Luftwaffe bombing was seriously affecting the flying efficiency of his command.

It has been said that, "the bombers will always get through". However it is the number that get through which will determine the fate of the battle.
RAF tactics concentrated on attacking the bombers rather than the fighters. Spitfires were used to keep Luftwaffe fighters at bay whilst Hurricanes tore through the bombers.
The Luftwaffe had to develop tactics to protect the Bombers. There was a good deal of controversy about this and in fact the "layman's" tactic is wrong. Luftwaffe fighters recognised that to beat the RAF they needed surprise, height and the room to manoeuvre. Two methods were developed:

Free - Luftwaffe pilots were allowed to fly ahead of the bombers and intercept the RAF fighters.

High - Fighters fly much higher and behind the bombers. As the RAF pilots come in and attack the rear of the Bombers. Luftwaffe fighters can then pounce on the unsuspecting RAF pilots. If the attack can be from the sun then all the better.

German bomber losses mounted as RAF tactics improved and Goring had to do something. He decided that the fighter pilots were either avoiding battle or were just flying around enjoying themselves. Bomber Command would feel more assured if they could actually see the escort. So, against Fighter Command advice, Goring ordered that fighters should provide a close escort. At a stroke, the Luftwaffe fighters were denied the advantage of surprise, height and the ability to manoeuvre.

Damage

If you take a hit you won't go down immediately. However you could have sustained damage which will hamper you.
There are no damage lights like you find on the modern fighter jets and so you will have to diagnose the problem.

If you are flying a one or two seater then try this:

as you move the stick from right to left (full deflection) watch the control surface indicator. If the indicator does not move as much as usual you know that you have sustained aileron damage.

repeat the test for the elevators

flying straight and level and select maximum rpm by pressing the / key. When flying an RAF Fighter, if you don't get the rpm dial to point straight up you know that you have engine damage. On the Luftwaffe aircraft, the max. rpm at straight and level is at 4600 rpm Once damage has been sustained, further hits will make the situation worse. So disengage once damaged.

"The Phantom F4 is living proof of the aerodynamic principle that given enough power you can even make a brick fly."

Obviously all aircraft are governed by the same aerodynamic principles and forces. However it is true that most of the subtleties of flight can be largely disregarded when your aircraft can deliver huge quantities of thrust.

Second world war aircraft have limited thrust outputs and so some of the subtleties of aerodynamics become more apparent. Knowing about them could save your skin.

Health Warning

If you think that all this will get in the way of you enjoying the simulation, you can bypass most of it by putting a bigger than normal engine into your aircraft. This is done by unticking "Real Flight" on the Options menu.

Flight is governed by four main forces: lift, thrust, drag and weight.
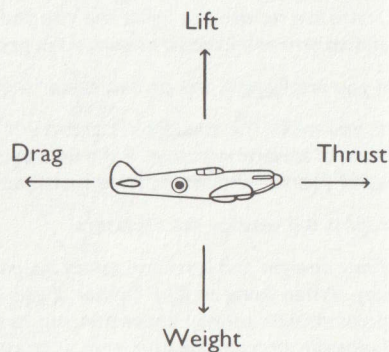

For an aircraft to fly straight and level, the four forces must be perfectly balanced. If they were not, an acceleration would develop which would result in a change in velocity or direction. All the forces would then be different. Changes occur until either nature or the pilot finds a situation where all the forces are balanced. IT IS IMPORTANT to note that the aircraft is moving when the forces are balanced but it won't be accelerating.

The weight is due to the mass of the aircraft and it always acts downwards. During flight in this simulation, the weight will drop as fuel is burned (if "Limited Fuel" is selected). The lighter you can make an aircraft, the longer it can stay in the air. In modern aircraft fuel and weapons can be jettisoned to reduce weight. In the aircraft of this simulation, the only thing of any weight that you can jettison is yourself. The theory of flight is the last thing on your mind when you are floating down at the end of a parachute.

The thrust is supplied by the engine(s). Control in the simulation is simplified to modifying the rpm. This is not strictly accurate but the effect is the same as reality: the pilot can control the thrust supplied by the engine. Thrust is also effected by altitude and velocity.

Thrust gives the aircraft a velocity. The resultant movement of air over the wings provides lift. This is a force at right angles to the velocity and is due to the design of the wings. The air pressure below the wing increases and the pressure above the wing decreases. The end result is that the wing gets pushed upwards. As well as the design and size of the wing, the size of the force depends on two variables: velocity and drag.

velocity: - lift is proportional to velocity squared
angle of attack(AoA): - lift is directly proportional to angle of attack. the AoA is the angle between the airflow and a line drawn from the front to the back of the wing:
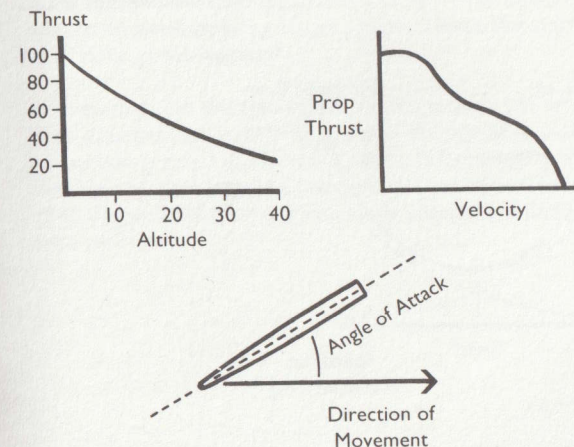
From this, you should be able to explain why it is possible for an aircraft, when it has built up sufficient speed, to takeoff without the pilot touching the stick. Also you should be able to explain why it is possible for a pilot to takeoff at lower speeds by pulling back on the stick.

Drag is a very interesting force. It is made up of three significant parts: parasitic, shock and induced. Parasitic drag is closely linked to the drag experienced in automobiles. The faster you go, the greater the drag. To oppose this drag, greater engine power is needed. So to go faster you put your foot down. Also to stay at the higher speed, you KEEP your foot down.

Shock drag is encountered as the speed approaches the speed of sound. This is not a concern here because the speeds of aircraft in straight and level flight are too low.

Induced drag is important though because induced drag is at its greatest at low speed. This is the exact opposite to parasitic drag and it leads to some very odd effects. Lift is proportional to AoA and velocity squared. So to maintain an aircraft in the air, as the velocity decreases then the AoA must increase. As the AoA increases it is possible to see how the aircraft presents a less streamlined profile to the airstream. So increasing the AoA increases the induced drag.

Merging the two curves leads to a u shape. At the bottom of this u, you can find the speed for minimum drag. From this it is possible to develop the argument to obtain the speed for minimum fuel consumption and maximum range.

If you are travelling at the speed for minimum drag and then increase thrust, you will speed up. At some velocity the drag will have increased until it matches the new thrust and the aircraft will stop accelerating. Reducing the thrust to a level between the two previous levels will result in a velocity between the two previous velocities. Just like the effect in a car.
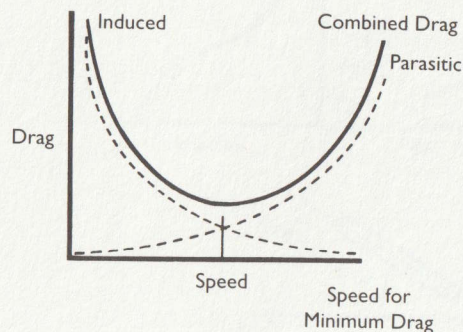
Reducing the thrust when travelling at minimum drag has very unexpected results. First of all the aircraft slows as expected. However no new balance is achieved. The drag has increased, not decreased as it would in a car. The increased drag actually results in a braking effect and the aircraft will move towards the stall. In fact, to maintain the aircraft on the "backside of the drag curve" you need to apply thrust, more thrust than was needed to maintain the higher velocity achieved at minimum drag.

In some instances there may not be enough power to overcome the high induced drag and so acceleration is sluggish or even non existent. Sometimes it is better to dive out of trouble rather than fight the situation by pouring on the power.

Turning
When the aircraft is banked, the lift force no longer faces straight up.

This has two effects:

the sideways force results in the aircraft turning

the vertical force is diminished, the aircraft's weight is no longer balanced and so the aircraft will nose down

To counter the second effect pilots pull back on the stick to produce more lift. The measure has further knock on effects:

the turn is made tighter because the sideways force is increased

the induced drag is increased

Now the increase in induced drag can vary from negligible at high speeds, to overpowering at low speeds. Hence the saying, " avoid tight turns at low speeds".

In this simulation the correction needed to maintain level flight is done automatically at low bank angles. At high bank angles a manual correction is required. So diving turns, as favoured by the pilots of the day, are quite possible. Just bank the aircraft to an angle in excess of 45 degrees. Of course, if you really want to get down, flip over onto your back.
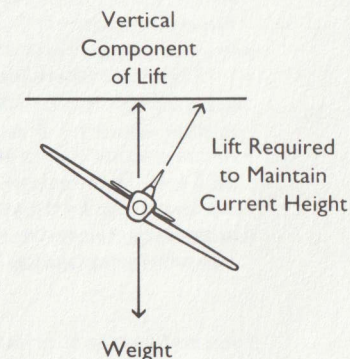
Earlier it has been stated that to maintain lift as velocity is reduced, it is necessary to increase the angle of attack (AoA). There is a limit though:
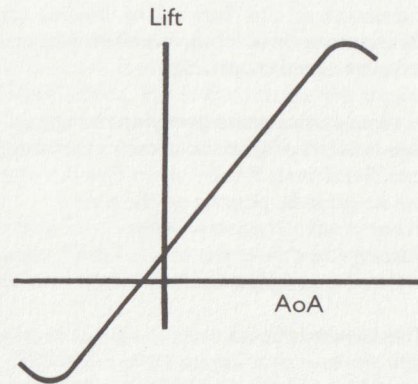
The graph shows that the lift rises steadily as AoA is increased. However, at the stall angle and beyond, lift rapidly drops off.

You can practice stalling your aircraft. First get to an altitude of over 5000 feet. Then remove all power and attempt to maintain straight and level flight. As the speed drops below 100 mph you may notice that the even though the nose of the aircraft may be pointing up, the aircraft is descending. This indicates that the AoA is getting quite large.

If you continue to stop descent by pulling back on the stick (increasing AoA), the velocity will continue to drop. As the velocity approaches the low 80's and high 70's, the aircraft is near the stall. Buffeting of the aircraft will now be experienced.

Finally in the low 70's mph, the aircraft will stall. As lift is lost, the nose drops and the aircraft's control will not respond.

Provided that you have the altitude, recovering from a stall is relative easy:
let go of the stick
apply power
allow the aircraft to build up speed as it dives
at a speed of over 120 mph, gently pull back on the stick

Stalling at low altitude is dangerous!

The Menu Bar (F10)

The Menu Bar has a number of features that you will find useful whilst running this simulation. It is identical for both R.A.F and Luftwaffe players except for the choices available in the 'Rank' category.

Pressing F10 will display a menu bar at the top of the screen with the following categories:
ABOUT, FILE, RANK, CONTROL, OPTIONS and DETAIL.

Each of these categories features a number of options (listed below) but you should note that some options are not available while you are in the aircraft cockpit. (You can not change options to do with difficulty as this would effect your scoring).

To make menu selections, move the pointer to the menu you wish to activate and press the RETURN/ENTER. The menu options will pop down and remain displayed. To select a menu option, move the pointer down to highlight the option of your choice and press RETURN/ENTER. The menu will then close. To make multiple selections from the same menu, press the number 5 key on the numeric keypad for each selection in turn.

About
This gives you information about the people who created 'Reach for the Skies' as well as the version number of the software and any other relevant information.

File
This category has a number of choices available. They are related to the mission in hand or the taking of photographs or video film during flight.

(i) Abort Mission
Selecting this will abort the mission. It has also been referred to as 'giving up'! You are taken back to the screen before you started the mission so you can try again.

(ii)   End Mission

Selecting   End Mission   will allow you to end without having to go back to the airfield and land. Normally this will only be selectable once you have been told that the Luftwaffe are returning home. You will then go to Debriefing.

(iii)   Return

This will turn off the menu bar and return you to whatever you were doing before you pressed F10 or Escape.

(iv)   Exit

This gives you the chance to exit out of the simulation altogether and reset your machine. You will be asked to confirm this choice. No scores from the mission in flight will be recorded.

(v)   Photograph (*)

As soon as this is selected the photo will be taken and the simulation will resume. You can take a photo without bringing up the menu bar by pressing the * key during flight. Photographs can only be viewed via an option found during Debriefing. They are saved to floppy or hard disk automatically.

(vi)   Video On/Off (V)

This choice will toggle the video film recorder on and off. The video can only be viewed after the day's mission has been ended via the debriefing screen. You can also toggle the video on and off by pressing the V key during flight without needing to bring up the menu bar first. O will rewind the video back to the start so you can record over one already in memory. The video is off by default at the start of each mission. Video film can also be saved and restored to and from floppy or hard disk during Debriefing. Until then the latest footage is held in R.A.M only.

The length of film footage that you are able to shoot depends on the amount of memory you have available on your machine. Footage will be truncated (shortened) when saved to hard disk or floppy if there isn't enough room for the entire footage to be saved. IBM PC users should note that if EMS is present, it will be utilised to store film footage in expanded memory as well as conventional base memory.

Rank

The five ranks ranging from Pilot Officer through to Wing Commander (for the R.A.F) or Leutnant through to Oberstleutnant (for the Luftwaffe) are available. Once you have entered the cockpit of the aircraft you cannot change the rank manually. Note that when you do, the realism options change automatically to match the selected rank.

You will start at the rank of Pilot Officer. After a set number of successful events you will be promoted up through the ranks. Each increase in rank will in turn affect the difficulty level of the simulation so that it gets progressively harder and more realistic the more experience you accumulate.

R.A.F rank	Luftwaffe	
Pilot Officer	Leutnant	Easiest
Flying Officer	OberLeutnant	
First Lieutenant	Hauptmann	
Squadron Leader	Major	
Wing Commander	Oberstleutnant	Hardest and realistic flight

Control

There are a number of different choices during flight available, depending on the computer that you are running the simulation on.

(i)   Keyboard

This is the default setting for IBM PC.

(ii)   Recalibrate - This allows the joystick to be calibrated again if there was an error or the maximum range of the mouse to be reset.

(iii)   Joystick

IBM PC users will have to calibrate their joysticks before using them. Joysticks can only be used during flight. To manipulate the various pre-flight screens and menus you must use a mouse or keyboard.

(iv)   Mouse

IBM PC users must have loaded a mouse driver into memory before loading the simulation. You must then set the maximum movement range by calibrating.

(v)   Stick and Throttle - Some joysticks have throttle controls. This is equivalent to the pitch control on a second joystick.

(vi)   Stick and Rudder - This option selects both analogue throttle and analogue foot pedals as rudder. This is equivalent to the roll control on a second joystick.

It is possible to use the pitch trim knot on a second stick as the throttle.

There are also a few choices available on the control menu affecting sound during flight.

(vii)   All Sound Off

This makes the simulation run without any sound effects at all.

(viii)   Engines Off

This will play all of the sound effects apart from the noise of your own engine.

(ix)   All Sound On
This will play all of the sound effects available.

Pressing the S key will cycle through the three sound options in turn.

(x)   Radio Speech
If your sound card supports digitised speech then selecting this will enable radio messages from your controller.

(xi)   Music
This option switches on/off music when on option or map screens

Options
These effect the way the flight simulation behaves in regards to the realism and difficulty of the opponents. Note that they are directly related to the player's current rank and they cannot be altered once the player is in the cockpit of their aircraft.

(i)   Real Flight
This option allows you to experience the real flight dynamics of second world war prop aircraft. It will result in you having a much less powerful aircraft at your disposal than if you were flying without real flight. This is due to the aerodynamics of a 1940's aircraft and the limitations it imposed on its pilot. These limitations include stalling and the effects of drag, amongst others.

(See 'Real flight' for details).

(ii)   Limited arms
This limits ammunition to the amount that the relevant aircraft could carry in reality. An unlimited supply is assumed if this option is not selected.

(iii)   Limited fuel
This limits fuel to the amount that the relevant aircraft could carry in reality. An unlimited supply is assumed if this option is not selected.

(iv)   Vulnerable
You will be affected by enemy fire or collisions with other aircraft and the ground, if you have this option selected, just like in reality. Invulnerability (i.e. being indestructible) is assumed if this option is not selected.

(v)   Low, Medium or High Enemy Activity
This affects the number of Luftwaffe aircraft that you can encounter during each days mission.

(vi)   Soft, Medium or Hard Targets
This affects both your's and the enemy's capacity for taking hits before being damaged or shot down. On Soft, one shot is enough to take aircraft out of the battle.

Detail
You are given the choice to change the complexity of the detail included in the 3D flying sections. The lower the detail level, the faster the simulation will run because it will have less to do. The more options you enable, the slower it will be. The speed differences are not as noticeable on a fast IBM PC but they are on a slower machine.

(i)   Distant 3D
When other aircraft and other objects are in the distance they will still be shown. The default for this choice is on.

(ii)   Mirror 3D
The rear view mirror as seen in the 'look up front view' of most aircraft will show all aircraft behind you. The default for this choice is on.

(iii)   Do Roads
As it suggests, this will display all roads on the ground. The default for this choice is on.

(iv)   Do Railways
This will display all railway lines featured on the ground. The default for this choice is on.

(v)   Do Rivers
Rivers featured on the ground will be displayed if this choice is on. The default is on.

(vi)   Most Detail
This affects the level of detail shown on the aircraft themselves when viewed from the available external views. The aircraft obviously look better with most detail on, but the simulation might run slower as a result.

(vii)   Light shade (256 VGA PC only)
This will add realistic light source shading to the aircraft, which depends on the position of the aircraft relative to the sun.

(viii)   Sky Gradient (256 VGA PC only)
For a more authentic skyline, this option will provide a realistic colour gradient to the horizon.

(ix)   Canopy Clear (256 VGA PC only)
The Canopy of all aircraft can be displayed as solid or clear. The default is clear.

(x)   Polysmooth (256 VGA PC only)
The surface of the aircraft is smoothed over to hide the polygons used to create the aircraft in 3D. It results in a more realistic looking aircraft.

Quick Start

You can get into the thick of things quickly by following the quick start instructions given below. They describe the first day for an R.A.F pilot. For a more detailed explanation you will need to go back and read the detailed instructions beginning with the section 'STARTING UP'.

After loading of the simulation you will see an introduction sequence (256 colour ONLY) followed by the title/credit screen. Pressing ESC at any time will terminate the intro or credits and take you to the first game screen.

SIDE SELECT:

This screen allows you to choose between playing the R.A.F or Luftwaffe. Two aircraft are displayed (Spitfire and BF109 and beside each one is a plaque giving the name of the side. The default setting is the RAF, which is shown by a small flashing dot on the plaque. Press RETURN/ENTER to select.

READY ROOM:

This screen shows the R.A.F Pilot's ready room where a player can decide between starting a new game or selecting a previously saved position.
A stack of unused log books lie on the table, each with the name SPROG on the side. The top book is highlighted with a dark bar over the name. Select this book by pressing RETURN/ENTER.

LOG BOOK:

You are now shown the cover of the log book you have selected. As you are starting a new game the name field is blank. Type in your name (max. ten characters) then press RETURN/ENTER.

ROLE SELECT:

This screen is where you select either PRACTICE, CONTROLLER or PILOT. You will recognise the flashing square next to PILOT indicating that it is the currently selected role. Confirm the choice by pressing RETURN/ENTER.

PHASE SELECT:

The Battle of Britain is divided into four phases, details of which are given later. The flashing square tells you that the first phase - "Convoys: Jul. 10 - Aug. 8" is selected. Confirm this choice.

CONFIRMATION SCREEN:

You are now shown the Orders Board, which has your orders for that particular day of the phase pinned up for all to see. The number of aircraft available that day is also shown here. At the bottom are three options, with CONTINUE highlighted. Select this option as normal.

SUMMARY SCREEN:

As a PILOT you are given orders by a computerised CONTROLLER. The summary screen gives you details of the aircraft going out with you on the first day. The first 'flight' (group of aircraft) will be highlighted in red and details of the enemy raid it is to intercept will be given further down the page. By pressing the CURSOR DOWN key you can highlight each flight in turn and see details of each one's target. Move the highlight back to the first flight using CURSOR UP and then press RETURN/ENTER to accept.

At this point you will be asked to refer to the manual and type in whatever information is requested from a particular page and paragraph number. Once you have completed this password protection procedure, you will enter the cockpit of your aircraft.

You are now sitting in the cockpit of either a Hurricane or Spitfire aircraft preparing for take off, with the cockpit laid out before you. Press P to pause the simulation for a moment in order to refer to the cockpit picture below and familiarise yourself with a few of the key features.
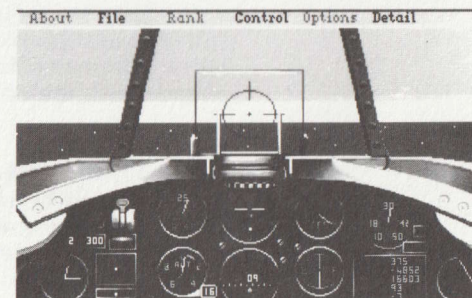
For this mission we will use the simulation's autopilot to handle take off so you should now press P again to un-pause and then press A to engage the simulation's autopilot. Your aircraft will accelerate down the runway and take off, then begin turning to the heading chosen by the computerised CONTROLLER. You might like to press F5 for outside view, in order to watch the take off. Remember to press F5 again to return to the cockpit when ready.

The controls you will be using during this first mission are the MINIMUM ones necessary to fly and fight. While the autopilot continues to control the aircraft you should familiarise yourself with the layout of the following keys on your keyboard.

LEFT/RIGHT CURSOR KEYS roll the aircraft onto its left or right side,
UP CURSOR is equivalent to pushing an aircraft joystick forward and so pushes the nose of the aircraft DOWN, causing the aircraft to dive,
DOWN CURSOR pulls the aircraft nose up causing the aircraft to climb.

To turn the aircraft to the left you will need to use the LEFT CURSOR to roll and the DOWN CURSOR to pull the nose 'up' (remembering that the aircraft's 'up' is actually to the left once it has rolled). Check that your aircraft is above 1000 feet by looking at the altimeter then try some simple flying by pressing A to de-select the autopilot and performing a gentle left turn. If you are successful you can try a right turn before re-engaging the autopilot. If you start to loose control of the aircraft press A quickly and the autopilot will recover and correct your course.

Now that you have had a go at moving the aircraft around in the sky, it's time to intercept those enemy aircraft (often referred to as Bandits during the simulation). Engage the autopilot if it is not already active and it will turn back to the correct direction (heading). The computerised controller will have decided on a point for you to circle around in order to be ready to intercept incoming enemy aircraft. The autopilot will head towards this point and will only change course if it comes within range of an enemy or the CONTROLLER gives more detailed course information to intercept a particular bandit.

Press the TAB key to activate ACCELERATED MODE and the passage of time will be increased. Your aircraft will stay in accelerated mode until it comes within range of an enemy aircraft. The simulation will then drop back into normal mode and it's time for your first taste of combat.

You should have noticed various messages appearing along the top of the screen. These are mostly chatter messages between various pilots. Only the white messages relate directly to you, and they try to keep you up to date regarding the position of the enemy bandits. As we are going to take on the enemy in visual range, we don't need to worry about the messages at the moment.

In a real fighter you would look for the enemy by turning your head and looking around to scan the skies. You can do this in 'Reach for the Skies' by pressing the number keys 3, 4, 5, 6, 7, 8 and 9 (6 is forward view). Unfortunately while these views are useful for checking one particular area of sky they can not match the ease with which you would look around during combat in real life. For this reason an alternative has been provided in the form of the COMBAT VIEW.

Press RETURN and provided that there is an enemy in range the view will change from cockpit to outside view. The positioning of the 'camera' is such that your aircraft will always remain between the camera and the nearest enemy. No matter how you or the enemy manoeuvre the camera will adjust automatically to track the enemy. (This view becomes vital when you wish perform complex aerial combat manoeuvres, rather than just 'turning in a circle' to find your enemy). Your autopilot should still be engaged and will be heading for the nearest enemy aircraft. Press L and your combat view will be locked to the aircraft your autopilot is currently engaging. Next make sure you know where the enemy is, relative to your aircraft, and press 6 to return to the cockpit. Press A to switch off the autopilot and begin to control the aircraft yourself using the cursor keys. The only other keys you should use during this engagement are + and - (ACCELERATE and DECELERATE) and SPACE BAR (fire your aircraft's wing mounted canon). Set the RPM to about 75% by using the + and - keys and manoeuvre to keep the enemy in view through the front cockpit windshield. If the enemy turns sharply and escapes from view then press RETURN to find out where they are, manoeuvre to face them and then RETURN again to jump back into the cockpit.

Your wing-mounted canon have an effective range of only 250 yards This means that a fighter would have to fill half your gun sight, or a bomber the whole gun sight, to be in range. As your aircraft currently has unlimited ammunition you can afford to fire at will by pressing the SPACE BAR. It is suggested at this point that you stop reading and start shooting until, either you or the enemy have been shot down.

If you survive your first encounter with the enemy you can continue with the mission until your controller informs you that the Luftwaffe are disengaging and that you should return home. In order to end this 'quick start' mission you should then press F10 for the menu bar and select 'End Mission' from the file menu. You will be presented with a debriefing which is described in the section 'Debriefing'.

If you lose in combat you will either be shot down and killed or forced to bail out (Ctrl & E). What happens then is covered in the sections 'Winning the Day' and 'Losing the Day'.
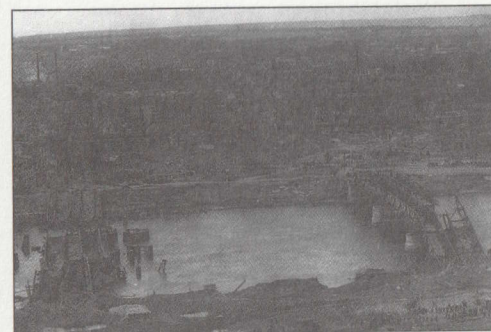
Summary of Controls

Joystick - The joystick is not used for making selections, only for flight control. You can use a Joystick, Joystick with throttle slider and Joystick with throttle slider and rudder attachment. The option for Joystick with throttle slider is referred to in the menu as "Stick and Throttle" while the option for Joystick, throttle slider and rudder attachment is referred to as "Joystick with Rudder"

Mouse - To use a mouse to make selections point at the option you want to select and click the left mouse button to highlight it and again to select it.

To use either the mouse or joystick during flight you will need to calibrate them. The program will take you through this procedure automatically when you select the control method from the menu. If the calibration fails you can try again by selecting recalibrate from the menu.

Keyboard summary

(see also Keyboard layout card)

Cockpit controls

Key	Function
+	Increase RPM (SHIFT and + increase faster)
-	Decrease RPM (SHIFT and - decreases faster)
/	Maximum RPM
Cursor Up	Stick forward (pushes the nose down)
Cursor Down	Stick back (pulls the nose up)
Cursor Left	Stick left (Rolls a/c left)
Cursor Right	Stick right (Rolls a/c right)
F3	Increase control sensitivity (keyboard only)
F4	Decrease control sensitivity (keyboard only)
Z	Rudder left
X	Rudder right
C	Rudder centre
Space Bar	Fire (guns or bombs)
G	Landing gear raise/lower
F	Flaps raise/lower
W	Wheel brake on/off
M	View pilots map
B	Air brakes (Ju87 only)
*	Take photograph
V	Video camera on/off
O	Rewind & restart video (overwrite)
A	Autopilot on/off
T	Auto gun on/off
I	Toggle info panel
Backspace	Toggle between gun/bombs (Ju87 only)
Ctrl & E	Eject from a/c

Internal views (Not JU88, DO17, He110 or He111 bombers)

Number key	View	Numeric keypad
3	Left back 45 degrees	Shift & 1
4	Left	Shift & 4
5	Left front 45 degrees	Shift & 7
6	Cockpit view	Shift & 8
7	Right front 45 degrees	Shift & 9
8	Right	Shift & 6
9	Right back 45 degrees.	Shift & 3
0	Tail gunner (Bf110 & Ju87)	Shift & 2
[	'Look up' view	
]	Return from 'look up' view	

Internal views (Ju88, Do17, He110 or Hell bombers)

Number key	View	Numeric keypad
6	Forward gunner	Shift & 8
Y	Upper rear gunner	Shift & 5
H	Lower rear gunner	Shift & 2

Outside views

Key	Function
F5	Outside view
F6	Tracking view
F7	Home base view
F8	Satellite view
F9	Ammo/bomb view
Return/Enter	Combat view (when enemy in range)
L	Lock/unlock combat view
' (inverted comma)	Waypoint increment
; (semi-colon)	Waypoint decrement
1 or 2	Rotate camera in outside view
Alt & 1 or 2	Rotate camera in opposite direction
F1 & F2	Zoom in/out when in outside view

Additional controls

Key	Function
Shift & 9	Move to Wingman/return from wingman
Shift & 1-8	Move to Wingleader of another flight
Shift & 0	Show enemy a/c (if assigned)
F10 or ESC	Menu bar
P	Pause
S	Sound mode select (All sound engines off etc)
TAB	Time accelerate

CHANGING YOUR CONFIGURATION
Once Reach for the Skies has been installed you can change the configuration by selecting the Reach directory and typing 'Reach ?'

Glossary and Abbreviations

AAA	Anti-Aircraft Artillery
ACM	Air Combat Manoeuvring. The art of dog fighting
active airfield	one of the ten airfields from which RAF fighter can be scrambled in this simulation
Angels	Altitude in 1000's of feet. "Blue 1 at angels 9" means that Blue 1 is at 9000 feet.
AoA	Angle of attack. The angle between the airflow over a wing and a line drawn from the front to the back of a wing.
Autopilot	Almost self explanatory: a device to fly an aircraft automatically, that is without pilot input. In reality, auto pilots exist that will fly an aircraft from point A to point B. In the simulation, the autopilot is also capable of engaging the enemy.
Bandit	This is an enemy aircraft
Bf109	Messerschmidt 109
Bf110	Messerschmidt 110
Big bombers	Collective name for He111, Ju88 and Do17
bogey	An unidentified aircraft, it may be friend or foe.
bunt	push the joystick forwards
callsign	A name used over the radio instead of the pilots real name. Pilots were grouped into flights, so for instance in Blue flight the leader would be called Blue 1 and the second in command would be Blue 2.
Combat circle	When a dogfight develops into a turning fight, the two aircraft will fly in circles. These circles are called combat circles.
Do17	Dornier 17: the flying pencil
dogfight	Combat between two aircraft. The name was coined by early writers who recognised that the constant circling which is typical of aerial combat resembled the circling typical of dogs when they are fighting.
He111	The Heinkel 111: two engine Luftwaffe bomber

IAS	Indicated airspeed. This is the speed measured by the flight instruments. It is only equal to the true air speed at sea level. As an aircraft climbs, the error increases. At an altitude of about 50000ft the indicated air speed is only half of the true airspeed. The error is due to the fact that the instrument works by measuring pressure changes. The air density is an important element of the calibration. As the air density falls with increasing altitude, the error gradually increases. At first sight then, the instrument doesn't seem to be all that useful. It is certainly not useful for navigation work. However it is useful to the pilot. This is because air density also effects the lift on the wings. So if an aircraft stalls at 90mph IAS at sea level, it will also stall at 90 mph IAS at 20000 ft.
IFF	Identification Friend or Foe
Jink	Fly in an irregular flight path to prevent enemy gunners from tracking you. The flight path should be changed every 15 seconds or so.
Ju87	Junker 87: the famous Stuka dive-bomber
Ju88	Junker 88
knot	A measure of speed, 1 knot equals 1.15mph
Luftwaffe	The German Airforce
nautical mile	6076.12 feet or 1.15 statute miles. This distance represents one minute of latitude.
one seater	collective name for Spitfires, Hurricanes and Bf109s
operational airfield	All the airfields visible are operational. This include the ten active airfields.
pancake	The act of landing in a controlled fashion.

piloted aircraft	This is the aircraft in which the player is "sitting". During a mission the player can move into and control any of the aircraft on his side that are taking part in the mission. In single and two seater aircraft, the player can control flight and the guns. In two-seaters the player can control the rear gunner. In the big bombers, the player can control the three moveable gun stations.
six o'clock	Pilots use a clock code to indicate the position of things. 12 o'clock is directly in front, 3 o'clock is abeam on the right. So six o'clock is directly behind.
sprog	RAF term for a beginner, youngster or offspring. It is equivalent to the American term "Rookie".
two-seater	collective name for Bf110 and Ju87
TAS	True air speed. This is the actual speed and is only equal to the indicated airspeed at sea level. The true air speed is essential for navigation work.
wireless	radio

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