
PC CD-ROM
BATTLE OF BRITAIN
II
WINGS OF VICTORY
INCLUDES Exclusive 52 minute Discovery / Wings DVD Movie!
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CONTENTS

Developer's Notes

Back in the year 2000, Rowan Software created a game called "Rowan's Battle of Britain. Battle of Britain II "Wings of Victory" is built on top of the hard work of a very dedicated team. Rowan Software may no longer exist, but their legacy still remains. In some ways their light is now shining brighter than ever.

Today, Battle of Britain II is everything the original was and more. Never have we played a flight simulation with such in-game atmosphere and delivered it on top of one of the most ambitious, historical re-creation of a living, strategic theater. The world is vast, yet detailed down to a single building or ammo shack. The action is real and with consequences as you watch events unfold on a grand scale. You may be just flying back from a huge battle, and just by chance stumble upon a friendly flight going out on a mission, or perhaps an unknown enemy en-route to complete their mission. The enemy makes tactical decisions like, "it is worth attacking them at this point, or should we carry on?" Weather effects the ability for planes to be spotted from the air and from the ground.

If you just want to jump in and have fun playing all sorts of missions, fly INSTANT ACTION missions. These missions play out differently all the time. In fact, some favorites are the DIVE BOMBING and LOW LEVEL BOMBING missions. You are also free to do whatever you wish too. For example, you can fly the TURKEY SHOOT mission and decide to spend your time strafing the airfield below.

Whatever you do, it is our truest hope you have fun with our game. All we hope is you, our customer, experience some of the magic we've been experiencing and excitement we've had while we've been making Battle of Britain II "Wings of Victory."

- The Battle of Britain II "Wings of Victory" Team

CHAPTER 1

OVERVIEW

The Battle of Britain started on July 10th, 1940. It was the beginning of a campaign by the German Luftwaffe to destroy the defensive capabilities of British Fighter Command. The ultimate aim was a sea-based invasion of southern England in an operation codenamed Sealion. It was recognized that air supremacy was vital if that operation was to succeed. Although there were expectations in Germany for a quick victory, the air campaign lasted for well over two months. The battle went through a series of phases, which culminated in a major air battle over London and southern England on September 15, 1940. That event is still celebrated in Britain as 'Battle of Britain' day. Two days later German plans for Operation Sealion were abandoned.

G2 Games's Battle of Britain II – Wings of Victory will completely immerse the player into the combat experiences of a WWII fighter pilot as well as a fighter wing commander. As the commander on either side you will have a strategic overview of the conflict using authentic campaign maps. Using these maps and your own cunning, you can make the key decisions throughout the entire campaign. Some of the Luftwaffe's 1,000 aircraft raids are reproduced, affording a unique insight into what it might have been like flying against or with, such numbers of aircraft.

In 'Campaign' Mode the player can select one of four starting points to enter the air war. The campaign begins with attacks on British coastal shipping by the Luftwaffe, who then move on to attacking radar installations, coastal facilities and airfields. This is followed by concentrated attacks against the RAF's major airfields and aircraft factories, which leads on to the final showdown during the 'Blitz' of London in September 1940.

The specially designed INSTANT ACTION missions take the player from 'Basic Training', which involves starting the engine and learning to take off from a grass strip, to the more advanced areas of formation flying and dog-fighting. A number of historic missions are based on actual engagements, and these culminate in a massive simulation of the final raid of the war on September 15th 1940 - Battle of Britain Day.

Manual Layout

The Battle of Britain II – Wings of Victory manual is laid out in seven chapters.

Chapter One contains an overview, followed by full installation instructions and a Quick Start list that will get you off the ground and flying in the minimum amount of time.

Chapter Two describes the function of the Main Menu and details the Replay facility within the game. Section 2 has full descriptions of the OPTIONS configuration screens. These screens allow you to set all of your preferences for the game.

Chapter Three lists the available missions in the Instant Action section of the game. These are individual scenarios that put you in a variety of flying and combat situations. The layout of the Instant Action screens is described in full.

Chapter Four details the game's Campaign system. The general functionality of the campaign is described in the first section. Sections 2 and 3 provide tutorials for the Campaign from the perspective of a Luftwaffe Commander and a RAF Commander, respectively.

Chapter Five is a large chapter dealing with flying and the aircraft available to fly in Battle of Britain II. Section 1 lists the available aircraft controls in the simulation. Section 2 shows cockpit layouts that can be manipulated in 'interactive cockpit' mode. Section 3 focuses on engines and propellers. Section 4 shows how to start your engines, taxi and take-off. Section 5 concentrates on solo and formation flying. Section 6 deals with combat maneuvers. And, finally, Section 8 provides technical summaries of the major aircraft in the game.

Chapter Six, The Battle of Britain Remembered, is a historical perspective of the battle by author Dilip Sarkar.

Chapter Seven notes the game credits, acknowledgements, and technical support details.

Installation

A. INSTALLATION INSTRUCTIONS

To install G2 Games's Battle of Britain II, please make sure that you follow the instructions below.

1. Insert the CD-ROM into the CD-ROM drive. If the game proceeds to autorun then go to step three.

2. Click on the START button on the Windows taskbar and select RUN, followed by BROWSE. Select your CD-ROM drive after clicking on the down arrow to the left of the LOOK IN box. Double click on the file named SETUP.EXE followed by OK.

3. A welcome message will be presented. Click on the NEXT button to continue and follow the installation instructions.

B. UNINSTALLING BATTLE OF BRITAIN II

If you wish to remove Battle of Britain II from your system we suggest that you do PANEL to bring up the Windows control panel. Double click on ADD/REMOVE PROGRAMS to bring up the add/remove programs properties box. Look for Battle of Britain II under the installed software list and select the ADD/REMOVE button. Follow the on-screen instructions.

Getting Started

QUICKSTART

1. Install and load the game as referred to in the installation section above.

2. G2 Games's Battle of Britain II begins with an animated title sequence. This can be terminated at any time by clicking on your left mouse button.

3. You will be presented with the Main Menu of the game, which allows you access to every area of the simulation. The Main Menu is described in detail in Chapter Two.

4. Select OPTIONS from the main menu. The OPTIONS screens allow you to configure a wide range of details that relate to your display, sound and control capabilities. Select the Controller option - the third from the left at the top of the screen.

5. Ensure that you have selected an appropriate input device. We strongly recommend that you use a joystick with this simulation.

6. Select Continue at the top right corner of the OPTIONS screen to return to the Main Menu.

7. Select the Instant Action option at the top of the main menu. This option allows you to fly in one of twenty-eight pre-designed missions. The default first scenario is a Basic Training mission involving your plane taking off. Using the radio buttons you can change your aircraft and airfield. If this scenario is too simple for you, by all means choose something more advanced. You may, however, find the Historic raid on September 15th 1940 a bit too much at this stage!

8. Click on the Fly option at the bottom of your screen, and once you have noted which squadron you have been assigned to, select Fly once more in order to load the simulation.

9. Assuming that you have chosen the Basic Training Take-off scenario, you will be on a runway ready for take-off. You should release your left and right wheel brakes using your "," and "." Keys (comma and period keys), set your throttle to 100% (hit the 0 key or set your

joystick throttle axis to full) and as your Spitfire picks up speed gently pull back on your joystick. You may find it more comforting initially to use the Outside View, which provides a third person view of your aircraft (hit the “F6” key or use the 4th button on your joystick). Control is now in your hands!

10. If you wish to pause the game while in flight, press P. For more information on how your aircraft is performing during a flight, press I. Your Altitude, Heading, and Windspeed will be displayed in the lower left corner of your screen. Use the joystick to control your aircraft’s attitude and direction when flying. Pull the joystick back and the nose of the aircraft will rise and you will start to climb. Push the joystick forward and the nose will drop and the aircraft will begin to dive. Moving the stick to the left or right causes the aircraft to roll in that direction. To turn, gently move the joystick left or right to roll the aircraft into a bank and then ease the stick back to the center. Extreme or sudden movement of the stick can cause the aircraft to stall or spin. If you do not have a throttle enabled on your joystick use the number keys to control the engine power settings (“1” key for idle, “0” key for maximum). See Chapter Six for more details on flying.

11. Once you have mastered the basic controls, you can end a Instant Action mission at any time by selecting the key combination “Alt” and “X” keys. A combat report will be displayed at the end of the mission, which will summarize what happened during the mission. Select BACK to return to the Instant Action missions selection screen.

CHAPTER 2
THE MAIN MENU

The first section of this chapter deals with the contents and function of the Main Menu. Not only does it describe each available option in general terms, but it provides the key information for the Load Game and Replay facilities. Section two provides a detailed description of the available OPTIONS screens, which allow you to configure the game to suit the specifications of your PC, including your sound card and game controllers. Section three deals with the Simulation configuration screens. These let you configure Battle of Britain II to your desired level of detail, authenticity and complexity.

THE MAIN MENU

The available Main Menu options are laid out as follows:

- Instant Action
- Campaigns
- Load Game
- Replay
- Options
- Credits
- Quit
- Contact Us

INSTANT ACTION

The Instant Action option takes you to the Instant Action selection screen, where you can set up on of the twenty-eight single missions available within the game. These are limited, pre-designed scenarios which vary from simple tasks such as take-off and landing through formation flying and dogfighting, to taking part in one of six historical missions based on their major engagements during the Battle of Britain. As is the case throughout the simulation you can choose to take part on either side. The Instant Action section is described in greater detail in Chapter Three.

CAMPAIGNS

The Campaigns option lets you play on either side during the Battle of Britain. You can take the role of the commander where you will have at your disposal all of the RAF or Luftwaffe resources that were available at the time. The campaign can either be played straight through from its beginning in July 1940 until the climax on September 15th, or can be started at the beginning of any one of the four 'phases' of the battle. Chapter Four details the campaigns and provides a tutorial for both the RAF and Luftwaffe sides. The campaigns themselves have an extensive help facility that describes the function of every option available to the player.

LOAD GAME

The load game facility allows you to load in a Campaign game that you have previously saved. You are only offered the option to save your game during the Campaign section of Battle of Britain II. The Instant Action missions cannot be saved.

From within the Load Game screen, first select RAF or Luftwaffe at the bottom of the page (RAF is already selected). Then select the saved game of your choice from the list, and then click on Load at the bottom of the screen to restart your campaign at the point where it was saved. If you wish to return to the Main Menu without loading a saved game then select the Back option at the bottom of the screen.

Campaign games can be saved in three ways:

1. Use the ‘filing’ icon to open the filing dialogue with both "load" and "save" tabs, then either select a game to overwrite from the list, or enter a new name. Then click the SAVE icon.
2. After clicking the close icon to exit you will be offered a chance to save the current game. The process is then effectively the same.
3. The game "Auto Save" is generated every time you enter the frag screen on the way to flying a mission. The "Auto Save" entry in the list of saved games will always be in the situation just prior to the last time you entered the campaign mode

REPLAY

The replay feature allows you to access footage that you have taken while flying. To set the cameras rolling in flight you need to press the C key.

RECORDING
There are several ways to record footage. The simplest is to set the Gun Camera option in the Sim Config/Views screen to On. This will record the mission from start to end. Setting this option to Trigger will record when the player shoots or drops a bomb.

The recording will stop shortly after the player has stopped firing, and for one minute after a bomb has been dropped. The player can also toggle the gun camera on/off by using the “C” key. Both this and the recording on trigger will concatenate recorded pieces during the same mission together into a single replay file for that mission. It is possible to throw away all current footage and begin again by pressing the “X” key.

SAVING
In Instant Action missions. when the mission has ended the player returns to the Debrief screen. There is a replay option here which allows the player to save and/or view the footage from the mission he has just flown. To save the footage, select an existing file to overwrite, or type a new name in under current file and click on Save. To view the recent mission click on View. During the Campaign, click on the replay icon on the main toolbar on the map screen. This will give the player the option of saving and viewing footage in the same way as for Instant Action missions.

REPLAYING

To replay footage that you have recorded, either select the replay option from the Main Menu, or use the replay icon on the map toolbar in the campaign section of the game. If you choose replay from the Main Menu, the replay screen is displayed. On the replay screen, you should select the desired footage. A list of previously saved replay files will be displayed, to view one, click on the name so it is displayed in current file and click on View.

The simulation 3D system is then loaded, and a set of 12 icons and a running bar are displayed at the top of the screen. When a recording is being replayed, a line moves along the running bar to indicate the current position relative to the start and stop positions. The two other lines on the running bar are for Start Marker and End Marker. The default position for these markers is at the start and end of the running bar. These markers allow you to select significant footage.

Starting from the left icon, the functionality is as follows:


Rewind to the previous marker


Rewind to the previous block The recording is saved in discrete blocks.

Forward and Rewinding through the blocks is a quick way of moving around the recording.

Rewind one frame (only available when paused)


Play/pause


Forward one frame (only available when paused)


Forward to the next block


Forward to next marker


Save the marked block


Reset the markers to the default position (beginning and end of recording)


Exit replay 0 or c


Set the start marker to the current position

Setting the marker to after the end marker moves the end marker to the end.


Set the end marker to the current position

Setting the marker to before the start marker moves the start marker to the beginning.

The icons can be selected using the keyboard number row (1 for the first icon, 2 for the second icon etc. up to -and = for set beginning and end marker) or the mouse pointer (so long as the interactive cockpit has the mouse allocated to it in the controller preferences). In addition to the controls provided by the icons, most of the usual view keys are available using the function keys. No cockpit views are available, because they are not part of the recording.

OPTIONS

The OPTIONS screen in the Main Menu gives you access to various menus. These can be used to select your preferences for the display, controller, and sound preferences. The selections you make will be determined, to some extent, by your PC hardware. Once you have made your choice of preferences they are saved when you exit the game. A full description of the OPTIONS screens is presented in the next section of this chapter.

The Sim options give access to the four screens of the simulation configuration menus. These can be used to select your preferences for the choice of flight models, views and mission tactics within the game. Generally, your level of experience will determine your choice of preference settings. Your preferences are saved when you exit the game, and also saved as part of a campaign save game.

CREDITS

Select the credits option on the Main Menu to view the team that put Battle of Britain II together. Select your left mouse button at any stage to return to the Main Menu.

QUIT

The quit option leaves the Battle of Britain II and takes you back to Windows.

CONTACT US

Select the Contact Us option to open up your default web browser and connect to the Battle of Britain II web site. You will already need to be connected via your Internet Service Provider if you are to connect successfully. The web site contains information regarding the latest news on the game.

OPTIONS IN DETAIL

The PC menus have four main pages that relate to the preferences associated with your PC setup. You can move from page to page using the five active areas at the top left of the screen:

- GFX (graphics)
- More GFX
- Controls
- Sound

TECH NOTE:
If you find that you are no longer able to play the game and are unable to change the options to a safe set the configuration file can be deleted. The file is \Battle of Britain II\SAVEGAME\SETTINGS.CFG.

GFX

The GFX menu contains the following options:

Display Driver
This combo-box holds the 3D drivers on your PC that Battle of Britain II has detected. The displayed driver is the one that is currently selected.

3D Resolution
These are the range of resolutions that your current display driver can use to display the 3D simulation section of the game.

Campaign Resolution
These are the range of resolutions that your current display driver can use to display the campaign section of the game.

Gamma Level
Every 3D video card and monitor setup produces a different brightness and contrast output. The Gamma Level option allows you to set the monitor output to a level of your taste without altering your standard monitor settings. Choose lower options to darken the image or higher options to brighten it.

Ground Shading
This controls the shading of light on the ground. Light shading takes processor time, so if that is a concern, then turn it off.

Item Shading
Item shading can be turned on or off. It controls the light shading on aircraft and other moving objects.

Reflections
If reflections are turned on then a cockpit mirror will be drawn if present in that aircraft model. Also the in-cockpit canopy and instrument glass will have reflections which fade out depending on the angle to the sun.

Weather Detail
With weather effects off there is simply a general average cloud base. If clouds are turned on individual clouds will be displayed. These are realistic, but have an impact on the frame rate on slower machines.

MORE GFX

The More GFX page menus contains the following options:

Filtering
None, Bi-Linear, Tri-Linear, All, Anisotropic 2X-16X
These filtering settings increase the quality of image-mapping. The "all" setting enables multi-textured dithering effects and may not be supported by all cards. Anisotropic 16X gives the best visual quality, especially with the terrain as it is drawn out.

Smoke
This option toggles smoke special effects and early morning fog banks.

Texture Quality
Texture quality has a considerable effect on the displayed frame-rate for slower machines but improves the quality of certain aspects of the 3D, especially the cockpit view.

Routes
The display of small roads, rivers and rail lines can be turned on or off with this option.

A/C Shadows
When this option is turned on then aircraft shadows are visible on the ground.

Item Shadows
This option toggles the visibility of ground shadows for objects other than aircraft.

Horizon Distance
With Near Horizon enabled, the ground detail does not extend as far into the distance, but the frame-rate is improved. Far Horizon will not be selected by default if your video card cannot run with a z-buffer of greater than 16 bits. This feature may require a color depth of 24 to 32 bits depending on the graphics card and adapter.

Water Detail
Raising this detail allows very high quality water to be seen, but at a cost in performance.

Terrain Mesh
Maximum Detail has a range from minimum through to maximum. It allows the detail level of the landscape and shapes to be altered. The smaller the level of detail the greater the gain in frame rate. High is our designed level, but we have provided Maximum for future improvement in machine specifications.

G Effects
With the effects of G (gravity) turned on, then it is possible for you - the pilot - to blackout and red out, depending on the maneuvers you make.

Injury Effects
This toggles the display of injury effects if the pilot is hit.

White Outs
The white out option toggles the display of sun glare on and off.

CONTROLS

The controls page offers EXPRESS and CUSTOM options. For most people with a single joystick, EXPRESS should set things up so you can fly. If you wish to further customize your keystrokes, buttons, or sliders, select CUSTOM.

CUSTOM:
Clicking on the In-Game Axis brings up the following options:

- Deadzone
  Most of the options below have independent dead zone settings. The dead zone is the region at the center of the stick where no control input is provided to the aircraft. The player can choose to set the deadzone to Small, Medium or Large depending on the quality of the hardware being used. Generally speaking, for a joystick that centers well, and produces a signal which is steady and with little noise, a small deadzone is appropriate. However, if, when the joystick is released, it does not zero exactly or the signal continues to vary, this can be compensated for by selecting a larger deadzone. You will need to find the best arrangement by trial and error.

- Saturation (default – NONE)
  Reduces the maximum throw of an axis. If set to large, moving the axis 3/4ths to the extreme position is read by the game as a full movement.

- Reverse
  Simply reverses the axis.

- Filtering (default MEDIUM)
  Smoothes out joystick movements by eliminating spikes

Use for FF If you have a 'force feedback' joystick then you can tick this box. If your controller is not force feedback enabled then this feature will be grayed out. You can also disable or select 5 different feedback levels for each of the following effects:

Gun fire transmits vibrations caused by the guns on your aircraft.
Buffet transmits vibration caused by buffeting if you are near the stall condition, close to an explosion, or close to the speed of sound (unlikely).

Aerodynamic setting causes stiffening of the controls at high speed.
Airframe transmits vibrations transmitted through the airframe from the ground - i.e. when you are taking off or landing (or crashing!).

Rudder This provides control of your rudder, which yaws the aircraft in flight, or steers the rear wheel when taxiing**.**

Throttle The throttle provides control for selecting the desired engine power. When this combo is set to keyboard, the row of numbers on the main keyboard can be used to select the throttle level in 10% increments There is a second box for the Bf110, which has two throttle levers, one for each engine. When this second combo is set to keyboard, the two throttles can be controlled either together or individually. In flight, pressing E will cycle through the available engine to control - both together, port engine only or starboard only.

Prop Pitch The propeller pitch controls the angle of the propeller blades. This can be used manually, just like the gearbox in a car, to maintain the correct engine speed. Or the computer can control it automatically. When this combo is set to keyboard, m and 9 gives maximum prop pitch (and therefore lower rpm) whilst m and 0 gives minimum prop pitch (and higher rpm). m in combination with the -and + keys will increase and decrease (respectively) the propeller pitch by smaller increments (having the opposite effect on the rpm).

SOUND

The sound page contains the following options:

Sound Driver The sound driver box displays the currently selected driver, along with other drivers available on your machine.

3DSFX Volume
This setting controls the volume of the sound effects in flight, and also affects the radio chatter and engine volumes below.

UI SFX Volume
This setting determines the volume of sound effects in the user interface.

Ambient SFX Vol
This setting controls the volume of the ambient sound effects in the non-flying sections: e.g. office sounds in the 2D Map Room**.**

Radio Chatter Volume
This setting controls the volume of the radio chatter while flying and in the 2D Map Room.

Engine Volume
Controls the volume of the engine noise.

SFX Quality
Allows you to set the quality of sound effects to low or high.

SIM

The Sim configuration menus have four main pages of preferences associated with the setup of the simulation when you are flying. You can move from page to page using the four active areas at the top left of the screen:

- Flight
- Game
- Mission
- Views

There are also two options at the top right of the screen. PC takes you to the PC Config screens, discussed in the section above. Continue either takes you back to the previous screen or back to the GFX to continue your flight.

All of the configurations options are displayed within 'combo' boxes. These can be manipulated either by selecting the down arrow on the right hand side of the box (and then choosing from the list within the drop-down menu that is displayed), or by clicking on the main part of the box (and cycling through the available options one at a time).

FLIGHT

The Flight page of the Sim menu contain the following options:

Flight Options
Minimum, Low, Medium, High, Maximum, Custom
Setting this box will change all the options below to 5 pre-configured difficulty levels. For instance, minimum uses the Novice flight model with most of the options turned off, and maximum will set up the full flight model with the options set up to give full realism. If you manually change the options below, then the Flight Options box will show "custom".

Flight Model
Realistic, Novice
There are two flight models available that can be used to control the way in which the aircraft flies. The 'realistic' model allows the player to experience all the flight characteristics of each aircraft such as the stability, control responses, stall and spin characteristics. The 'novice' version provides accurate performance modeling of the aircraft but keeps it within the normal safe flying envelope. This second model allows the player to fly a very stable version of the aircraft without worrying about stalling or spinning.

Engine Management
Manual, Auto
The game offers the player the chance to use many of the engine controls present in the real aircraft. These include such things as Magnetos, Fuel Cocks and Starter Buttons. This allows the player to take control of the engine management, just like the pilot of a real aircraft. These controls may only used with the 'interactive cockpit'. Due to the complexity involved, no keyboard control is provided in this mode. This option is not

available if the novice flight model has been selected. If you wish to fly the aircraft without worrying about the management of the engine, select Auto and the computer will control the engine and fuel systems automatically.

Prop Pitch Control
Manual, Auto
This allows the player either to control the propeller blade angle manually, or to let the computer automatically control the propeller, based on the engine speed and the throttle setting for the engine. The automatic system will always attempt to provide the player with the most power appropriate for most flight and combat conditions, but it will not necessarily allow effective windmill braking or propeller feathering (see Chapter Six - Section Three).

Power Boost
This option allows the player to increase the power of the engine in order to give an advantage during combat. If the power boost is Off, the power produced by the engine will be realistic. When switched On, the engine will produce approximately 50% extra power which provides the player with increased speed and climb performance.

Wind Effects
The wind is modeled at all altitudes and it varies in direction and strength on a day to day basis. The wind will affect the take-off, cruising, bombing and approach of all the aircraft in the game. This option allows the wind to be turned off completely.

Wind Gusts
If the wind effects are switched on, then random gusts are also modeled, and their strength depends on the weather conditions each day. This option allows the player to switch gusts on or off. Gusts will not occur if Wind Effects are switched off.

Airframe Stress
The aircraft and their pilots are subjected to very large forces during combat and aerobatics. Although the structure of the aircraft is very strong, aircraft were known to break up in the air, especially when pulling out of steep, high speed dives when the aerodynamic forces on the wings and tail section can be very great. The effects of these large forces are modeled in the game and if the player puts too much stress on the aircraft it may break up. These effects can be switched off and there will be no danger of the player damaging the aircraft as a result of very high G

maneuvers.

Torque/Slipstreaming
The effects of the propeller, such as the torque reaction in the fuselage, the effects of the rotating slipstream on the tail surfaces and the gyroscopic effects of the large diameter propeller are all modeled in the game. These affect the handling of the aircraft both on the ground and in the air, but can be difficult for an inexperienced pilot. This option allows the player to ignore all of these effects and consider only the thrust produced by the propeller in the flight model.

109 Fuel Capacity
Realistic, High
The Messerschmitt Bf109 has an internal fuel tank with a capacity of 400 liters. This limited the range of the aircraft, restricting it to only 20 minutes flying time over British soil before it had to turn home. This had significant tactical implications for fighters escorting bombers to targets in England and often meant that the fighters had to leave the bombers before they had reached their targets. An external auxiliary fuel tank with a capacity of a further 300 liters was provided for the Bf109. This was made of molded plywood, and tended to leak significantly with a danger of catching fire, making these tanks very unpopular with the pilots. In order to model the increased range which could be achieved with the increased fuel capacity, without the dangers of the plywood tank, the player can choose to increase the effective capacity of the internal fuel tank (to 700 liters) by switching this option to High.

GAME

The Game page of the Sim menu contains the following options:

Weapons
Realistic, Unlimited
When the Unlimited weapons option is selected weapons will be automatically reloaded when they are emptied. If the weapon selection is set to Realistic, the setting still can be over-ridden in the 3D by using the reload cheat key lR.

Vulnerable to Fire
When turned off enemy fire will not damage your aircraft.

Ground Collisions
When enabled, collision with the ground will damage or destroy your aircraft.

Midair Collisions
When enabled, collision in midair with other objects will damage or destroy your aircraft. This option also controls collisions with 3D ground objects such as buildings and vehicles.

Accel Off
Tactical, Engage
This setting relates to the use of accelerated time during the game. When the trigger is set to engage, your aircraft will drop back into real time only when you are directly threatened and enemy aircraft can fire at you. If the trigger is set to tactical, then real time is reset much earlier in the encounter. This will give you time to engage the enemy at a tactical level and allow you to gain height or maneuver, so that you may be able to achieve tactical dominance.

Target Size
Altering this setting affects the apparent size of a target.

Autocanopy
This option will automatically open and close the cockpit canopy at low speed so that takeoff and landing can be performed realistically.

Aircraft Names
This option toggles the display of names below the aircraft.

MISSION

The Mission page of the Sim menu contain the following options:

LW Skill Modifier
Minimum, Low, Medium,High, Maximum
This setting determines the skill level of the Luftwaffe in a campaign setting. At medium, the true skills of the squadrons will be used. At minimum and low settings the skills will be reduced, and at high and

maximum settings the skills will be increased. You may wish to increase the LW skill when you are playing LW commander, and reduce it if you are playing the RAF commander.

RAF Skill Modifier
Minimum, Low, Medium, High., Maximum
This setting determines the skill level of the RAF Luftwaffe in a campaign setting. At medium, the true skills of the squadrons will be used. At minimum and low settings the skills will be reduced, and at high and maximum settings the skills will be increased. You may wish to decrease the RAF skill when you are playing LW commander, and increase it if you are playing the RAF commander.

Luftwaffe Tactics
Historic, Optimum
The LW tactics can both follow history and take notice of the orders passed down from Berlin, or they can follow a more optimal route. For example, in the more optimal game-plan, the one month convoy phase will be curtailed and the highly successful airfield phases will be extended. This option primarily effects the RAF commander.

Luftwaffe Intell
Historic, Accurate
The LW were plagued with poor intelligence on the precise use of various factories and airfields and had to run many reconnaissance missions to get accurate damage assessments. When playing as a LW commander it is useful to be able to get accurate information.

Map Plotting
This option primarily affects the RAF commander. When this option is on, Map plotting will be represented historically, and flights that have been temporarily lost on the radar screens will stop moving. When the option is off, the map plotting will always be fully accurate.

Auto Vectoring
Auto vectoring determines how the aircraft in your Group will react during combat when you are flying as the leader. When Auto Vectoring is on, the other pilots will determine how they should react automatically. When Auto Vectoring is off, you will be offered a range of sensible choices. Selection should be made using either the number keys or the mouse pointer. If a choice is not made within a few seconds then the options are removed and the other pilots will make their own choices.

VIEWS

The Views page of the Sim menu contain the following options:

Restricted Views
When turned on the player is restricted to the cockpit view. This option is provided so that during a Multi-Player session all players are limited to the same view.

Peripheral Vision
When Peripheral Vision is on, you will notice RAF and Luftwaffe identification symbols near the edges of the screen. These represent aircraft that would be in the peripheral vision of a real pilot. The computer presents a much smaller field of view than human vision.

Auto External
When turned on, and when 'inside padlock cockpit' has been selected, the view will automatically change according to the position of the target. If the target is in front of the player, then the inside view is presented.

View Mode Select
Panning, Fixed Views
This controls how the number pad arrow keys respond. If panning is switched on then pressing a key will produce a smooth pan. If fixed views are switched on then key presses will jump straight to a new view. The “b” key also toggles this selection in game.

Padlock When Visible
When this option is on, padlocking is only possible when the target is in view. When off, the object has to be in visible range but not necessarily in view to be padlocked.

Info Line
Off, Flight info, View info
The 'info line', which is at the bottom of the screen when flying, can be in one of three modes. Flight info mode gives flight-specific information about your speed and altitude. View info mode tells you which views you currently have enabled. If the info line is turned on then the last spoken radio message will also be displayed for a few seconds.

Units
Imperial, Metric
The selection determines the units displayed during the game. For instance, in imperial units speed is displayed in miles per hour, while in metric units speed is displayed in kilometers per hour.

Gun Camera
Off, Trigger, On
The gun camera can either be off all the time, on when the trigger is pressed, or on all the time. When Trigger is selected, the camera is not switched off immediately the trigger is released. The amount of time that the trigger is left on after releasing the trigger depends on the ordnance selected. So, for example, the camera is left on longer after a bomb release than when firing cannon/bullets. The X and C keys can over-ride this option.

Head Up Display
Virtual threat indicator and artificial horizon instruments are available to help you to retain situational awareness during combat. These instruments are designed to compensate for the fact that in a simulation you do not get the same feedback during combat as would a real pilot. A real pilot has full peripheral vision and feels the effect of gravity. When turned on, the Virtual Threat Indicator is displayed on the top left of your screen. It shows an isometric perspective of a 360 degree circle of view. Any threats are marked as vertical lines. They show the angle of the threat relative to your aircraft and the relative importance of the threat (height of line is proportional the size of threat). The artificial horizon is the same as is found in most aircraft.

CHAPTER 3
MISSIONS

This chapter deals with the options that are available when you choose Instant Action from the Main Menu. Instant Action allows you access to any of the twenty-eight specially designed single missions in the game. It is the easiest and quickest way in which to jump into an aircraft and fly. And it also provides you with a training ground to hone your flying and tactical skills before deploying them in the full Battle of Britain II campaign.

In order to make the most out of these Instant Action missions you will need to make the appropriate adjustments to the PC and Sim configuration settings in the game. The default settings for the game are appropriate to the less experienced user, so if you are an experienced flyer you may well wish to select more challenging preferences. These are discussed in detail in Chapter Two. You may also wish to learn more about certain aspects of flying authentically modeled World War Two aircraft. In that case you will find a great amount useful information in Chapter Six.

It is possible to play all eighteen of the non-training Instant Action missions in multi-player mode, where up to seven other remotely-connected players can take part in the action with you.

INSTANT ACTION

Choose the Instant Action option from the Main Menu and you will be presented with the Instant Action screen. On this screen all of the details of your Instant Action mission can be set up.

At the top of the screen there are two combo-boxes that allow you to choose your Instant Action scenario. The upper box divides the scenarios up into six basic types, while the lower box allows you to choose between all of the missions available with that type of mission. The basic mission types are as follows:

BASIC TRAINING

Five basic missions to ease you into the art of take-off, landing and circuit training.

Take-Off
Practice engine start-up and take off.

Landing
Landing practice from final approach.

Circuits
Practice a circuit around an airfield and land.

Squadron Take-Off
Learn how to take off in squadron formation.

Squadron Landing
Learn the art of squadron landing, and communicating with your wingmen.

ADVANCED TRAINING

These five missions move you up to the more advanced art of complex flying and landing problems.

Follow the Leader
Attempt to follow your squadron leader and see if he is able to lose you as he tries to throw you off his tail.

Formation Flying
Maintain your position in formation while your leader puts you through a series of course changes.

Free Flight
A free flight allowing you to familiarize yourself with the landscape near your home airfield.

Landing - Engine Failure
With an engine that has stopped operating you must perform an emergency glide landing.

Landing - Heavy Damage
Make an emergency landing with a heavily damaged aircraft.

DOGFIGHTING

Actual combat training with several different customizable dogfighting scenarios. Go on your own, or set up multiple aircraft engagements with either side having the advantage.

Turkey Shoot
Shoot down a plane you are tracking from behind.

One on One
A straight fight against one determined opponent.

Random Advantage
A British squadron is vectored against a Luftwaffe fighter sweep. The tactical advantage at the start is changed randomly.

RAF Advantage

The RAF squadron is positioned at the rear of a Luftwaffe fighter sweep with the clear advantage.

LUF Advantage
The Luftwaffe fighter sweep is positioned behind an RAF squadron.

GROUND ATTACK

Get the practice you'll need to fly for the Luftwaffe against the varied types of ground targets that can be found in the Campaign.

Dive Bomb Attack
Luftwaffe bombers initiate a dive-bombing attack while their fighter escort deals with RAF fighters scrambled in response.

Anti-Shipping
A Channel convoy is under attack from dive-bombers.

Low Level Attack German aircraft have approached a coastal target at low level to avoid detection by radar and are now initiating an attack.

INTERCEPTIONS

When encountering enemy aircraft you'll want to have plenty of practice with the different techniques of interception. Particularly when it happens in a dynamic campaign.

Lone Fighter vs. Lone Bomber
A fully laden bomber against a single RAF fighter.

Front attack against Bombers
Two RAF squadrons positioned ahead of an enemy bomber force and escort.

Rear attack against Bombers
Two RAF squadrons positioned behind an enemy bomber force and escort.

Scattered Attackers, Scattered Escort
Two RAF squadrons are separated and up against two Luftwaffe fighter squadrons defending an enemy bomber force.

HISTORIC

Six scenarios based on actual historic engagements that took place during the Battle of Britain. These will provide the ultimate test of how much you have learned in the previous training missions.

July 19th - End of the Defiant
The day before the Boulton-Paul Defiant was removed from service.

August 13th - Eagle Day
The start of a new phase of the Battle - attacks on Fighter Command airfields.

August 15th - Black Thursday Morning
The morning of the largest surprise raids of the Battle of Britain.

August 15th - Black Thursday Afternoon
88 Dornier 17s on a massed raid over England.

September 9th - London
Heavy raids launched against South London.

September 15th - Battle of Britain Day
Two massive raids over London that sees the climax of the Battle of Britain.

ADDITIONAL INFO

Underneath the Instant Action mission choice there are four radio buttons, and each of them bring up further information about the selected scenario:

SCENARIO
Provides a textual description of the chosen mission.

PARAMETERS
The parameters radio button gives access to four boxes that allow you to edit the basic parameters of the mission:

Target Area
Defines the type of area where the action takes place - for instance airfield, docks etc. Sometimes you are not allowed to edit the location type, at other times you are provided with a choice.

I.D.
Defines the specific location - for instance, the specific airfield etc.

Weather
Choose between clear, patchy cloud, low cloud and high cloud.

Time
Choose between dawn, morning, afternoon and dusk.

Name
Choose your call sign by selecting the name and editing.

LUFTWAFFE AND RAF
Clicking the Luftwaffe or RAF radio button provides information on the groups of aircraft from either side taking part in the mission. Each panel listed shows details for a specific squadron / staffel unit. They are:

Duty / Target

This field is displayed at the top left of the panel, and it cannot be altered. It either shows the duty that

Aircraft icon
The aircraft icon can be clicked and highlighted to specify which unit you want to fly in. This icon is non-selectable if the aircraft type is a non-flyable, such as the Defiant.

Aircraft type
This combo-box allows you to alter the aircraft that the unit will use. You are limited to choosing another aircraft of the same type that can perform the same duty. For example, if the unit initially has a Dornier Do17 assigned then you can only change it to another medium bomber type (He111 or Ju88). Sometimes a mission will force a specific aircraft type and no other types are selectable.

Number of flights
You can change the number of flights within the unit. The total number of aircraft is dependent on the type of aircraft. For example, Spitfires, Hurricanes and Ju87s operate in flights of 3 aircraft, Me 109s operate in flights of 4 aircraft and all the medium bombers (He111, Do17 and Ju88) operate in flights of 5. So two flights of Spitfires comprise six aircraft while two flights of He111 total ten aircraft. Selecting 0 flights means that the unit does not take part in the mission. Some mission will not allow units to be disabled in this way, or restrict the option completely.

Altitude
You can set the initial altitude of the unit. Sometimes the field will be blank and cannot be altered. This is because the unit is closely escorting a previous unit (one that appears above it) and shares its altitude.

Skill
Sets the average overall skill of the pilots within the unit.

A NOTE ABOUT HISTORICAL MISSIONS
These missions are large, consisting of many units attacking numerous targets over a large area. As an example, take the ‘Aug 13th Eagle Day’. When you change the details in the first unit panel of the Luftwaffe, you are actually changing the details for each of the 3 Staffel units that make up 1 Gruppe. You are only able to fly in the lead staffel if you select the aircraft icon.

There are two choices at the bottom of the Instant Action screen:

BACK
Returns control to the main Menu.

FLY
Takes you to the so-called 'Frag' screen, where you are shown your unit, aircraft, duty and call sign. If the settings are acceptable to you, then chose FLY at the bottom of the screen. This will then take you into the Instant Action mission itself. You may also choose to enter the Sim Config screens for any last minute tuning, or to return to the Instant Action screen by selecting Back.

The 'frag' screen is laid out as follows:
Unit
The list of the staffel or squadron units taking part in the mission.

Aircraft
The major aircraft comprising the units taking part in the mission.

Duty
The duty of the aircraft in the mission.

Callsign
The callsign of the leader of the unit.

Below this list is a bank of pilot slots corresponding to the current highlighted unit. This is automatically set to the unit you selected on the Instant Action screen. The arrangement of the pilot slots shows the flight formation that will be used in the air. Your player name should appear automatically in the lead pilot slot. You can change your position within the squadron / staffel by clicking another pilot slot. You can view other units by clicking different unit lines at the top of the screen (if there are any).

If you lose track of your current pilot selection then hit the 'Return to Player' button. The unit containing your pilot will be selected and displayed.

THE END OF A INSTANT ACTION MISSION

You may exit a mission at any point by pressing the Alt and X keys. Once a mission is completed, you will be presented with an on-screen menu containing the options 'Continue' and 'Stand down' (exit) with a key prompt for each. Press the appropriate key to continue flying or exit the mission. The menu will default to 'Continue' after a few seconds and will not appear again - in this case, you must press the g and X keys when you are ready to exit. A mission is deemed completed for a variety of reasons. For a take-off For combat missions, either destroying all enemy aircraft or allowing any remaining bandits to stray too far out of range will trigger completion.

Once you have completed a Instant Action mission, successfully or otherwise, you will be presented with a full Combat Report.

The combat report details the mission you have just completed, particularly location and casualty information. At the bottom of the report there are four active areas:

Back

This returns the player to the Instant Action screen.

Report
Displays the combat report.

Diary
Displays the combat diary, with
more details of the mission that
has just been performed
including the number of intercepts and the number of losses.

Replay This allows the replay of any material recorded by the gun camera during the mission. Click on replay to go to the replay file selection screen. This allows you to name the most recently selected footage, or to choose a file from the box of previously saved replays. Select Back to return to the Instant Action screen. Select Save to save newly taken footage. And select View to view saved footage - this takes you back into the 3d system and provides you with a replay facility as detailed in section one of Chapter Two.

CHAPTER 4

Every dialogue box displayed within the campaign section has an associated help file that fully describes the function of the contents of the dialogue box. The relevant help file can be accessed by clicking on the question mark at the top right corner of any box. You have the option to print out the help file at any time.

Section Two
Campaign Screen

The campaign screen is generally dominated by the campaign map, with a set of icons in the top right corner of the screen and five toolbars:

- **The time toolbar**
- **The main toolbar**
- **The map toolbar**
- **The scale toolbar**
- **The teletype toolbar**

The layout of the toolbars and the function of some of the icons is slightly different depending on whether the campaign is being played from the side of the RAF or the Luftwaffe.

The Map

The campaign map is capable of displaying the entire area of the Battle of Britain campaign, from northern England to northern France, based on original Ordnance Survey data from the period. The large scale map can be displayed at 4 major levels of magnification, from 400 miles square down to a 50 mile square area. At a finer level of detail the map becomes a continuously scaleable down to a scale of 2 miles square. The zoom level is easily adjustable, and the map may be scrolled, either using the scroll bars at the right and bottom sides of the map, or by clicking and dragging with the left mouse button while the pointer is over the map portion of the screen.

It is possible to change the map zoom by one of three methods:

1. by using the scale toolbar (see below)

2. by clicking with the right button while the mouse pointer is over the map and choosing either the 'zoom in' or 'zoom out' option.

3. rotating the wheel on a Microsoft Wheel Mouse (or similar) while the mouse pointer is over the map. If the mouse wheel zoom doesn't work initially, then try clicking on the map first.

Screen Control Icons

The fixed set of icons in the top right of the screen offer the following functions:

- **Quit**
  Return to the Main Menu.
- **Toolbar Control**
  This gives access to the toolbar dialogue box. This box allows the player to select which of the five toolbars will be displayed on the screen at any one time

- **Size**
  Toggle between full screen and maximized displays

Right Click

Right click while the mouse button is anywhere apart from the campaign map on the campaign screen and a menu system that duplicates the functionality of the toolbars will open.

Context Sensitive Help

Every dialogue box that is displayed within the Battle of Britain campaign has an associated help file. The help file explains the function of every element and option within the dialogue box. To access help left click on the question mark at the top right of any dialogue box.

Main Toolbar

The main toolbar consists of nine square notebook icons (eight in the case of the Luftwaffe) at the bottom right of the screen. The name and function of some of the icons varies slightly depending on whether you are playing the campaign from an RAF or Luftwaffe command:

Luftwaffe Icons **RAF Icons**

Aircraft Allocation

The aircraft allocation dialogue box shows where the nation's current aircraft production is destined, and what is required. There is a line of information for each type of aircraft under production

Luftwaffe Resources or RAF Resources

The resources dialogue shows the location and strength of each Geschwader or Squadron available to central command.

Geschwader Lists or Squadron Lists

The Geschwader and Squadron lists provide more detailed information about strength and battle readiness of the aircraft at your disposal.

Weather

The weather information box shows the day's weather forecast for the south-east England.

Review

The review summary box shows all of the major information about the campaign and the known state of RAF and Luftwaffe resources.

Pilot Info

The pilot info icon brings up the pilot log book

Target List or Asset List

The target/asset list details all of the major British assets in the south of England.

Mission Folder

The mission folder lists all of the missions that have been planned for the day. It shows all missions that have been authorized and that have been flown and completed. All missions are cleared from the folder at the end of each day.

Hostiles List (RAF only)

The hostiles list dialogue lists all the raids that have been detected for the day. As soon as a raid is detected it is added to the list, so it is in chronological order.

Map Toolbar

The map toolbar consists of the seven telephone icons just below the map view:

Luftwaffe Icons **RAF Icons**

Thumbnail Map

Click on the thumbnail map icon to bring up the thumbnail. The red rectangle indicates the area covered by the main campaign map.

Zoom Level

The zoom level displays two user-definable levels of zoom on the campaign map.

Zoom Toggle

Clicking on the Zoom Toggle icon toggles between the two user definable zooms that are set in the Zoom Level dialog.

Directives Toggle

The Directives Toggle Icon is used to toggle the appearance of the directives dialogue box. If the telephone icon is on the hook the directive dialogue box will not appear. The directives dialogue, which by default appears at the start of each time period, allows you to build up missions automatically.

Map Filters

The Map Filters dialogue is used to control the icons and lines that are drawn on the main campaign map.

Filing

Click on the filing icon to display the filing dialogue box, which is used to save and load campaigns. You can save or load a campaign at any stage of the game.

Replay

Allows you to replay footage from in-flight cameras that has previously been recorded. See Chapter Two Section One for further details.

Scale Toolbar

The units shown on the toolbar scale are either imperial or metric depending on the selection under the units option in the Sirn Config menu. If imperial units are selected then the scale is displayed in nautical miles. Kilometres are used if metric units are selected.

The scale is fully dockable so that you can move it around the map. The scale can be forced to display horizontally or vertically If the scale is currently vertical, then click and hold on the top portion of the scale above the origin and drag it to the desired location.

One method of altering the map scale is to click and hold with your left mouse button over the map toolbar. Select a location at the bottom of the scale and move the mouse upwards to decrease the map resolution. Select a location at the top of the scale and move the mouse downwards to increase the map resolution.

Teletype Toolbar

The teletype toolbar is just below the map on the left hand side of the screen. It displays a summary of the last three Messages received by central command. The originating location is on the left side of the message, followed by a message on the right.

Click on a message to open the Message dialogue and see the full body of the message.

Time Toolbar

The time toolbar is located at the bottom left hand side of the screen.

The Teletype section of the Time Toolbar shows the current date, time and acceleration rate of the game. Click in the teletype area to display the clock. The control icons below the teletype section determine the flow of the campaign:

- **Game Speed Icon**

This opens the Time Control dialogue box.

- **Pause Icon**

The pause icon pauses the game. To resume a paused game you must click on the Play Icon or Accel Icon (described below)

- **Play Icon**

The play icon plays the game in real time, where one game second takes
one real second (this is the default setting).

- **Accel Icon**

The game will run at the accelerated rate determined by the settings in the Time Control dialogue. The accelerated time can range from x0, when the game is paused, through xl, which indicates that the game is running in real-time, to x600.

Section Three
Luftwaffe Tutorial Campaign

Command Briefing

- You are in command of Luftwaffe 2 and 3 in northern Europe. In preparation for the forthcoming invasion of England, an operation codenamed Sea Lion, you will engage RAF Fighter Command and achieve air supremacy over the skies of south east England.
- In early July 1940 you have 3 Geschwader, totalling about 300 aircraft under your command. Over the next few weeks this will rise to 24 Geschwader. All told, you will have over 2000 aircraft under your command. You are limited to scheduling missions for a maximum of 90 staffeln at any one time.
- In pursuit of your campaign objectives, you will plan missions on the map display.
- The full range of Mission Types can be designed. You can either design a mission personally or just set the overall parameters and let your staff complete the details by using 'directives'.

You are also cleared to fly missions in Messerschmitt 109, Messerschmitt 110 and Junkers 87D 'Stuka' aircraft. In addition you can act as gunner in any of the three medium bombers: Junkers 88. Dornier 17 and Heinkel 111.

Overview and Luftwaffe Organisation

It is estimated that the RAF are left with about 50 fighter squadrons after their losses in France earlier in the year. The British also have limited production capacity. At this stage there is no firm intelligence on the major aircraft production locations.

Most of the RAF's fighter squadrons are assigned Hurricanes. Some squadrons do have the more modern Spitfires. Both fighters are inferior to our Me109, however the

Spitfire does seem to have the advantage over the Me110 You should develop a strategy so that the RAF can be attacked in the air and on the ground.

The Luftwaffe organisation bears no resemblance to that used by the RAF. Two of the Luftwaffe's three Luftflotten are involved in the battle. The headquarters of Luftflotte 2 is in Brussels, while Luftflotte 3 are headquartered in Paris. Each Luftflotte consists of a number of Geschwader. A Geschwader is a unit of about one hundred aircraft all of the same type. Each Geschwader consists of up to 3 Gruppen and each Gruppe is made up of up to three Staffeln. A complete fighter Staffel will have three Schwarme of four aircraft each. Bombers normally fly in Kette of threes in a Vic formation.

Our understanding of the state of British intelligence is as follows. The RAF have built radio masts on the English coast. Their purpose is unclear, however there is a strong likelihood that they form some sort of aircraft detection system. The RAF seem able to intercept raids successfully. However there has yet to be a significant test of their capabilities. It seems likely that the RAF fighters are under some kind of Ground Control System that relies on the information provided by the radio masts. Experience shows that this is a difficult and inflexible method of operation and so there is some merit in leaving the radio masts intact. This will mean that the RAF will continue to attempt to use their system even when they are overwhelmed by superior forces.

Part 1
Using Directives

Overview

Each day is split into three time periods - morning, midday and afternoon. You are given the chance to make major strategic decisions at the start of each period. As the Luftwaffe Commander, you hold the initiative. The RAF must react to the raids that you will be making over the south of Britain. Once your own Luftwaffe raids have left the ground you cannot issue any more direct orders to them. You can only watch the progress of raids on the map and, if you wish, choose when to take a place in a cockpit, to take a more active role.

So that the process of ordering raids is not too complex, a mission directives dialogue box is displayed at the start of each time period. Directives automatically generate missions based on a broad set of instructions from you. Once you have configured the directives to reflect your broad strategic plans, complex raids will be generated without requiring much more interaction from you.

Setting Directives

From the main menu screen, choose the Campaign option, and request a campaign as a Luftwaffe Commander during the Eagle Attack' phase of the battle. As you first enter the campaign screen you will see the directives dialogue box. The help screen for directives, accessed by clicking on the question mark at the top of the dialogue box, is available for all screens displayed during the campaign.

The time is 6:30 a.m. on the morning of August 12, 1940. A certain number of aircraft are available to you, representing an accurate reflection of the resources available to Luftflotte 2 and 3 at this stage of the war. The losses and damage sustained by your aircraft during the campaign, combined with the rate of Luftwaffe aircraft production, will determine how the number of available aircraft varies as the days progress.

A gruppe can fly one mission per day You can reserve a percentage of your gruppen for missions in a specific period. At this point, say we wish to increase the number of gruppen available for raids in this first morning period. Click the down arrow in the Bomber Allocation Mid-day box until it is zeroed. Increase the allmation for the morning period so that it reads 60%, and set the Ju87 setting to 'maintain %'.

The section that dominates most of the directives dialogue is used for aircraft allocation. It shows how many gruppen are being directed to attack British targets of a certain type. Some default entries have already been made at the start of this time period. Let's start afresh, by hitting the 'REST ALL' button at the lower right of the screen in order to zero all aircraft entries against targets. We wish to send our Ju87 Stukas to attack Radar (RDF) targets. Find the aircraft allocation cell for Ju 87s and RDF targets. Click the up arrow until 5 Stukas are assigned. 5 gruppen of Ju87 have now been made available for missions against RDF targets. Note the way in which Luftwaffe ainraft are organised - one gruppen generdy represents 36fighters. or between 27 and 45 bombers.

These vulnerable Ju87 dive-bombers will need some escort. Follow the RDF row along to the Me109 column. Assign 5 gruppen of Mel09's by clicking the up arrow five times. We want the Mel09's to escort the Stukas closely Follow the RDF row along to the % Tied field and increase it to 100%. All escort fighters will now fly in close formation with the bombers. It is worth pointing out that the % Free slot lets you specify how much of the escorting force will be flying detached escort – this means they will be flying the same route as the bombers but will be flying ahead, behind or above them by some distance. If these two fields do not add up to 100% then the difference is used for Return escort -these fighters will meet up with the bombers as they return from the target area. (If you wish, you may also determine how these escorts fly relative to the bombers by altering the 'Attached Escort' section further above in the directives dialog.)

Click on the Tick on the top right of the box to confirm the campaign orders that you have given. You are now shown a list of proposed missions generated from your directives. Targets have been automatically chosen based on priority, and gruppen assigned according to availability. More Missions can still be added to this list (and, of course, missions can be changed or deleted). Hit the cross at the right of the proposed missions dialogue box to go back to the directives set up.

Let's assign some of our twin-engined medium bombers to attack airfield targets. On the airfield target row choose 4 He 111 bomber gruppen. Also, assign 3 Me109 and 1 Me110 fighter gruppen as escort, on the same line. We can make half of the fighters fly in close, attached, escort while the rest are detached. In the % tied box set the allocation to 50%. The strafe box should be ticked, which means that fighters will strafe the target if the opportunity presents itself. On each row to the right of the bomber allocation cells you will find the 'size per target' field. This determines how many aircraft will form each separate mission. This in turn affects how many raids will be launched. Since airfields are large area targets we will send 2 gruppen to each target by setting the size field to 2 gruppen.
(RDF and convoy targets can often be dealt with using smaller sized raids.) You will notice that the 'Missions' column - the number of raid missions that are being proposed - has dropped from 4 to 2. Two raids will be launched against airfields with these directives. The two Heinkel

bomber raids will be flying separately to different targets. We can force them to fly together as one raid that will split as it nears the target area. This is a useful tactic for confusing the British defence network. On the airfield line, increase the 'Secondary' target field from 0 to 1. This means there will be one additional target for each raid. Notice that the number of missions has now dropped to 1. So, with these directives, a raid of 4 He 111 gruppen will be launched, and it will split in half near the target area so that two separate airfield targets can be attacked. The automatically chosen targets are likely to be geographically close since the '2nd' target option is chosen. Click on the tick button at the top of the directives screen to see the new set of proposed missions. The first raid has 120 bombers, escorted by 144 fighters, involved in a raid on two separate targets. Click on the tick at the top of the proposed missions box to confirm these missions.

Part 2
Following Raids from the Campaign Map

Overview

You are now looking at the campaign map screen. Click on the pause button near the bottom left hand side of the screen, so that we can take our time to understand how everything is laid out. When time is progressing normally you will see the markers representing your raids move across the map. You will receive warnings when most vital events occur.
The campaign map screen is divided into a number of areas:

1. The campaign map, in the upper left, dominates the display – showing southern Britain and northern France. The map is scrollable (use the scroll bars; or click, hold and move with your mouse) and scaleable (click and hold on the scale on the right hand side, or use your mouse wheel, if you have one). Using map filters you can determine how much information is displayed on this screen. At this stage you will see that your directives have already generated a lot of information!
2. The main toolbar is on the lower right of the screen.
It displays 8 'folder' icons (9 in the case of the RAF) that relate to all of the relevant campaign specific information you can display and the commands that you can make.

3. Above the main toolbar is the map toolbar The icons on the map toolbar allow you to modify **all** aspects of your map display There is also a game save facility under a 'Wind icon on the map toolbar.

4. On the lower left of the display is the time toolbar, displaying the campaign time and game play speed controls.

5. Above the time toolbar is the teletype area, where important Command centre messages are displayed as they are received.

6. At the top right of the screen there are three overall display controls. Including a quit icon that allows you to quit the campaign and return to the main menu of the game.

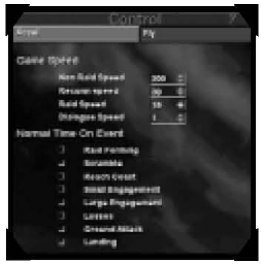
The Map

In the area of northern France on the campaign map you will see a number of tall boxes with yellow, red and blue horizontal bands. These 'tokens' represent the raids that you have generated from the directives screen. These P tokens were actually part of the RAF plotting system during the war, and were used to keep track of known Luftwaffe raids. We have adopted it for use by the Luftwaffe itself in this simulation, so that Luftwaffe raids are always displayed in a consistent fashion, whichever side you choose to play on.

The top, yellow bar shows the raid ID number, using ROO1 for the first Luftwaffe raid of the day The red band shows the number of aircraft involved in the raid. The bottom blue band shows the altitude of the group in thousands of feet or metres (depending on the default system of units chosen). A raid marker only shows the position of the aircrafl forming the head of the raid, which in a mixed mission would be the main bombers. It does not show the escort aircraft, as they move from their airfields (often different to the bomber airfields) to form up with the main raid. Later, we will learn how to use a modern plotting system to track all aircraft in a raid

Managing Time and Warning Messages

Look at the time toolbar panel, showing the date and time, at the bottom left of the screen. The two buttons on the right hand side of this toolbar set the simulation to play either on 'normal' time (where one second of game play is one campaign second), or 'accelerated' time (where one second of game play is a larger number of campaign seconds). Click on the leftmost 'game speed' button to display the game speed 'control' box. This dialogue allows the accelerated time button to be configured and also allows the setting of preferences for when warning messages are displayed during a mission.



The first bank of four options at the top of the game speed control box configures the accelerated speed for different campaign situations. Note, for instance, that the default 'non-raid' speed is *300*. This means that if you run the game in 'accelerated' play, then for every second you are watching the simulation there will be five minutes of campaign time, so long as you are in 'non raid' mode. The game runs in 'raid' mode once any active Luftwaffe raid is detected by British Radar or by the Observer Corps.

Configure the 'Normal rime' feature on the lower part of t h s box by ticking the boxes for small and large engagements. This setting means that accelerated time will be slowed down to normal time when any form of engagement arises. Select the 'Fly' tag at the top of the box and ensure that 'offer take-over on event' tick boxes are selected under the 'All' column in the engagement and ground attack rows. These settings determine when during the campaign you will be offered a chance to fly. All tick boxes should be de-selected if you simply wish to follow the entire campaign from the perspective of the Commander. Close the dialogue by clicking the tick in the top right corner.

Now, it's time to get the raids we have created under way. Hit the accelerate button. You will see that time accelerates rapidly while the elements involved in the raid takeoff and form up. Once a raid has formed and is en route to England it will be picked up at some point by the British Radar net and the game speed will drop to fifteen times normal speed.
The raid tokens, representing each raid, move along the route of the main raid group and will eventually either be intercepted by the RAF or will reach their target.

Understanding and Acting Upon Warning Messages

A warning dialogue will be displayed at the start of any engagement, offering you the opportunity to ‘takeover’. This means you can get into a cockpit of an assigned aircraft in the engagement and fly this part of the mission. We will do that later! At the moment - pause the game by hitting the pause button on the time toolbar panel. Hit cancel on the takeover dialogue to decline the chance to fly. You will see your last *3* messages on the teletype screen below the map. Click on the teletype and the full log will appear. Examine the most recent transmissions carefully to understand what has been happening. Close down the message box when you are completed.

The Mission Folder

You will find the mission folder icon within the main toolbar at the bottom right of the campaign screen. Click on the icon to open the folder. The mission folder shows a full breakdown of the five raids that were generated from your initial directives.

Look at the first raid - R001. There are three lines associated with this Heinkel bombing raid. The first line shows the information about the Heinkel bombers carrying out the strike, including take off time, expected time over the target POT) and the name of the target. The status field lets you know how the raid is organised at this moment. For instance. 'farming' means that the raid has yet to pull its separate elements together and set out to the target area. ‘Target Area' means that the raid is within range of the target or actually carrying out an attack. The RAF field shows you how many British fighters are currently engaging the raid (if any) and the tally shows the current number of kills against the RAF by the raid as a positive number and the number of losses as a negative number.

The two lines below the level bomb description of the Heinkels shows the information for the attached and detached Messerschmitt escort sorties that protect the bombers. Use the scrollbars to view all of the elements of the missions in progress. The buttons at the bottom of the mission folder allow you to re-task and alter the routing of any raid, so long as it is not in progress. We will approach those topics later on. Click on the tick box at top right of the dialogue when you are ready to proceed.

Note that you can also access the mission folder at any time by clicking on any of the raid tokens on the campaign map. The mission folder will be displayed with the appropriate raid marked in red.

Now, hit the accelerated time button and hit cancel on each takeover warning message that appears. Watch the raids as they move to the targets, attack and then turn back. You will see that some new tokens appear on the campaign map during these raids. These are RAF tokens, which signify individual RAF patrols which will have been launched in response to your raids. They are displayed with white and blue bands. When your raids have landed the period will continue until it ends and the directives dialogue will appear again for the midday period. We previously reallocated all the aircraft from the midday period to the morning, so we have no aircraft available at this time. This is not quite as alarming as it sounds. While the RAF are given a break, it also allows the Luftwaffe time to regroup and gain some rest. And we will take a look at how to debrief the missions we sent out in the morning.

Summing Up After One Period of Raids

Hit the pause button and close the directives box. Open the mission folder. The raids from the morning period are still listed. Note that the status for most of them will be set to 'complete', which means that they have returned and landed. Highlight the line for the first raid ROO1 Hit the 'Gruppe' button (at the bottom right of the box) to see details of the lead bomber gruppen that made up this raid. The Gruppe dialogue is split into three panels. Each panel contains details about one gruppe Three gruppen make up one Geschwader.

To see how the selected gruppe performed during the raid, access the gruppe's mission diary by clicking the 'Details' button at the lower right of the geschwader box. In the gruppe diary box, if you click on 'view single', then you will get a very detailed breakdown of the raid debriefing. All of the other gruppen involved in the same raid can be accessed from this screen. Look at the target and result field to see if the raid managed to reach the target and inflict any damage on it. Also look at the Enemy Losses to see how many RAF fighters intercepted the raid and how many of those fighters were knocked out by the gruppe. Close down all gruppe and mission folder windows, and go into accelerated time until the end of the mid-day period. Since no Luftwaffe aircraft are set to fly there is no significant action at all during this time. When the next time period (afternoon) starts, the directives box is displayed once more. Pause the time button at this stage.

Part 3
Authorising and Editing Raids

The directives tool is very efficient for quickly setting up missions using numbers and types of aircraft that you prefer. The targets that are automatically assigned for each type of target are taken from a list ordered by priority. Relative priority is determined by a number of things; for instance the target's perceived value to the opposition - fighter command - as well as the amount of damage already sustained by the target are important.

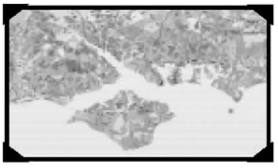
For this reason, in this stage of the war for example, British airfields that house bombers are less important to the Luftwaffe than airfields servicing fighters. You may decide that targets might be best approached in an order different to the one generated automatically by a directive set. In this section we will learn how to authorise our own individual missions and learn how to alter the details of those raids.

First, we should start with a clean slate. Click on the 'REST ALL' button and click on the tick at the top right corner to dose the directives box with no proposed missions. Go forward to close the proposed missions box. All available aircraft are now ready for us to allocate manually

The Target List

Click on the target list button - which is second from the right on the lower main toolbar. The target list displays every possible British target on a number of pages. Each page has a list of targets for one distinct target type according to the selection of the 'tab' at the top of the box. The list is ordered by absolute priority to the Luftwaffe war effort.

Find Gosport airfield and click on its entry in the box. To get more information about this target click on the 'details' button at the bottom of the dialogue box. This opens a 'target dossier' with the heading Gosport AF. Click on 'centre' to centre the airfield on your campaign map and click on 'zoom' three or four times. Your map will be centred on Gosport airfield. Targets appear as round icons on the map. Different colour icons are displayed for different target types. Airfields are green. If you cannot see any airfields being displayed on your map, find and select the map filter icon on the map toolbar. Click on the 'airfields' tick box, making sure that the box is checked before leaving the map filter dialogue box. The exact location of the Gosport airfield should now be identified on the campaign map by its icon. If a target suffers damage, then a red outline is displayed around the icon. A red cross on the icon means that the target is considered to be destroyed and non-operational. Select any target icon on the campaign map to bring up its information dossier.



Currently we have very little information in the dossier for this target. Its status is unknown and we have no idea how much damage it has sustained (we haven't flown a raid against it yet so it's safe to assume it is undamaged). The available intelligence is restricted because we are playing the campaign with the same handicaps as the Germans at that time. There is an option on the Mission Page of the Sim Config menu for Luftwaffe Intell (igence). It is possible to change this from 'Historic' to 'Accurate' and have constant up to date and accurate intelligence for all the targets. This makes the campaign a lot easier when playing as the Luftwaffe and very difficult when taking the role of the RAF commander. For the moment, let's stay with the default 'Historic' setting.

The information in the dossier will be updated after you have raided the target. This information comes from the Bomber crews who watch their bombs fall on the target. You will find that their information is often biased. From the bomber's viewpoint the damage can seem quite spectacular but on the ground it is a different story. The bombs may be hitting buildings or areas that have no real value, or the damage they cause is quickly repaired. The damage report in the dossier quickly becomes out of date. To get an accurate and up to date report you must periodically dispatch reconnaissance aircraft to the target. Reconnaissance aircraft take detailed photographs of the target (the photo option becomes available) which are analysed by skilled intelligence officers. They will give a more accurate assessment of the damage to a target. They will note any aircraft types in residence at a field and update their classification of the field correspondingly -Airfields that were part of Bomber or Coastal command that played no real part in the battle were commonly mistaken for fighter command stations. These mistakes can be recognised through the use of reconnaissance. Such aircraft are mainly deployed against airfields and radar sites. You can request a reconnaissance mission against a target by clicking the 'Reconn' button on a target dossier or by using the automatic feature on the directives dialog.

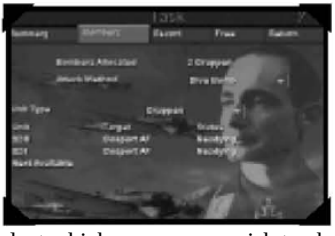
Authorising a Mission

Say we want to create a mission against Gosport Airfield as a target. Select the 'authorise' button at the lower right of the target dossier. In turn, the mission folder is now displayed. Scroll down to the latest mission to be assigned, at the bottom of the mission list. A new raid will have been added to the list, with Gosport AF as a target. It has been set up using a standard mission profile. Let's now take a closer look at how this raid is put together.

Editing the Task

Select the first line of the new raid (it will have a bombing mission type) and click on the 'task' button at the bottom of the mission folder. The task dialogue is split into five separate pages that afford you great flexibility in altering the profile of this new raid. The 'summary' page gives you an overview of aircraft types and numbers that have been assigned, and allows you to make sweeping changes to those broad parameters if you wish to.

Click on the 'bombers' tag to set up the major attack force. By default, one staffel of bombers is assigned and on the bottom list you will see the name of the assigned bomber unit. Click on the 'next available' unit twice and you will see the number of allocated bombers increase from one staffeln to two guppen. Automatically the computer tries to assign gruppen from the same Geschwader, but if it cannot then the unit dialogue box comes up and you can manually select which gruppe you wish to choose.



You can change a unit you have already added by clicking on the unit name. The unit select dialogue will be displayed, and you may select a new unit. You can also change the target for a unit by clicking the on the target name. The easiest way to choose a new target is to select a target icon on the main campaign map. Since the gruppen all make up the same main raid, any new targets will be secondary ones, and the raid will split up after it has formed. Close the task box and return to the mission folder. Note that once a raid has taken off further task editing cannot be performed.

Editing the Route

With the original raid leader unit highlighted in the mission folder, select the 'route' button on the bottom of the box to display all of the 'waypoints' on the route. Waypoints are the significant map locations where important mission events and direction changes occur - ranging from take off to the entry into the target area. It is possible, through this screen, to insert new waypoints. The major waypoints cannot, however, be edited. Full details of the meaning of waypoints are described

in the help file in the route dialogue box. If you look at the map screen you will see that the route of your selected bomber group has been highlighted in white. Waypoints are displayed as rings.

Map Filtering

It was mentioned earlier that raid tokens on the campaign map are a representation of those used by the RAF during the Battle of Britain. We have a modern alternative that allows you to see more detail - more detail than would have been possible at the time.

Click the 'map filters' icon on the map toolbar, and select the 'aircraft' tab. You will observe that 'authentic plots' are currently selected. Tick the option for 'one icon per Gruppe'. A small icon will appear on the map for every Luftwaffe staffeln that is in the air. You will need to zoom in very close to distinguish the individual staffeln flying in gruppen formation. Extra information about each icon is displayed as a hint when the mouse is rested over it. You will see the possible complexity of a campaign map with this level of detail.

Part 4
Flying

Now, click on the accelerate button. As the campaign progresses you will eventually be given a 'takeover' warning message when the RAF intercepts one of your missions or a ground attack has started. Click on the 'fly' button. Control will now move to the 'frag' screen, where you can select your aircraft from the raid that has been intercepted. It is also worth noting that it is possible to fly any aircraft from any raid that is in your mission folder at any time. Simply select the raid component of interest in the mission folder and click on the 'frag' button on the lower left of the screen.

The frag screen displays every gruppe involved in the chosen raid. Choose which unit you wish to join by selecting its name from the list at the top left of the screen. The flight configuration of the unit is graphically displayed on the lower part of the screen. You will note that fighter gruppen are organised into three 'schwarmes' of four aircraft. The name of each schwarme

leader, and the call signs of the other pilots, are identified. The actual formation of each schwarme is displayed (according to the assigned configuration in the task dialog). Bomber gruppen are generally formed from three ketten, comprising three bombers each. To assign yourself to a particular aircraft, simply select one from the list. You will note that your name replaces the name or call sign of the pilot that was there. You may make last minute alterations to the flying configuration of the simulation by selecting the 'Sim Config' option at the bottom of the screen. See Chapter 2 Section 3 for more details. And, of course, you can click 'Back' to return to the campaign. Select fly to get into your cockpit! (If you have selected a Kampsgeshwader medium bomber squadron, though, you will be sitting in the gunner's position during the flight.)
When you enter the 3D you should get straight into the action. If you drift away and are not under immediate threat then hit the TAB key to enter four times normal acceleration. The auto pilot system will take over and guide you to the area where you should be.
When you decide to stop flying, hit Alt 'X to return to the map and select the time Pause button. All plots on the map will have moved since you entered the 3d. At this point you could accelerate time again and choose to fly in any other situations that arise, but for the moment let us review our progress in the campaign.

Part 5
Reviews

Open the review dialogue by clicking the review icon on the main tool bar. This dialogue shows you a breakdown of Luftwaffe and RAF aircraft strengths and RAF target statistics (the same dialogue is available when playing as the RAF but from the RAFs viewpoint). The dialogue is broken down into pages. The strength and aircraft pages let you see how your crews are performing and show the current losses and replacements of your aircraft. The targets page is very important as it shows you how your attacks against target types are fairing. The claims page shows a breakdown of kills against the RAF and the enemy page shows an estimation of the current number of RAF fighters based on losses and manufacturing intelligence. Be aware that any numbers relating to claims against the RAE aircraft availability and manufacturing rates are estimates and may vary wildly in accuracy!

Managing Resources

This is not so much of an issue for the Luftwaffe as their manufacturing facilities are not under direct threat. However, it can become a problem if your aircraft are shot down in large numbers. You have the following dialogs accessed from the main tool bar to manage and view your resources

- **Aircraft Allocation**

This shows the current manufacturing output and which units are the next to be replenished.

- **Luftwaffe Resources**

Each page lists the number of aircraft in each Gruppe of each Geschwader. If the number of aircraft in a Gruppe is bracketed then that Gruppe is not available for duty in this period, either because it is already flying or has flown a mission, or because it is resting due to losses. This will have an impact on the number of raids generated by directives.

- **Geschwader list**

This lists Gruppen in detail according to the options you have chosen, for example listing by Geschwader type or Category.

Day End Review

Each 'day' ends at 22:OO hrs. The day end review screen will appear listing news items from each day. The news will usually be general assessments of progress so far and updates on the proposed invasion date.

Section 4
RAF Campaign Tutorial

Command Briefing

- You lead RAF Fighter Command charged with the duty of defending the air space over the United Kingdom. Specifically you must defend your country from the invasion force building up on the continent of Europe You must ensure that Fighter Command remains an effective force throughout the summer until mid September 1940 when bad weather begins to eliminate the risk of invasion.
- You have 53 fighter squadrons at your disposal: 34 have Hurricanes and the rest are equipped with Spitfires. All told, there are over 600 aircraft in your command. You are limited to scheduling missions for a maximum of 32 squadrons at any one time.
- In pursuit of your campaign objectives, you will respond to threats as they appear on the map display. This map shows the result of collating intelligence about enemy movements from various sources including the RDF and ROC.
- It is possible to define both patrol and intercept missions. Patrols can be redirected to threats when they are in the air. You can either design a mission from scratch personally or just set the overall parameters and let your staff complete the details using 'directives'. (In the following section we will generally call all missions patrols, for brevity.)
- You are cleared to fly missions in Spitfire and Hurricane fighters

Overview and RAF Organisation

Your role as an RAF Commander is quite different from that of a Luftwaffe Commander. The RAF is on the defensive. You must react to incoming raids by scrambling fighters, yet always holding enough in reserve so that you have cover when you most need it. Unlike the Luftwaffe, the RAF plans few missions at the start of each time period throughout the day, other than standing patrols over convoys or other vulnerable assets. You'll scramble squadrons as and when you feel it necessary throughout the day.

It is expected that during the course of summer 1940 the Luftwaffe will be able to allocate up to 2000 aircraft to prepare for the invasion of England. They have

codenamed the operation 'Sea Lion'. Initially you can expect to be confronted by Junkers 87D Stuka dive-bombers and the formidable twin-engine Me110 fighter. Later in the campaign you will encounter heavier bombers like the Dornier 17, Heinkel 111 and Junkers 88. The single engine Me109 will act as escort to the bomber formations.

It is vital that you don't damage the integrity of Fighter Command by over committing your forces. Obviously it makes sense to respond to threats against Fighter Command assets. On the other hand, defence of other assets should be limited to the minimum that is deemed to be politically acceptable. Fighter Command consists of four Groups: 10, 11, 12 and 13. Each group is assigned a geographical area rather than a specific set of squadrons. Squadrons can move from group to group to fulfil the objectives of Fighter Command. Although a squadron can have more pilots and aircraft assigned to it, a complete squadron in the air consists of twelve aircraft. You have 53 fighter squadrons at your disposal: 34 Hurricane and the rest are Spitfires. All told, there are over 600 aircraft in your command. 11 Group covers the south-east of England and so it is in the front line. 12 Group is in central England and 10 Group is to the south-west. Both these groups are actively involved in the Battle. 13 Group is stationed in the north of England. Squadrons in 13 Group do not take part in the Battle; they use the time in the north to recuperate. 10, 11 and 12 Groups are further divided into sectors, which are again based on a geographical area. Each sector has its own control room at an airfield in the sector from where ground controllers 'vector' RAF fighters to their intercepts. Most of the intelligence about enemy movements is gathered by either Radio Direction Finding (RDF) methods or the Royal Observer Corps (ROC). RDF methods are now universally referred to as Radar. Fighter Commands had two coastal systems in operation during the Battle of Britain. The Chain Home (CH) system was capable of detecting aircraft at a distance of up to about 150 kilometres (90 miles), but this reduced by about 30% for an aircraft at 15,000 ft. The Chain Home Low system was developed to overcome this limitation. This type of radar had a range of about 30 kilometres (20 miles) at low altitude. Neither system could be used to track aircraft once they had passed by the system and flown inland. The job of detecting aircraft over England fell to the Royal Observer Corps. Groups of two or three people were stationed all over the south east of England and they reported all aircraft movements to a central station. This system worked remarkably well – however heavy cloud did have a large effect on its effectiveness. All the information generated passed through a filtering stage so that the information presented on the map was consistent and as error free as possible. This is the information that you will see presented on your campaign map.

RAF Directives

Note that to avoid repetition, many of the topics covered in the Luftwaffe campaign in Section Three above are assumed when discussing the RAF campaign. From the main menu screen, choose the Campaign option, and request a campaign as the RAF Commander during the 'Eagle Attack' phase of the battle. At the start of the morning time period on August 12th 1940 you are presented with a directives dialogue box. You'll notice that it is substantially different from the Luftwaffe directives dialog. It is more concerned with defining how missions will be launched later if the situation and need arises, rather than specifying missions to launch immediately. The Luftwaffe will be leaning towards raids into mainland England at the start of this 'Eagle Attack' phase. Radar installations, coastal airfields and docks will be their preferred targets.

Setting up Patrols

In the 11 Group Squadron section there is a Holes in Radar' setting. This setting allows you to set aside a number of squadrons to patrol those areas in the coastal radar net that are not covered. If all of the Radar sites are working correctly then there are no holes in the coverage. One squadron will cover each hole in the net. Hit the tick to confirm your directives. The 'Proposed Patrols' dialogue is displayed, showing the patrols that are planned. Click on the tick box to get started.

RAF Response Markers

The battle is now under way. You will see your patrols represented on the map as one token for each squadron. These are representations of the tokens used by the RAF during the war. The top white bar shows the number of aircraft in the patrol, and the blue bar at the bottom shows the current altitude on thousands of feet or metres - depending on the default units setting. The square lollipop' above the top of the token displays the squadron number. There can be more than one lollipop above a p patrol, as more squadrons are added. If you click on an RAF token the mission folder will be displayed and the proposed route to be taken by the patrol will be highlighted on the campaign map. Around lollypop indicates that only part of a squadron has been launched. The colour and number of lolipops correspond to the call signs of the sections. If you wish to see more closely where a squadron that has been scheduled for patrol is located, then highlight one of the patrols listed in the mission folder and click on

the 'squadron' button at the lower right corner. The squadron details are displayed as part of the airfield dialogue relating to where the squadron is located. Select the 'general' tab for the airfield at the top of the airfield dialog, and click on the 'centre' button at the bottom. The airfield will now be centred on your map display - and you can zoom in to see its precise location.

Authorising Scrambles

As the day progresses, the Radar net (assuming it has not been knocked out) will detect a build-up of Luftwaffe raids over France. Sometimes the raids will be detected late as they cross the channel into southern England. As soon on as a raid is detected you will be asked whether you wish to set up an intercept patrol. Select the 'Ok' button, and a scramble response mission will be automatically generated as soon as possible - usually within a few minutes. The Task button will 1 do the same thing but opens the relevant dialogue to edit the mission before it leaves the ground We will learn more about t h s later.

There are also occasions when you will be asked if you wish to take over control of aircraft in intercept situations. At this stage you should decline the offer.

Mission Folder

Open the mission folder on the main toolbar. Each line shows the details of an RAF patrol mission. The order number is a unique identifier for today's missions, starting with FOOl identifying the first RAF patrol of the day. The squadron column displays the relevant squadron number and, in brackets, the number of aircraft from that squadron involved in the mission. The status field shows the current state of action of the squadron. If the status shows 'At 30 mins', then the squadron is at a low state of readiness, prepared for takeoff in thirty minutes. Some squadrons will be 'forming' after takeoff - in other words still manoeuvring into their patrol configuration. If the objective is a place name, then the squadron's mission will be to patrol that asset or area. If the objective is a four character identifier, then the objective is a Luftwaffe raid. In the case of a raid, its currently known size and status are displayed along with the raid's target and status if it has been confirmed. Luftwaffe raids have an H prefix, and the three digit identifier gives the order of Luftwaffs raid detected during that hour of the day For example, the third raid detected after 7:00

Altering Mission Profiles

Missions that have yet to take off can be re-'tasked' by selecting the task button at the lower part of the mission folder. Re-tasking allows you to alter the numbers of aircraft in a mission, the squadrons they come from, the location of the targets, as well as the fine details of fighter attack methods. It's a very precise tool. As an example, in the task dialog, find a squadron under either the Hurricane or Spitfire tab that represents part of the unit involved in the mission. Click on the name of the target for that squadron, and you will be offered to select a target on the main campaign map. If you click on any British asset or Luftwaffe raid displayed on the map it will become the new chosen location for the highlighted patrol. Obviously the first type of mission will be an area patrol and the second an Intercept against a raid. Select the tick at the top of the task box to approve the new target. Once a mission has taken off, however, it can only be 'revectored', or ordered to return to base 'RTB'. Revectoring a mission in flight allows you to alter the target. The easiest way to do this is to select a new target on the campaign map. A target can be any Luftwaffe raid. Patrols over radar will be automatically vectored against any threats that come close to the radar site. Patrols over other assets will only automatically vector to defend their asset. As a player you may decide that it is quicker to revector a patrol to a raid than it is to scramble an intercept from the ground.

Routes

You will find that the dialogs and controls relating to route management are very similar to the Luftwaffe but there are some differences. A special 'estimated location' waypoint marker is displayed on the map route for missions assigned to intercept an incoming raid. This shows the location where the interception is expected to take place given the raid's current course.

Tracking Raids

As the campaign progresses and more raids are launched you will be put under increasing pressure. You must develop a strategic and tactical picture based on the events developing before you. There are different tools available to aid you in keeping track of the enemy raids:

1. **Watch the map.**
Always keep your eye on the campaign map. Raid icons, once raids are on the move, have large arrows next to them showing the last reported heading of the raid.

2. Use the intelligence teletype.
This provides the nerve centre for all intelligence information. After a time, the campaign map can become cluttered with Raid and RAF response markers. There's always the danger that as Commander you will lose track of a raid or underestimate the threat it poses.

3. Use the Hostiles List.
The hostiles list is a modern tool (unavailable in the 1940s) that helps you keep track of all raids and responses. Open the 'hostiles list' dialogue by clicking either on a raid token on the map or on the hostiles list icon at the left of the main toolbar.

The hostiles table lists all of the Luftwaffe raids that have been detected. Each line shows the current information that has been gathered about the raid. The columns at the end of each line display the number of RAF aircraft currently flying out to intercept the raid, the number currently in combat, the number returning to base and a running tally of losses for each side. Obviously a major raid with no planned response is potentially a very serious threat. This list is very useful as it lets us see an overview of all the raids and therefore make sure that they all have adequate responses. Raids that are inbound or in the target area pose more of a threat to your assets than those that have dropped their bombs and are going home. Click on a raid and you can automatically 'authorize' an appropriate response to the raid. The fine details of the authorised response can be tuned in the mission folder, which is why the mission folder is displayed once the 'authorize' button is selected.

Debriefing Sorties

Once a squadron has returned to its home airfield, details of its sortie become available. Highlight the squadron in the mission folder and select the squadron button at the bottom right to display the squadron dialog. Click on the 'details' button to display the squadron diary and full details about the sortie just completed.

End of a Period

At the end of the morning period the directives dialogue will be displayed for the midday session. Pause the game briefly, so that you can review the outcome of the morning's action. Select the 'review' icon on the main toolbar. The review box contains all of the details about your current airforce strength. The aircraft tab displays the numbers of damaged

and destroyed aircraft, and the assets list will show the accumulated damage to all major asset types. A glance at the most recent teletype output will also help you to keep track of the recent key events. You will need to use the information you have gained to help plan your strategy for the next session. At the end of each day of the campaign - after the third period of the day – there will be a summary of important events and some video footage.

Then it is on to the next day Occasionally you will notice that you'll be offered to skip a particular session because of foul weather.
Normally, you should do so. In bad weather it is unlikely that there will be enemy action, and you need to conserve your resources and gain some rest.

Detecting and Intercepting Raids

It is possible for raids to slip through the radar net, avoid detection or confuse controllers if:

- The radar picture is confused due to too many overlapping raids.
- A raid comes in at low level.
- The raid consists of few aircraft.
- Cloud cover obscures the raid from the Royal Observer Corp who then have to rely on sound location equipment.
- The raid splits in the target area
- The raid uses a dogleg and does not reveal its intended target until the last possible moment.

Managing RAF Resources

If you select the 'resource' icon in the main toolbar, you'll bring up the RAF resources display box. This displays ALL of the aircraft available to the RAF according to group - the major organising principle of RAF fighter command. Each group is divided into a number of geographical sectors, and you will see that the RAF resource list for each group is divided by sector. Each sector's squadrons are controlled from one sector control station, which is listed at the start of each row. If you look at the map of England at lower levels of zoom you will notice that the map is divided into the individual sectors, identified by a different sector letter. These are the sectors referred to in the resources listing. You can also identify the extent of the four major RAF groups, divided by solid black lines at the lowest zoom level on the campaign map.

During the battle, if the buildings housing your sector operations are knocked out then all airfields in that sector are affected until new operations can be established at a new location.

The Importance of Squadron Readiness

There are various readiness states that a squadron can be at which determine how quickly the squadron can get off the ground (if at all) once they receive an order to scramble. The states are described below:

- **Released:**

  The squadron has been released from duty for this period and is not expected to fly. The pilots will be resting and recuperating. While released, the squadron's morale will slowly increase, which will increase the squadron's category after a while.

- **At 30** mins:

  The squadron is ready to be called on to fly during this period. It will take 30 minutes to prep the aircraft when the order to scramble comes. It is still quite stressful for the pilots waiting for the call to arrive at any moment.

- **At 5** mins:

  The aircraft are fueled, armed and lined up with the pilots nearby. On the scramble order, it will take 5 mins for the pilots to get into the cockpits, start their engines and get away.

- **At 2** mins:

  The pilots will be sat in their cockpits with the engines running. You must be careful not to leave a squadron 'at 2 mins' for a great length of time as it uses valuable fuel and will tire the pilots.

Changing the state of readiness can have a major impact on the effectiveness of your fighters but you must ensure you do it in the right circumstances. For example, squadrons based to the North of London which are tasked with protecting the capital would be best kept at 30 mins or even released if the Luftwafffe are busy attacking targets along the Southern coast. Conversely, when London is being blitzed, those same squadrons should be kept at '5 mins'. You can see the current readiness state of a squadron by viewing the squadron page of an airfield dialog. You can then request a new readiness state using the relevant control. The change will take time, so moving from 'At 30 mins' to 'At 5 mins' will take 25 mins When you make the change it will say 'to 5 mins' to warn you of the transition. Requests to squadrons that are 'released' will not take effect until the next period.

If you click on the sector control station you will bring up the 'tote board' for that sector. This is an authentic representation of the style of display used by the RAF during this period. The lights show the readiness of each squadron in that sector.

Managing Aircraft and Pilots

It is important to keep a watch on your squadrons. A squadron that is continually asked to fly missions without rest will suffer from low morale and fatigue. The squadron category (A. B. C) gives you an insight into the fighting ability of a squadron. When this reaches Category *'C'* it is definitely time to pull the squadron from combat to rest.

Use the Squadron List dialogue accessed from the main tool bar to view the details of all your squadrons. The list of squadrons can be filtered using the controls at the top of the dialog Click on a squadron line and open its details dialog. At the top of the dialogue page you will see an option for requested readiness that you can use to change the state and below it a report of the current readiness. Setting the squadron readiness to 'released' means that the squadron is not expected to fly and can take time out to relax. They will slowly recuperate.

The 'Rest if': option at the top of RAF directives automates this process. Squadrons are released from duty if their category or number or aircraft drop below the level you specify. Each time a pilot is lost he is replaced. But, you will notice that the overall average skill and morale of the squadron will drop to represent the arrival of an under-trained novice.

The morale of the squadron leader has a great impact on the remainder of the squadron. While flying, the rest of the squadron are concentrating on formation flying with the leader, so it is down to him to lead them into the best position and spot the enemy.

Transferring Squadrons

You will find the need to transfer squadrons to different airfields during the course of the campaign. There are various reasons for doing this:

The current airfield may be too badly damaged to handle the squadron.

The squadron is fatigued and must be moved out of the combat area for rest.

Naval types come under the Jurisdiction of Coastal command. Others are Bomber command or training units only used by your fighters when making emergency landings. The Luftwaffe acting on poor intelligence will often attack your Naval and Bomber airfields. This is good and bad - it means less attacks against fighter stations but the loss of other staff and resources.

- **Docks**

An industrial and commercial target. Docks are not repaired within the time frame of the battle. You cannot simply hold your fighters back and let the docks take a pounding. If too much damage is sustained then the Prime Minister and his cabinet may well step in to order your replacement as Commander.

- **Convoys**

The coastal transports were kept in operation in the early phase of the Battle to show to Germany and the world that England stood defiant in the face of the Luftwaffe. Towards the end of August it was accepted by those in command that the battle for the Channel was lost. Ships were no longer paraded up and down the south coast. The cost in lives of crewman and pilots, and of aircraft and ships was high. As with Docks, if you neglect to provide adequate cover for the convoys then your removal will be requested by the Government.

- **Radar**

If Radar is knocked out then mobile units can be brought in to cover the gap but they are not as efficient.

- **Factories**

The most important factories are those used to manufacture components for fighter aircraft and those that actually assemble the finished fighters. The number of fighters that can be assembled is restricted by the output from the component factories. The vulnerability of these sites is recognised early in the battle and preparations are made to disperse production throughout workshops in the nearby areas.

Open the asset list and view the Factory page to see all your factories and their production type. Find the Woolston Supermarine factory and open its dossier by clicking it then the details button. The dossier will tell you the current weekly production capacity for that factory Damage to the factory will diminish its output or stop it all together.

Other factories make components for or assemble bombers which play no part in the battle. Finally, there are Industrial factories that play no part in aircraft production but are a vital part of nation's resources.

- There are not enough squadrons in a particular sector to deal with concentrated raids against it.
- The current airfield is too far forward and the early warning system is down, and hence it is in danger.

There are 2 main ways of transferring a squadron b y using the Directives dialogue or the Airfield dialog.

- **Directives:**

The Front Line airfields option at the top of the dialogue allows you pull your squadrons back or move them forward through 3 bands of airfields: North London, South London and Coastal. The default is 'Coastal' airfields. If you change this to 'South London' then any squadrons on coastal airfields will be pulled back and relocated at available airfields in North and South London. South London is the new front line. This is a dramatic and sweeping change so use it in the right situations. For example, make South London the front line if radar is out and Coastal airfields are getting hammered, or if London is being raided. The transfers will take place at the end of the current period, so during the period the squadrons will still be available for duty.

- **Airfields Dialog:**

At the bottom of the squadron page of this dialogue are two combo boxes. You can select a Group and then select an airfield within that group to transfer to. You can only move to airfields that have space to accommodate further squadrons. There are also restrictions when trying to move squadrons out of Group 10 and 12, as the controllers for those groups must have a minimum number of squadrons available at all times. Any requested transfers will take effect by the start of the next period. The squadron will still be available for duty during the current period.

Assets and Production

To get an overview of the state of your assets open the asset list dialogue from the main tool bar. This is similar to the Luftwaffe's target list.

- Airfields

The airfield type shows the command that the airfield comes under. Fighter Command airfields are the most important as these are used by your RAF fighters.

The Ultimate Objective

Operation Sealion, the invasion of Britain, is planned for September 1940. The date is flexible based on the success of the Luftwaffe. If Luftwaffe air superiority is not secured by September 15th then the invasion will be postponed indefinitely.

German command requires that the RAF is diminished as a fighting force and has insufficient fighters to counter the Luftwaffe over the Channel and landing areas. If the Luftwaffe believes that they have accomplished this then the invasion date may be brought forward.

You will be informed of these events in the End of Day news

CHAPTER 5

FLYING THE BATTLE OF BRITAIN AIRCRAFT

This chapter begins with a description of the controls available while flying the aircraft in this simulation. Section Two describes how to access 'interactive' cockpits in the simulation, where the player is directly controlling the equipment in the cockpit of the flyable planes. Section Three gives an analysis of the engines and propellers on Second World War fighters and bombers. Section Four details how to start an aircraft's engine, taxi down a runway and take off. Section Five follows various solo flying and formation flying tips. Section Six deals with the various combat maneuvers that the player will need to learn to become a proficient pilot. The final section provides technical specifications of the fighters and bombers in the game.

THE AIRCRAFT CONTROLS

The five aircraft that can be flown in G2 Games's Battle of Britain II have very similar controls, these being relatively simple compared with modern fighter aircraft. The flight controls are used for directing the aircraft in the air or on the ground whilst taxiing. The engine controls are used to set the power of the engine and the pitch of the propeller blades. A further set of engine controls is provided for engine starting and stopping. The more complex engine controls can only be used with the 'interactive cockpit', and otherwise will be controlled automatically if the Engine Management preference is set to Auto. The Messerschmitt Bf110 has twin engines and so all of the engine controls appear twice in the cockpit, one set for each engine.

All of these controls may be identified on the separate key-guide that accompanies this package. Further points about the control setup on your PC are made in Chapter Two Section Two (Controller).

FLIGHT CONTROLS

The aircraft in the game can be flown using just the keyboard, but it is strongly recommended that a joystick is also used. Many of the controls can

also be operated using the interactive cockpit.

Elevator and Ailerons
These are used to pitch and roll the aircraft. The arrow keys can be used for aileron and elevator control. However the use of a joystick is recommended. Battle of Britain II uses the Windows joystick configuration and the simulation can be played using the default options. To fine tune control input go to the Controller page in Chapter Two Section Two.

Rudder
The rudder yaws the aircraft in flight, or steers the rear wheel when taxiing. Crude rudder control is provided by the number pad ì and ; keys. Finer control is available if you use dedicated rudder pedals or a twist joystick. K and mK increase and decrease the keyboard sensitivity.

Flaps
Flaps can be set to slow the aircraft down ready for landing. Press the F key to retract the flaps and the V key to extend them. The Spitfire has only two settings for flaps (extended or retracted). All other aircraft have 4 stages (retracted, 1/3, 2/3, full). Assuming you start with flaps retracted, you must press V three times to reach full extension.

Undercarriage
The undercarriage can be retracted or extended during flight by pressing the G key. Warning - attempting to extend the undercarriage at high speed may cause the hydraulic or mechanical systems to fail.

Independent wheel brakes
The main wheels have individual brakes. These brakes, one on each wheel, can be used for slowing the aircraft down once on the ground, and can also be used individually to aid steering. The brakes should be used with care at high speeds as severe braking can cause the aircraft to flip forward onto its nose. The "," key is the left wheel brake and the "." key is the right wheel brake.

Elevator Trim
The trim allows the pilot to set the position of the elevator when the control stick is released. This means he can set the trim to keep the aircraft level, for his current speed and altitude, and then let go of the stick. This way, he does not have to hold the control stick in one position for long periods just to keep the aircraft flying straight and level.

The "End" key adjusts the trim upwards, while the "Home" key adjusts the

trim downwards. The trim can be reset to a neutral position pressing the "Alt" and "End" keys at the same time.
Alternatively you can use joystick buttons [5], [7] and [10] respectively.

Rudder Trim
The rudder trim works in the same way as the elevator trim, but allows the pilot to take his feet off the rudder pedals and continue in a straight line. It is generally used to counteract the effects of the engine torque and slipstream under different flight conditions, such as climbing, cruising and diving. Some aircraft such as the Bf109 do not have rudder trimming and therefore the pilot has to press one or other rudder pedal throughout the flight.
The "Delete" key adjusts the rudder trim to the left, while the "Page Down" key adjusts the rudder trim to the right The trim can be reset to a neutral position pressing the "Alt" and "End" keys at the same time.

Dive Brakes
These can be extended on the Ju87 to produce extra drag on the wings and maintain the correct speed during a dive-bombing attack. The "D" key will toggle between extended and retracted dive brakes on the Ju87 only.

Emergency Undercarriage
Lowering can be attempted if the undercarriage cannot be extended using the normal control. This could be due to a number of reasons. Bullets from enemy aircraft or Anti-Aircraft guns may have damaged the undercarriage. An attempt may have been made to lower the undercarriage at very high speed. Or the engine may not be providing enough hydraulic pressure to lower the wheels. The emergency lowering system typically consists of a cylinder of compressed gas that can be released into the undercarriage hydraulics system, and may be able to force the wheels down. The system can only be used once. Pressing the "Ctrl" and "G" keys at the same time releases the emergency cylinder.

Canopy
The canopy can be opened or closed during flight to allow the pilot to move his head outside of the cockpit and look along the side of the long nose and engine. The Bf109 and Bf110 have hinged rather than sliding canopies and therefore trying to open the canopy will result in them being ripped off by the flow of air past them.

ENGINE CONTROLS

Throttle

The throttle provides control for selecting the desired engine power. The number keys give throttle control from 10% through to 100%. The "+" and "-" keys thereafter give fine control with changes in increments of 1%. The Bf110 has two throttle levers, one for each engine. These can be controlled either together or individually. Pressing "E" will cycle through the available engine to control - both together, port engine only, starboard only.

Propeller Pitch
The propeller pitch control alters the angle of the propeller blades. It can be used manually, just like the gearbox in a car to maintain the correct engine speed, or controlled automatically by the computer. Decreasing the prop pitch increases the RPM and vice versa. Pressing "Shift" and "9" together gives minimum RPM by setting the prop pitch to its maximum angle. The "Shift" and "0" keys together gives maximum RPM by setting the prop to its minimum pitch angle. Similarly, the "Shift" and "+" keys together increases the pitch and decreases the RPM. The "Shift" and "-" keys together decreases the pitch and increases the RPM.

Automatic Boost Control Cutout.
If the engine is run at full power for any length of time, the engine temperature will rise and permanent damage will be caused to the engine. If the temperature gets too high, there is a chance of the engine ceasing completely. In some aircraft an automatic system limits the setting of the throttle (to 90%) to prevent the engine overheating. Other aircraft have a gate in the throttle quadrant, or a piece of wire that limits the movement of the throttle lever. The pilot can override this system by using the Automatic Boost Control Cutout, or pressing the "0" key to push the throttle fully forwards (through the gate, or breaking the wire) and getting 100% power.

ADVANCED ENGINE CONTROLS
These controls are only available when the interactive cockpit is engaged.

Magneto
The magneto provides the electrical power to the spark plugs in each cylinder of the engine. Each engine has two magneto circuits consisting of the engine driven magneto connected to a set of sparkplugs. Should one circuit fail to work, the second circuit will keep the engine running, although at a little lower performance as there will only be one spark in the cylinder rather than the normal two. Each circuit can be switched on or off independently but both should be turned on for engine starting.

Fuel cock
The fuel cock is used to select the fuel tank from which fuel is delivered to

the engine.

Primer pump
The primer pump is used to squirt neat fuel directly into the cylinders of the engine to enable the engine to be started from cold. A cold engine will require about 3 strokes of the primer pump before attempting to start it.

Starter button
The starter button works differently depending on whether the aircraft is British or German. The Spitfire and Hurricane use an electric starter motor, just like a car, to rotate the engine up to speed. This is operated by pressing the starter button until the engine fires, and then releasing. The German aircraft use an 'Inertia starter' which consists of a large flywheel that is rotated by hand or by an electric motor. When the starter handle is pulled out, the motor is used to accelerate the flywheel for approximately 10 seconds, until it has enough energy to start the engine. Releasing the starter handle connects the flywheel to the engine and the inertia it has from spinning is used to start the engine rotating.

THE MAJOR FLIGHT AND ENGINE CONTROLS

		Keyboard	Joystick	Interactive Cockpit
Elevator		↑ & ↓	✔	✘
Ailerons		← & →	✔	✘
Rudder		0 & Delete	✔	✘
Throttle	(10%, 20% ..... 100%)	1 to 0	✔	✔
	(1% Up and Down)	+ & −	✔	✔
Prop Pitch	(Max. & Min)	Shift 9 & Shift 0	✔	✘
	(Up and Down)	Shift − & Shift +		
Cycle Engines	(Bf110 only)	E	✘	✘
Elevator Trim		Ctrl Home & Ctrl End	✘	✔
Rudder Trim	(Where Available)	Ctrl Delete & Ctrl Page Down	✘	✔
Gear	(Retract / Extend)	G	✘	✔
	(Emergency Lower)	Ctrl G	✘	✔
Lower Flaps	(Raise and Lower 1 stage)	F & V	✘	✔
Canopy	(Open / Close / Eject)	O	✘	✔
Dive Brakes	(Extend / Retract - Ju87 only)	D	✘	✔
Wheel Brakes	(Left and Right)	, & .	✘	✘
Fuel Gauge Selector Switch		Ctrl F	✘	✔
Cheat Lift	(1,000 ft)	U	✘	✘
Spin Recovery		Shift S	✘	✘
Keyboard Sensitivity	(Up and Down)	K & Shift K	✘	✘

THE INTERACTIVE COCKPITS

The interactive cockpit allows the player to control various aircraft devices and engine settings, such as those mentioned above under advanced engine controls. It also gives you the experience of controlling an actual World War Two aircraft in an authentic manner. The interactive cockpit will only work if the Engine Management option is set to Manual in the flight preferences.

- To activate the interactive cockpit press the right mouse button. This will bring up a white mouse pointer.

- To activate switches, place the pointer over the switch, and press the left mouse button.

- To push a button, such as the starter motor button, place the pointer on the button and hold down the left mouse button.

- Levers, such as the throttle lever or propeller pitch control, can be moved by clicking the mouse on the handle of the lever and moving the mouse up or down while holding down the mouse button.

- Wheels, such as the elevator and rudder trim wheels can be used in a similar way. Hold down the mouse button and move the mouse left and right or up and down as appropriate.

- The interactive features in the cockpit cannot be used while the game is paused.

- In G2 Games's Battle of Britain II there are five aircraft that you can fly, and each one has its own interactive cockpit.

- Appendix One at the back of this manual shows the cockpit layout for each of these five aircraft (Spitfire, Hurricane, Stuka, Messerschmitts 110 and 109).

ENGINES AND PROPELLERS

This section deals with the engines and propellers on the major aircraft in the Battle of Britain II simulation.

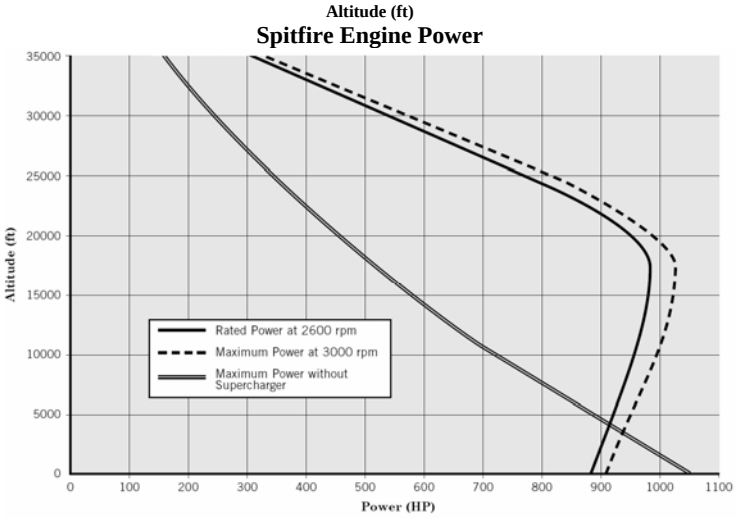
THE ENGINES

Water-cooled 12 cylinder Vee Supercharged engines power all the 5 aircraft available to fly in the game. The Spitfire and Hurricane are both fitted with a Rolls-Royce Merlin II or Merlin III. These two models differ only in the details of the propeller shaft, the former for use with a de Havilland 2 pitch propeller, and the latter for use with the Rotol constant speed propeller. The Messerschmitt Bf109 and Bf110 are both fitted with Daimler-Benz DB601A engines and the Junkers Ju87 uses a Junkers Jumo 211A.

The details of these engines are as follows:

Engine	Rolls-Royce Merlin II/III	Daimler-Benz DB601A	Junkers Jumo 211D
Capacity	27 litres (1648 in3)	33.9 litres (2,069 in3)	35 litres (2,135 in^3)
Rated Altitude	16,250 ft (5,000 m)	14,800 ft (4,500 m)	5,000 ft (1,500 m)
Rated Power	990 HP	1,020 HP	1,150 HP
Rated Rpm	2600	2,100	2,100
Maximum Power	1,020 HP	1,175 HP	1,200 HP
Maximum Rpm	3,000	2,400	2,400
Supercharger	Single speed	Single speed	Two-speed
Fuel Delivery	Gravity fed carburettor	Direct fuel injection	Direct fuel injection

A normally aspirated engine, with no supercharger fitted, would produce maximum power at sea level, but the available power would decrease with increasing altitude due to the reduction in air density. A supercharger draws more air into the cylinders and allows the engine to produce more power at higher altitudes, but also reduces the power available at sea level as a certain amount of energy is required to drive the supercharger.



The Carburetor and Negative G

In the British engine, the fuel was delivered to the engine cylinders via a gravity fed carburetor. In order to maintain a continuous supply of fuel to the engine, it was necessary for the engine to be under conditions of positive G. In other words, if the pilot of a Spitfire or Hurricane were to try to fly the aircraft inverted, the carburetor would almost immediately cease to supply fuel to the engine and power would be lost. The same thing would happen if the pilot was flying straight and level and pushed forward rapidly on the control stick in order to enter a dive. In this condition, the centrifugal force due to the aircraft pitching downwards would lift the pilot out of his seat and force his body up against the shoulder straps of his harness. Exactly the same thing happens to the fuel in the tanks and in the carburetor, and the engine will loose power for a few seconds, until positive G is restored.

This undesirable feature was not present on the German engines as they used direct fuel injection to deliver the fuel to the cylinders rather than a carburetor. This allowed the pilots of the Messerschmitt Bf109 to escape a pursuing Spitfire by pushing forwards on the stick and entering a steep German pilot to gain some distance from his attacker.

Throttle Settings and Engine Limitations

The recommended throttle settings and engine limitations for various flight conditions are given below. The figures quoted are appropriate to the Rolls-Royce Merlin engine, but the throttle settings are consistent for all the flyable aircraft featured in the game.

ENGINE LIMITATIONS

	Time Limit	Throttle	R.p.m.	Boost
MAX. TAKE-OFF TO 1,000 FT	1 MIN.	100%	3,000	+6¼
MAX. CLIMBING	1 HR.	90%	2,850	+4¼
MAX. CONTINUOUS	----	75%	2,650	+3½
COMBAT	5 MINS.	100%	3,000	+6

Note: +6 lb/sq.in. combat boost is obtained by operating the boost control cut-out.

Note: +6 lb/sq.in. combat boost is obtained by operating the boost control cut-out.

Exceeding these limitations will lead to excessive use of fuel, and if Manual Engine Management has been selected in the Flight preferences (see Chapter Two Section Three), then the engine may overheat and suffer permanent damage as a result. These limitations must be followed to maintain a fully serviceable, undamaged engine. If an engine has been damaged as a result of gunfire or overheating, then the pilot should be more conservative when considering any continued or future combat.

THE PROPELLERS

During World War I, aircraft used fixed pitch wooden propellers. These were easy to manufacture, as they contained no moving parts, but were only truly efficient under one set of flying conditions. The propellers would typically be designed with a blade angle that gave them the best efficiency in the cruise condition. This made for good fuel economy and high speed when cruising but meant that during take-off and climb, the propeller and engine were not working at their optimum efficiency. In order to improve this deficiency, propellers were developed in which the angle of the blades could be changed in the air. This means that the pilot can set the propeller blades to an angle suitable for take-off, thereby leaving the ground in as short a distance as possible. Once in the air, he can reset the propeller blades to an angle suitable for cruising. The following types of propellers were fitted to the aircraft used in the Battle of Britain II. All early Spitfires and Hurricanes were fitted with two-pitch propellers, but were later upgraded to use constant-speed propellers. The two Messerschmitts had a variable pitch propeller, and the Ju87 Stuka used a two-pitch propeller similar to that of the early British fighters.

Two-Pitch Propellers ***(Early Spitfires and Hurricanes, and Ju87)***

These propellers have two settings, Fine and Coarse. General speaking, the fine pitch is used for engine starting, taxiing, taking off and landing. Once in the air, leaving the propeller set to fine pitch would result in the engine speed increasing above the allowable range. The pilot should therefore select the coarse pitch which allows the aircraft to climb, cruise and engage in combat, while using the normal range of engine speeds. An additional feature of this type of propeller is the ability to use effective windmill braking. This involves throttling back the engine and selecting the fine pitch on the propeller control. This will cause the propeller to spin around rapidly in the airflow, and in turn drive the engine to high speeds. The allows the pilot to use the engine braking effect of the large engines to produce large amounts of drag on the propeller and slow the aircraft down**.**

Constant-Speed Propellers ***(Later Spitfires and Hurricanes)***

This type of propeller will automatically adjust the pitch of the blades in order to maintain the engine speed at a specified value via a small engine mounted hydraulic pump. As the engine speed increases, so does the pressure produced by the pump, and this pushed oil into the propeller where it moves a cylinder and increases the angle of the propeller blades. At the new increased pitch, the blades produce more thrust, but also more drag, thereby putting more load on the engine and holding down the engine speed. The pilot can select the desired engine speed between 1,800 rpm (for

maximum fuel efficiency) and 3,000 rpm (for maximum power). The engine speed is generally independent of the throttle setting, but when the throttle is opened, the propeller blades will always be set to the most efficient angle. This results in significantly improved acceleration and climb rate compared with a similar aircraft fitted with a fixed or two-pitch propeller.

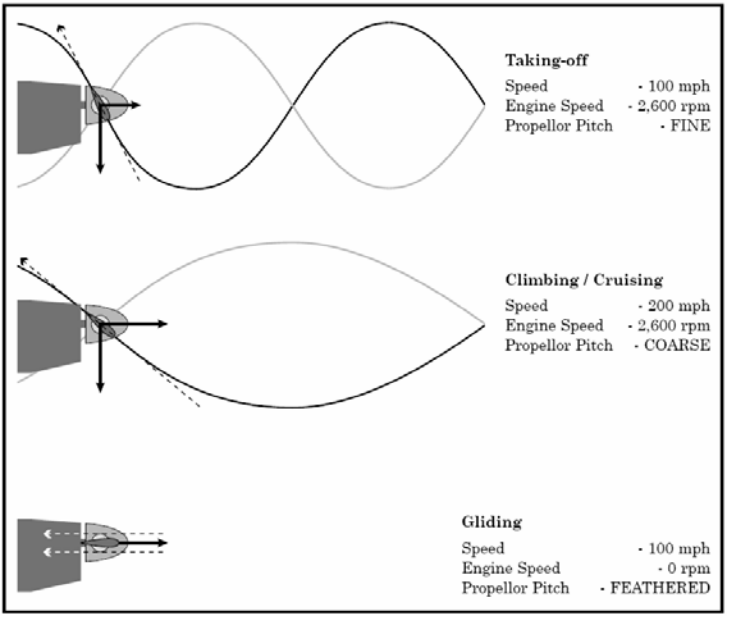
Variable-Pitch Propellers *(Messerschmitt Bf109 and Bf110)*
This works in a very similar way to the two-pitch propeller but rather than having just two possible positions, the blades can be set to a range of angles. This allows the pilot to continuously adjust the propeller pitch to suit the current flight speed. In addition, the propeller can be feathered. This means that the blades can be turned to an angle of 90º in the event of an engine failure. In this position they produce least drag and thereby improve the gliding performance of the aircraft.

All of these propellers can be thought of as doing a similar job to the gearbox in a car. A low gear is used for starting off, and can also be used to provide effective engine braking, and a higher gear is selected as the vehicle accelerates and engine speed exceeds the normal operating range.

Automatic Propeller Pitch Control
If the player does not wish to worry about the propeller pitch setting, the computer can control the propeller setting automatically. The automated system will always try to ensure that the propeller pitch is set such that the player has the maximum possible thrust available from the engine. To enable the automatic pitch control, the Prop Pitch Control flight preference in the Sim Config menu should be set to Auto. This option can only be set when Engine Management is set to Auto. See Chapter Two Section Three for further details.

Novice Flight Model
When the novice flight model is being used, the propeller is not modeled accurately. Therefore, the player has only the throttle to control and need not worry about the propeller pitch setting.

Correct Propeller Pitch for Various Flight Conditions



STARTING THE ENGINE, TAXIING, AND TAKEOFF

ENGINE STARTING

The player can only carry out engine starting if the Engine Management flight preference option in the Sim Config menu is set to Manual. If this is not the case, then the engine will always be running at the start of a mission, and will only stop if the fuel runs out or the engine becomes seriously damaged.

The procedure for starting the engine is similar for all aircraft, but in the case of the Bf110, the two engines have to be started separately. Starting the engine requires the use of the interactive cockpit controls.

The full engine starting procedure for the Spitfire is as follows:

PRELIMINARIES

On entering the cockpit check the Undercarriage selector lever , Flaps, and Contents of lower fuel tank.

STARTING THE ENGINE AND WARMING UP

PRELIMINARIES

On entering the cockpit check:

Undercarriage selector lever	- DOWN (Check that indicator shows DOWN; check that green lights appear).
Flaps	- UP
Contents of lower fuel tank.	

STARTING THE ENGINE AND WARMING UP

(i) Set:

Both fuel cock levers	- ON
Throttle	- half inch open (20%)
Airscrew pitch control	- Fully forward

(ii) Prime the engine, the number of strokes required being as follows:

Air temperature °C:	+20	+10	0	-10	-20
	3	4	6	8	15

(iii) Switch ON ignition.

(iv) Press the starter push button.
The push button should be kept depressed until the engine is firing evenly.

(v) While warming up, exercise the airscrew pitch control a few times.
Also make the usual checks of temperatures, pressures and controls.

(vi) After a few minutes move the airscrew pitch control fully forwards.

(vii) Open the throttle to give maximum boost for cruising and check each magneto in turn. The drop in r.p.m. should not exceed 150.

(viii) Open the throttle fully momentarily and check static r.p.m., boost and oil pressure.

(iv) Warming engines must not be unduly prolonged because the radiator temperature before taxiing out must not exceed 100°C.

Engine starting in other aircraft follows the same pattern but the inertia starter in the German aircraft is operated in a different way to the starter motor of the British aircraft. To energize the inertia starter, operate the starter handle for approximately 10 seconds, and then release the handle. Setting of fuel cocks, propeller pitch, priming and ignition is carried out in the same way as described above.

TAKING OFF

The aircraft featured in the game all have a similar undercarriage layout. This consists of two main wheels just ahead of the center of gravity (these wheels are retractable on all but the Ju87) and a fixed small tail wheel below the tail of the plane that allows the aircraft to be steered on the ground using the rudder pedals. This layout means that the aircraft sits on the ground in a nose-high attitude, typically 12º, and can seriously limit the forward visibility of the pilot.

When taxiing, the pilot must weave the aircraft from left to right to allow him to see ahead and ensure he is not going to taxi into anything. An alternative available to pilots of the Spitfire, Hurricane and Ju87 is to slide back the canopy and look over the side of the cockpit.

When taking off the pilot would normally raise the tail of the aircraft as soon as possible, thus lowering the nose and allowing him much better forward visibility. This also has the effect of lowering the drag of the aircraft, as it is now pointing in the direction of travel, and therefore it will allow the aircraft to accelerate more rapidly. Once take-off speed has been achieved, the pilot would lower the tail, to increase the angle of attack of the wings, and therefore increase the lift produced, and the aircraft will take-off. An alternative method (if the pilot is pointing straight down the runway and confident that there is nothing ahead of him) is to simply pull back on the stick during acceleration, and hold the tail-wheel on the ground. This method does not provide good forward visibility, but makes it easier for the pilot to keep the aircraft pointing down the center of the runway.

The take-off procedure is as follows:

FINAL PREPARATION FOR TAKE-OFF

FINAL PREPARATION FOR TAKE-OFF

Trimming Tabs	- Elevator about one division nose down from neutral. Rudder fully starboard.
Pitch	- Propeller pitch control fully forward.
Fuel	- Both cock levers ON and check contents of lower tank.
Flaps	- UP
Wheel brakes	- Parking brakes released on both wheels.

TAKE-OFF

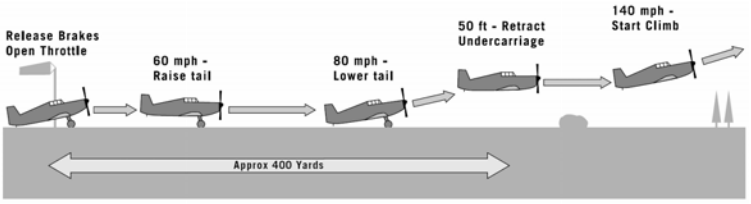
(i) Open the throttle slowly to the gate (RATED BOOST position). If taking off from a small aerodrome, full take-off boost may be necessary and can be obtained by opening the throttle through the gate to the TAKE-OFF BOOST position.

(ii) Any tendency to swing can be counteracted by the use of coarse rudder.

(iii) After raising the undercarriage, check that the red indicator light comes on.

(iv) Do not start to climb until a speed of 140 mph is reached.

Note: The rudder trim, where available, should be left neutral if propeller torque and slipstream have been disabled in the flight preferences. Similarly, if the novice flight model is being used, both the elevator and rudder trim should be left neutral.



RECOMMENDED SPEEDS
Spitfire

Take-off	80 mph
Best climb speed	180–200 mph
Cruise speed at 15,000 ft	300 mph
Max. speed at 15,000 ft	346 mph
Max. flap/gear extension speed*	140 mph
Landing approach	120 mph
Touchdown speed	80 mph
Max. controllable dive speed**	400 mph

Hurricane

Take-off	80 mph
Best climb speed	165–185 mph
Cruise speed at 15,000 ft	280 mph
Max. speed at 15,000 ft	315 mph
Max. flap/gear extension speed*	140 mph
Landing approach	120 mph
Touchdown speed	80 mph
Max. controllable dive speed**	400 mph

Bf109

Take-off	100 mph
Best climb speed	180–190 mph
Cruise speed at 15,000 ft	305 mph
Max. speed at 15,000 ft	340 mph
Max. flap/gear extension speed*	160 mph
Landing approach	130 mph
Touchdown speed	100 mph
Max. controllable dive speed**	380-400 mph

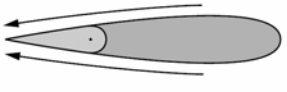
Bf110

Take-off	90 mph
Best climb speed	180–190 mph
Cruise speed at 15,000 ft	295 mph
Max. speed at 15,000 ft	330 mph
Max. flap/gear extension speed*	160 mph
Landing approach	120 mph
Touchdown speed	90 mph
Max. controllable dive speed**	380-400 mph

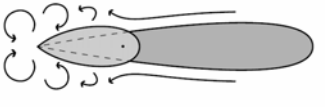
Ju87

Take-off	75-85 mph
Best climb speed	120 mph
Cruise speed at 15,000 ft	160 mph
Max. speed at 15,000 ft	230 mph
Max. flap extension speed*	150 mph
Landing approach	90 mph
Touchdown speed	75 mph
Max. controllable dive speed**	400 mph

* The flaps and undercarriage are activated by hydraulic jacks (or manually in the case of the Bf109 flaps). When these devices are extended, they stick out into the airflow where they will be subjected to strong aerodynamic forces. If the airspeed is very high, then the forces upon the devices and the hydraulic system become very large and can cause serious damage. Therefore, a maximum speed is specified below which it is safe to extend the flaps and gear without danger of damaging them. If they are deployed above this speed, they will typically cause lots of buffeting, and can become stuck in one position.



Normal Airspeed - Light Controls



Very High Airspeed - Stiff Controls

** A characteristic typical of all the aircraft featured was the stiffening of controls at high speed. One cause of this problem was that the control surfaces were covered with fabric rather than metal. This kept the controls systems light in weight but at high speeds, such as in a steep dive, the surfaces would tend to balloon outwards due to the airflow past them. This resulted in the controls becoming very stiff, such that the pilot may have insufficient strength to move the control stick and recover from the dive. In this case, it is necessary to close the throttle and reduce the speed of the aircraft before pulling back on the stick to raise the nose.
This problem was eventually remedied by replacing the fabric covered control surfaces with metal covered ones giving significantly greater maneuverability at high speeds, but this did not take place until 1941, after the Battle of Britain.

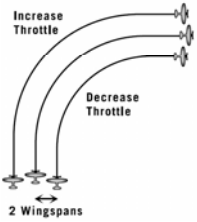
FLYING

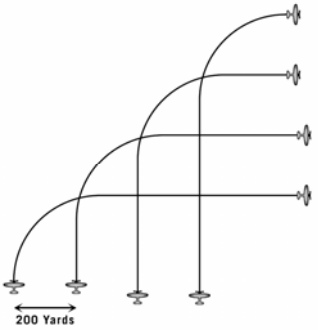
THE NOVICE FLIGHT MODE

The novice flight model is provided as a means of playing the game without having to consider the dynamic behavior of the aircraft including the level of stability and control effectiveness throughout the flight envelope. It also allows the novice player to throw the aircraft around the sky without having to worry about exceeding the limits of the aircraft or the consequences of doing so.

The novice model uses the same data as the full flight model which allows the performance of the aircraft to be modeled to the same high level of accuracy. The result of this is that the player can choose to fly using the arcade flight model and still be able to fly in formation with other aircraft, or enter combat with the same fighting capabilities as a player using the full flight model. Since the novice model does not represent the dynamic response of the novice, the control of the aircraft is considerably easier, due to the more stable behavior of the aircraft, and due also to the fact that the controls will only maneuver the aircraft within it's safe limits. Therefore, in a tight turn, the player can pull the control stick all the way back to get maximum turn rate, but will never be able to stall the aircraft, or loose control. The energy of the aircraft is modeled accurately so the aircraft will still loose speed in a tight turn, or if the player tries to climb too steeply. If too much speed is lost, the aircraft will not be able to continue flying in a straight line so, just like in a real stall, the nose will drop until the speed builds up again.

THE CROSS-OVER TURN



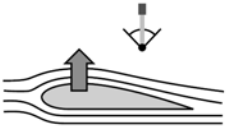


The RAF fighter formations were generally made up of vics of three aircraft with a separation of approximately 2 wingspans between adjacent aircraft. This requires very accurate flying and continuous concentration from the pilots. When turning onto a new heading, the two wingmen must maintain their position relative to their leader. This means that the aircraft on the inside of the curve must turn more tightly than the lead aircraft, and likewise the wingman on the outside must make a larger radius turn than his leader to stay in position. As well as making turns of different radii, the two wingmen must also adjust their speed so that they remain the correct distance behind the leader. This requires the pilot of the inner aircraft to reduce the throttle during the turn, and the pilot of the outer aircraft to increase the throttle as he has a greater distance to travel.

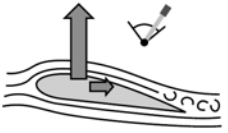
The Luftwaffe fighters would fly in Schwarm made up of four aircraft with adjacent aircraft being about 200 yards apart. If the pilots attempted to use the same technique as used by the RAF for turning onto a new heading, then the radius of the turn would be very large indeed and require the pilot on the outside of the curve to open the throttle fully, while the inner pilot would have to slowdown very rapidly, make a tight turn at low speed, and then accelerate again rapidly to regain the original speed. In order to avoid these problems, the Luftwaffe developed the crossover turn, as illustrated below. This allowed the all the pilots in the Schwarm to maintain their original throttle setting throughout the maneuver, but ended up with the positions in the formation being reversed.

STALLING AND SPINNING

As the angle of attack of the wings (or tail surfaces) is increased, the aerodynamic force produced due to the airflow will also increase. By pulling back on the stick, the pilot will lower the tail of the aircraft and this will increase the attitude of the aircraft relative to the airflow, thereby increasing the angle of attack. Unfortunately, the lift produced by the wing cannot be increased indefinitely by simply pulling back on the stick. As the angle is increased, the airflow over the top of the wing is required to change direction more rapidly to follow the curved surface. If the angle of attack exceeds the stall angle, the air can no longer follow the surface smoothly, and the laminar airflow breaks down to produce turbulent eddies over the wing. This turbulence results in a loss of lift, increased drag on the wing and because the eddies are irregular, the aerodynamic forces produced will be varying at a fairly high frequency. This unsteadiness causes buffeting which is felt through the structure of the aircraft as a shaking, and is a good warning that the
wings are approaching a stall. A stall can happen at low speed in level flight as the pilot pulls back on the stick to keep the nose of the aircraft from falling, or in a tight turn when he is pulling back to achieve a high turn rate.

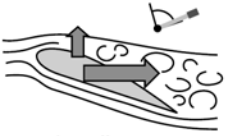


Stick Central
Low Angle of Attack
Moderate Lift - Low Drag



Stick Pulled Back
High Angle of Attack
High Lift - Moderate Drag

Slight Buffet

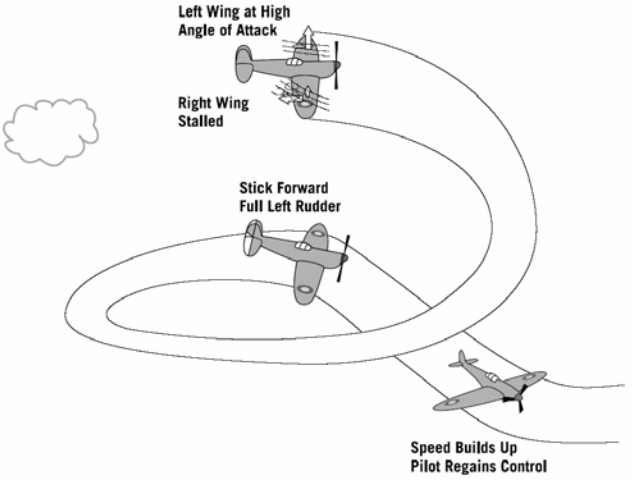


Stick Pulled Back
Wing Stalled
Low Lift - High Drag

High Buffet

Fighter aircraft like the Spitfire are designed to be highly maneuverable, and therefore the pilot is provided with lots of elevator power. This means that he can pitch the aircraft up or down quickly and enter a tight turn easily, but he must also be careful not to pull too hard on the stick and stall the wings. The Spitfire would enter a stall well before the control stick had been pulled back to its limit.

When the wings are near or beyond the stall angle, the ailerons usually loose their effectiveness, as they are no longer in smooth laminar airflow. Sometimes lowering the aileron on one side of the aircraft can cause that wing to stall earlier than the other and hence result in the aircraft rolling the opposite way to expected. Therefore, the pilot must take care when using the ailerons at low speed, such as during takeoff and landing, or in a tight turn.



If the aircraft enters a stall and the pilot holds the stick all the way back, the speed will eventually become so low that the wings can no longer produce enough lift to hold the weight of the aircraft in the air and the nose will drop rapidly. If the pilot now centers the stick, the aircraft will dive and regain speed such that the wings begin producing lift again and the pilot regains control. If the aircraft is not completely straight when a stall occurs, one wing may stall while the other continues to produce lots of lift. If this is the case, the stalled wing will drop and the aircraft can rapidly enter a spin during which the pilot have very little control. (The pilot can deliberately enter a spin by applying full rudder just before the stall is reached.) The nature of the spin will depend on the characteristics of the aircraft but in general, altitude it lost very rapidly and if the spin in not corrected the aircraft is likely to crash into the ground. During a spin, both wings are at high angles of attack so the ailerons cannot be used to stop the aircraft rotating. Similarly, the airflow over the tail surfaces in no longer smooth, and therefore the elevators have little effectiveness. Attempting to raise the nose of the aircraft by pulling back on the stick will only result in increasing the stall and worsening the spin.

To recover from a spin, the control stick should be held central or pushed forwards and full opposite rudder should be applied. This should be maintained until the aircraft stops spinning and begins to build up speed in a dive. Once the aircraft has accelerated to the normal flying speed, the pilot will regain control and can raise the nose of the aircraft and continue flying.

The player can also use the Spin Recovery cheat to regain control of the aircraft by holding down “Shift-S” until the aircraft stops rotating and the controls regain their effectiveness.

Stalling Speeds

As the aircraft loses speed, the pilot must pull back on the stick to maintain enough lift to keep the aircraft flying at the same altitude. If he attempts to maintain altitude with the throttle closed, the aircraft will eventually slow down so much that the wings cannot produce enough lift and the aircraft stalls. The approximate speed at which this will occur is given below. These speeds are correct for a normally loaded aircraft at sea level (i.e. indicated air speed) with its undercarriage and flaps retracted.

Supermarine Spitfire	75 m.p.h.
Hawker Hurricane	80 m.p.h.
Messerschmitt Bf 109	100 m.p.h.
Messerschmitt Bf 110	90 m.p.h.
Junkers Ju 87	70 m.p.h.

Stalling And Spinning Characteristics

Each type of aircraft will have its own specific stalling characteristics that will depend on the shape of the wing cross-section and the weight and geometry of the aircraft. The behavior of the aircraft will also be effected by the extension of devices such as flaps and gears, and damage to the wings and tail surfaces as well as the fuel load, the speed and the altitude.

Novice Model

If the Novice flight model is being used, there is no danger of the player stalling or spinning the aircraft at all. Pulling all the way back on the control stick will bring the wing almost to the stall limit but not beyond. If the aircraft looses too much speed, the nose will drop and the speed must be built up before level flight can be restored.

Spitfire

When the stall occurs, there is a violent shuddering throughout the aircraft and there is also a tendency for the aircraft to flick over, particularly in a high speed stall. Unless the control column is pushed forward rapidly, the aircraft is likely to roll and a spin will result. The aircraft can enter a flat spin, which may be irrecoverable and a number of Spitfires were lost in this way. The loss of height involved in recovering from a spin may be large, and the pilot should allow the aircraft to reach 150mph in the resultant dive before starting to raise the nose.

Hurricane
At the stall, it is typical for one wing to drop sharply, often beyond the vertical. This will occur with the flaps either up or down. Recovery from a spin is normal but like the Spitfire, a large amount of height may be lost in the process. A speed of 150 mph should be attained in the dive before the pilot attempts to return to level flight.

Bf109
This aircraft is fitted with automatic leading edge slats that will open at about 20mph above the normal stalling speed. These help to keep the airflow over the top surface of the wing smooth and laminar and delay the occurrence of the stall. Without these slats, the aircraft would have to take-off and land at higher speeds that requires a greater distance of runway and can lead to more serious accidents. Although the fighter stalls at quite high speeds, this is gentle, even under G, with no tendency to spin. The onset of the stall is signaled by buffeting of the elevators typically followed by the gentle dropping of the nose and left wing. The Bf109 would never enter a flat spin and there was never any difficult in recovering from a spin.

Bf110
Like the Bf109, this aircraft is fitted with leading edge slats that will open automatically as the airspeed reduces. Care should be taken when using only one engine as this can lead to uneven airflow over the two wings, causing the aircraft to swing and bank, and may cause uneven stalling of the wings leading to a spin. This is particularly hazardous when the flaps are extended and when making a single engine approach, with the stationary propeller feathered, the flaps should not be lowered by more than 25 degrees.

Ju87
The Ju87 is a stable bomber rather than an agile fighter. For this reason it has large tail surfaces giving it inherent stability and gentle stall characteristics. During the development of the Ju87B from the Ju87A, the fin was enlarged to compensate for the change in the engine fitted, and this had the effect of making the aircraft almost spin-proof.

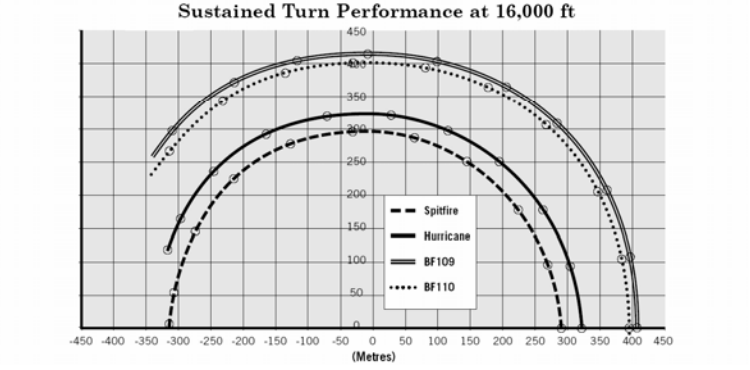
COMBAT MANEUVERS

COMBAT PERFORMANCE COMPARED

Turn Performance at 16,000 ft

Both the British and German aircraft engines were fitted with superchargers, giving them a maximum power output at about 15-16,000 ft. Combat would typically start at this sort of altitude, but descend towards the ground as the aircraft lost energy in turns. By using full throttle and pulling on the stick to achieve a tight turn, with the aircraft at the stall limit, the four fighter aircraft could maintain the rates of turn given below. These are theoretical results and would allow the pilot to maintain this speed and turn rate without loosing altitude, but in practice it is very difficult to do accurately.

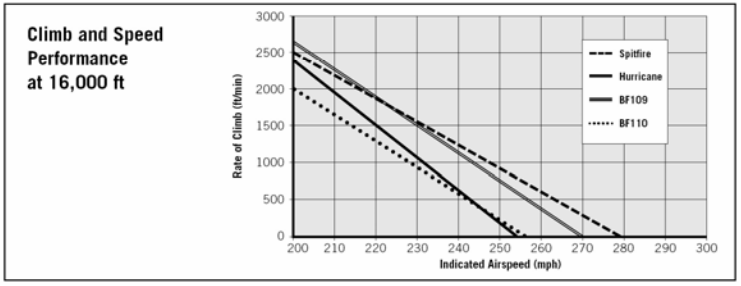
Aircraft	Speed	Turn Rate	Turn Radius	Normal
	(mph)	(deg/sec)	(m)	Acceleration
Spitfire	226	18.9	307	3.4 g
Hurricane	219	16.7	335	2.9 g
Bf 109	247	14.9	423	2.9 g
Bf 110	247	15.4	411	3.0 g



Speed and Climb Performance at 16,000 ft

As well as using the turn rate of the aircraft to get onto the tail of the opponent, the fighter pilots could also use maneuvers involving rapid climbing and diving. By climbing above the enemy aircraft, a pilot could start an engagement with an energy advantage, which he could convert to speed by diving down to the level of his opponent, and regain by climbing away to safely following the attack. The climb performance and maximum speed of the fighter aircraft at an altitude of 16,000ft are given below.

Aircraft	Max. Rate of Climb	Max. True Airspeed	Max. Indicated Airspeed
	(ft/min)	(M ph)	(Mph)
Spitfire	2500	360	279
Hurricane	2420	328	254
Bf 109	2640	348	270
Bf 110	2010	330	256



Spitfire and Messerschmitt Bf109 Compared

Comparison flight-testing of a captured Messerschmitt Bf109 and a Spitfire during the summer of 1940 carried out by the Royal Aircraft Establishment at Farnborough proved the following results:

- In a shallow dive the two aircraft have the same speed.
- In a flat-out straight and level race the German proved very slightly faster.
- In various rolls and turns, the Spitfire was decidedly more maneuverable.
- Pulling out of a steep dive, the 109E had a most definite advantage. It could pull up more sharply, and climb away a little faster.

As can be seen from the comparison above, the fighter aircraft had different relative strengths and weaknesses in combat. The tactics and maneuvers used by a pilot would depend on the type of aircraft he was flying, allowing his to exploit the aircraft's strengths and avoid the weaknesses that could allow his adversary to get an advantage in an engagement.

The main differences between the aircraft types with regard to their combat performance are as follows.

- The British aircraft have a lower wing loading than their German counterparts. The wing loading is the weight of the aircraft divided by the wing area, and is typically expressed in pounds per square foot or in kilograms per square meter.

- Generally, a lower wing loading allows the aircraft to pull more G, and therefore turn more tightly. This can be seen in the diagram above showing the relative turn performance of the 4 fighter aircraft.

- The German fighters have a higher thrust to weight ratio than the British aircraft. The Bf109 is approximately 10% lighter than the Spitfire, but has about 10% more engine power available. This results in a greater climb rate, and also a higher ceiling.

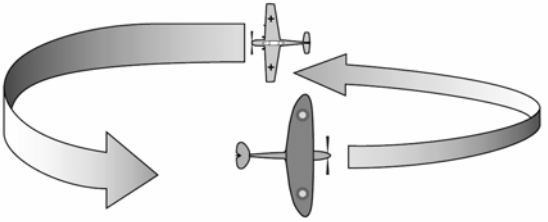
- The Rolls-Royce Merlin engine is fitted with a gravity-fed carburetor while the Daimler-Benz engine using direct fuel injection. This allows the German aircraft to experience negative G without loss of power, but the engines in the British aircraft would be starved of fuel if the aircraft does not maintain positive G during flight.

- The Bf110 and the Ju87 are both relatively heavy with less maneuverability than the Spitfire, Hurricane and Bf109. They do, however, have the advantage of a rear gunner giving them good all round visibility and allowing the second crew member to return fire when the aircraft is attacked from the rear. It should be noted that the single rearward facing machine gun is no match for the eight Browning 0.303in guns of the Spitfire or Hurricane. The gunner being situated towards the rear of the aircraft with little armor is highly vulnerable to enemy fire.

SPITFIRE

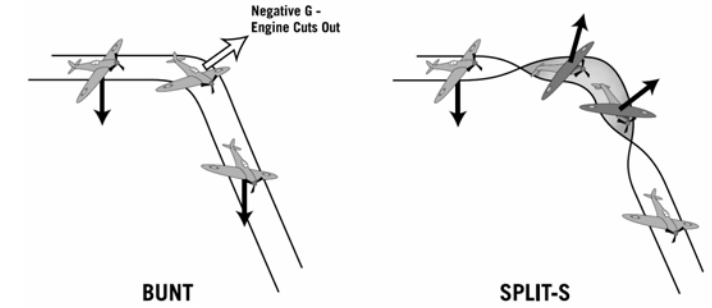
Level Turning Fight

As illustrated above, the Spitfire had the best turning performance of the 4 fighters. This gave the Spitfire pilot an advantage in a level turning fight, allowing him to turn more quickly than any German adversary, and thus get into an attacking position on the tail of the enemy aircraft.

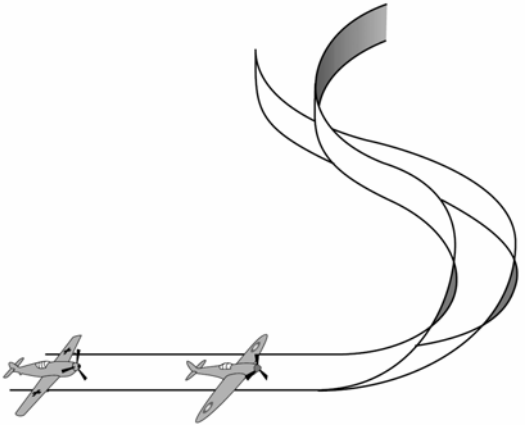


Split-S

As the Merlin engine must always have positive G to provide fuel to the engine, the Spitfire cannot enter a dive simply by pushing forward sharply on the stick. Doing this would result in negative G, which would cause the engine to cut out for a few seconds. This momentary loss of power is enough to allow a pursuing aircraft to gain ground, or an aircraft being pursued to escape. The Spitfire pilot must therefore use a Split-S maneuver, which involves rapidly rolling the aircraft into an inverted position and then pulling back on the stick. This manoeuvre maintains a positive G force on the aircraft throughout.



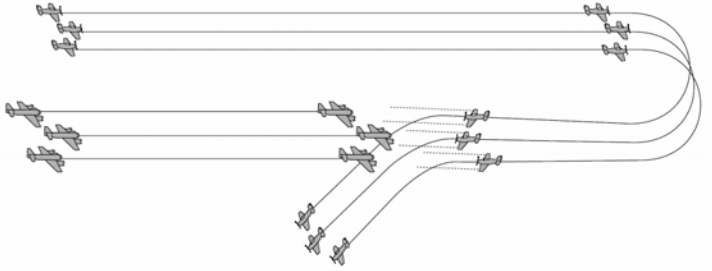
Climbing Turn
This was a defensive maneuver used by Spitfire pilots to take advantage of the aircraft's high turn rate. It was a steep climb with a spiraling turn during which the pilot would hope to out-turn a pursuing aircraft. Obviously, the aircraft speed will decrease rapidly during this maneuver so it cannot be maintained for any significant length of time.



Split-S
Like the Spitfire, the Hurricane is powered by a Merlin engine with a gravity fed carburetor. It must therefore use the Split-S maneuver in order to enter a steep dive without loosing engine power.

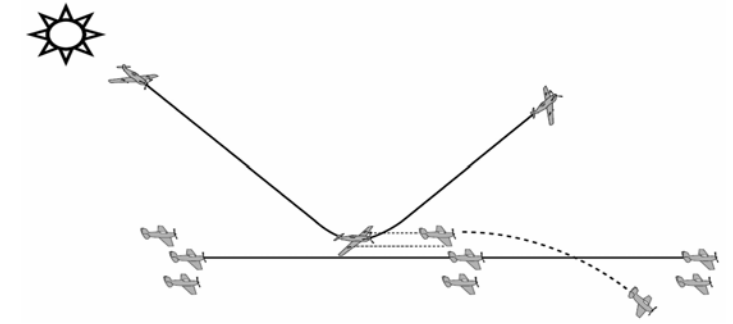
Head-on Attack

This was a tactic employed by some Hurricane squadrons when attacking order to launch an attack on the nose of the aircraft. The bombers often had all the crew members concentrated in the front section of the aircraft but with little defensive weaponry or armor against a head on attack. The fighter pilots would therefore hope to shoot through the glass nose of the bomber and kill or disable the pilot. As the fighters approach the bombers head on, they have a closing speed of some 500mph. This leaves them very little time to aim and shoot before having to bunt to avoid a collision. This attack method was later abandoned following heavy losses to the fighter squadrons.

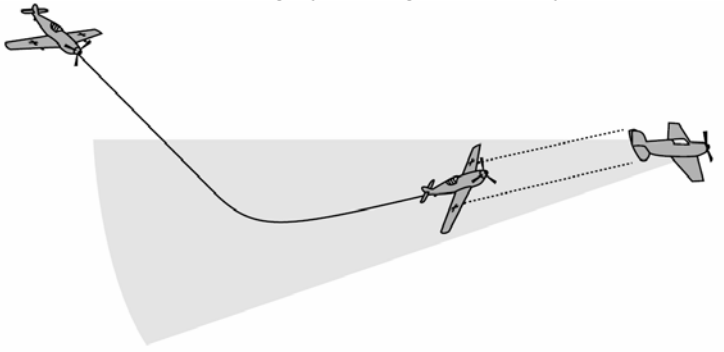


Dive and Zoom

As stated above, the Messerschmitt Bf109 has a high climb rate, but a lower turn rate than the Spitfire or Hurricane. These properties mean that the German fighter was more suited to combat in a vertical plane rather that a horizontal turning fight. The German pilots would attempt to start an attack from above the enemy and in the direction of the sun. From this position they could dive into a formation of British fighters undetected, fire at the aircraft in the rear of the formation, and climb back to safety using their superior climb rate.



Up and Under
This was a technique used for attacking an aircraft from astern without being spotted, and was favored by Adolf Galland, who made the majority of his victories in this way. All the single seat fighters offered the pilot poor visibility to the rear and below the tail, and had a significant blind spot which could be utilized by an aggressor. The attack started with a steep dive from above and behind the enemy, to a position to the rear and slightly below it. Here, the pilot of the enemy aircraft would not see the aggressor approaching and the first he would know of the attack was when it was too late. A right handed pilot with his left hand on the throttle and right hand on the stick could see slightly more over his left shoulder than his right. Therefore, this attack was best made from slightly to the right of the enemy aircraft.



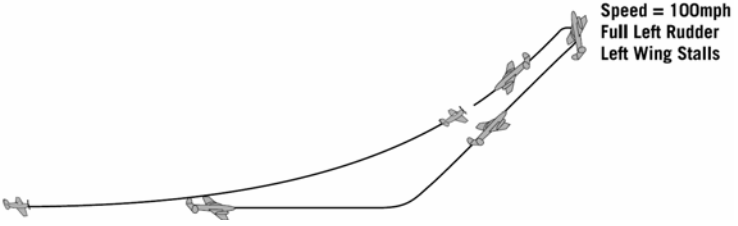
Steep Dive
The Messerschmitt was slightly faster in a dive than it's British counterparts. This allowed the German pilots to escape a pursuing fighter by pushing forward on the stick and entering a steep dive. As well having the superior diving speed, the Bf109 could withstand negative G without loosing engine power. This meant that it could enter a dive by bunting, whereas a pursuing British pilot would have to perform a split-S maneuver or loose engine power for a few second, both of which allowed the German to increase the distance between himself and his adversary.

BF110

Like the single engine Bf109, the Bf110 had a relatively large turning circle, but good climbing and diving speed. Therefore this aircraft was also better suited to combat in a vertical plane rather than a horizontal turning fight.

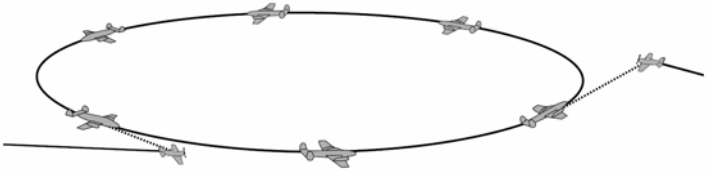
Stall Turn

The Bf110 was heavy and less maneuverable than the Spitfire, Hurricane would use a stall turn. This was done by adopting a nose high attitude and climbing until the aircraft speed dropped off and left the aircraft almost hanging in the air and on the verge of a stall. At this point, the pilot would apply full rudder in the direction he wished to turn, causing one wing to stall and the aircraft to rotate rapidly as the nose drops. Once the aircraft was pointing in the desired direction, the pilot would apply full opposite rudder to stop the turn, and hold the nose down to pick up speed before resuming normal flight. As one wing is being deliberately stalled, there is a risk of this maneuver going wrong and the aircraft entering a spin.



Lufberry

When attacked by British fighters the Bf110s, lacking the high maneuverability of their opponents, would sometimes form a defensive circle, called a Lufberry. The circle was usually about a mile across and often rather ragged in shape, but it allowed each aircraft to cover the tail of a fellow pilot to prevent the British fighters from getting into a firing position. This maneuver was also used by the Junkers Ju87 when threatened.

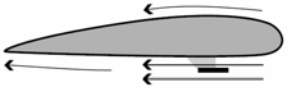


DIVE BOMBING PROCEDURE

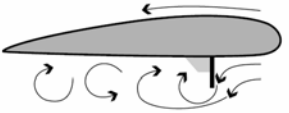
The Ju87 was used for highly accurate dive bombing attacks of convoys of ships as well as ground targets. The aircraft could carry a 1000 lb bomb on a

extending bomb crutch under the center of the fuselage. On releasing the bomb in a steep dive, the crutch would swing forwards and downwards, ensuring that the bomb was clear of the propeller disc at the point of release. A typical dive bombing attack would start at about 10,000 - 15,000 ft above the target, and involve a 80 degree dive through 8,000 feet reaching a speed of 350 mph, almost straight down. The bomb would be released at about 2,300 ft (700 m) allowing the pilot to pull out of the dive, sometimes clearing the ground by less than 100 m, and climb away from the target area.

In order to prevent excessive speeds in the dive, the Stuka is fitted with under-wing dive brakes, which can be rotated to lie perpendicular to the airflow. This results in a large amount of extra drag on the wings which, along with the large fixed undercarriage, holds the speed of the aircraft back to about 350 mph.



Dive brake retracted (Low Drag)



Dive brake extended (High Drag)

The Ju 87 cruises at about 160 mph. A window in the floor of the cockpit allows the pilot to look down on the area below and ahead of his aircraft in order to find the target and decide when to begin his attack. When he judges he is over the target he pulls a lever to rotate the underwing dive brakes to the maximum-drag position. This would cause a severe nose-up trim change, so to compensate for it and hold the aircraft level the trim tab lowered automatically beneath the elevator. The pilot would then enter an 80º dive by either pushing forward on the stick, or rolling the aircraft onto its back, and pulling on the stick.

During the dive, the inherent stability of the aircraft made it easy for the pilot to place the gunsight on the target and hold it there. When the aircraft passes below a pre-set altitude, typically 4,300 ft (1300 m) above the ground, a warning horn would sound in the cockpit. The horn would cease a few seconds later as the aircraft crossed the pre-set bomb release altitude, typically 2,300 ft (700 m). This was the signal for the pilot to release the bombs. Releasing the bomb would also return the elevator trimming tab to the neutral position, and the nose up change of trim associated with the dive brakes would cause the aircraft to that the aerodynamic loading on the aircraft was not greater than 6G, however, the pilot could bypass this system by pulling back hard on the stick and overriding the hydraulic limiting

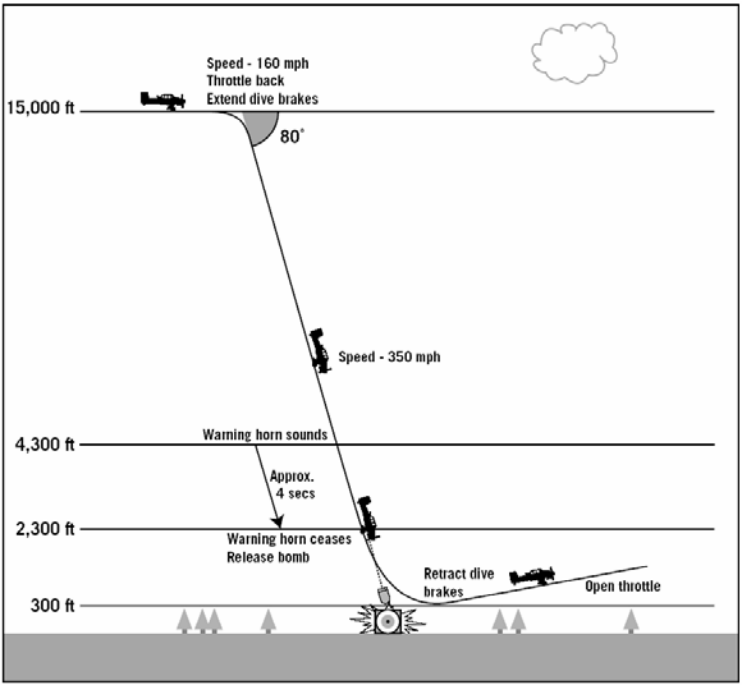
system. Once the nose of the aircraft had risen above the horizon, the pilot would retract the dive brakes, to the low drag position, open the throttle and continue flying as normal.

The check list for preparing the Ju87 to enter a dive was as follows:

Landing flaps	- Cruise Position (UP)
Elevator trim	- Cruise Position (NEUTRAL)
Rudder trim	- Cruise Position (NEUTRAL)
Airscrew pitch	- Cruise (COARSE PITCH)
Contact altimeter set to release altitude	
Throttle pulled right back	
Dive brakes opened	

Contact altimeter set to release altitude Throttle pulled right back Dive brakes opened

TYPICAL DIVE BOMBING ATTACK



HAWKER HURRICANE

The Hawker Hurricane made its first flight in November 1935. It was designed to be an easy aircraft to bring into production. The next year a prototype was fitted with eight Browning machine guns and eventually the guns were grouped in two quartets positioned to fire outside the propeller disc.

In March 1939 the first batch of 600 Hurricanes were delivered, powered by the Merlin III engine and with a three-bladed constant speed propeller. After the 681st Hurricane was made, the fabric-covered wings were replaced by metal wings in February 1940. The extra protection this armor provided (including rear protection for the pilot) made up for its inferior performance compared with the Messerschmitt. During the Battle of Britain two thirds of active RAF fighters were Hurricanes.

SUPERMARINE SPITFIRE

The Spitfire was the end result of a project by Vickers' subsidiary Supermarine Aviation to design an experimental high-speed single-seat fighter. Service pilots reported that the prototype was "simple and easy to fly

and [had] no vices". It seemed to give an excellent compromise between maneuverability and steadiness for shooting.

The first production aircraft flew on May 14, 1938. The Spitfire was not an easy aircraft to build, which was part of the reason for the easier constructed Hurricane being found in greater strength at the start of the Battle of Britain. The production difficulties with early Spitfires were shown by comparative figures from mid 1940, when the rate was still averaging only 80 a month compared with 236 a month for the
Hurricane. In spite of this, Spitfires inflicted more than half the total losses suffered by the Luftwaffe in the assault on Britain – a statistic that underlines the Supermarine fighter's particular merit in air-to-air fighting.

MESSERSCHMITT BF109

Designed by Messerschmitt and Lusser, the Bf109 first flew in May 1935. Some of its features, including poor taxiing view, aroused extreme skepticism among conventionalists. It was a powerful aircraft - in November 1937 the Bf109 V13 raised the world airspeed record for land-based planes to over 370 mph.

There was a single 400 liter internal fuel tank behind and below the pilots seat. This gave only 20 minutes actual combat time over Britain with London representing the effective limit of their tactical radius. 300 liter droptanks were developed, produced from molded plywood – but they were found to leak seriously after comparatively short exposure to the elements.

Most of the 1,172 aircraft lost by RAF Fighter Command during July-October 1940 fell to the guns of the Messerschmitt single-seat fighters.

MESSERSCHMITT BF110

The Bf110 was designed to fulfill the concept of a strategic fighter, which included performing the primary task of clearing a path for bombers in the light of an enemy's defensive fighter screen. The challenge was to make a twin-engine long range fighter compete in combat terms with a short range single seat fighter. In this sense the Bf110 was to fall short of the expectations generated by the Ministry of Propaganda in Berlin. It was sluggish by comparison with the maneuverability of the Hurricane and Spitfire. The acceleration and speed of the Bf110 were insufficient to enable its pilots to avoid combat when opposed by superior numbers of interceptors.

JUNKERS JU87

The Junkers dive bomber had an angular and rather ugly design, but it was an extremely sturdy aircraft. It gave its pilot light controls and good flying characteristics. Its crew members enjoyed good visibility and it was reputed to be capable of hitting its target with an accuracy of less than 100 ft.

Once the Ju87 encountered determined opposition, such as was to be found over the United Kingdom, its career dramatically entered its eclipse. By July 20, Luftflotten 2 and 3 had 316 Ju87s available for the assault on Britain. The first Ju87 sorties in strength actually took place on August 8, suffering severe losses despite Bf109Es providing top cover. The Stuka had been revealed for what it was – an inadequately armed and highly vulnerable warplane.
The Oberkommando der Luftwaffe had no recourse but to withdraw the Ju87 from the Cherbourg area to the Pas de Calais where it was to sit out the closing phases of the Battle.

AIRCRAFT DATA AND PERFORMANCE

FIGHTERS

AIRCRAFT	Hawker HURRICANE A	Hawker HURRICANE B	Supermarine SPITFIRE A	Supermarine SPITFIRE B	Messerschmitt BF109	Messerschmitt BF110
Nationality	British	British	British	British	German	German
Crew	1	1	1	1	1	2
Weight Empty	2,180 kg	2,260 kg	2,049 kg	2,138 kg	1,905 kg	4,750 kg
Weight Loaded	2,845 kg	2,924 kg	2,651 kg	2,744 kg	2,710 kg	6,250 kg
Wing Span	12.19 m	12.19 m	11.23 m	11.23 m	9.9 m	16.3 m
Wing Area	23.97 m^2	23.97 m^2	22.48 m^2	22.48 m^2	16.2 m^2	38.4 m^2
Engine	RR Merlin II	RR Merlin III	RR Merlin II	RR Merlin III	DB 601A	2 x DB 601A
Engine Power	1,030 hp	1,030 hp	1,030 hp	1,030 hp	1,175 hp	2 x 1,175 hp
Armament	8 x 0.303 in Browning	8 x 0.303 in Browning	8 x 0.303 in Browning	8 x 0.303 in Browning	2 x 7.92 mm MG-17 2 x 20 mm MG-FF Cannon	4 x 7.92 mm MG-17 2 x 20 mm MG-FF Cannon 1 x 7.92 mm MG-15
Bomb Load	-	-	-	-	-	500 lbs
Max Speed	340 mph	328 mph	346 mph	335 mph	348 mph	349 mph
Ceiling	33,900 ft	34,200 ft	34,400 ft	34,700 ft	36,000 ft	32,000 ft
Range	340 miles	325 miles	415 miles	395 miles	412 miles	530 miles

BOMBERS

AIRCRAFT	Bristol BLENHIEM	Junkers JU87	Junkers JU88	Heinkel HE111	Dornier DO17
Nationality	British	German	German	German	German
Crew	3	2	4	5	5
Weight Empty	3,674 kg	2,750 kg	9,860 kg	8,680 kg	5,210 kg
Weight Loaded	5,670 kg	4,250 kg	14,000 kg	14,000 kg	8,590 kg
Wing Span	17.2 m	13.8 m	18.25 m	22.6 m	18 m
Wing Area	43.6 m^2	31.9 m^2	50.2 m^2	87.6 m^2	55 m^2
Engine	2 x Mercury VIII	Jumo 211A	2 x Jumo 211B	2 x DB 601A	2 x Bramo 323P
Engine Power	2 x 840 hp	1,200 hp	2 x 1,200 hp	2 x 1,175 hp	2 x 1,000 hp
Armament	2 x 0.303 in Browning	2 x 7.9mm MG-17 1 x 7.9mm MG-15	3 x 7.92 mm MG-15	3 x 7.92 mm MG-15	up to 8 x 7.92mm MG-15
Bomb Load	1,000 lbs	1,100 lbs	4,000 lbs	4,400 lbs	2,200 lbs
Max Speed	285 mph	232 mph	286 mph	247 mph	265 mph
Ceiling	27,280 ft	26,500 ft	26,500 ft	26,250 ft	26,400 ft
Range	1,125 miles	370 miles	1,553 miles	1,224 miles	745 miles

OTHERS

OTHER AIRCRAFT	Boulton-Paul DEFIANT
Nationality	British
Crew	2
Weight Empty	2,757 kg
Weight Loaded	3,773 kg
Wing Span	12 m
Wing Area	23.2 m^2
Engine	RR Merlin II
Engine Power	1030 hp
Armament	4 x 0.303 in Browning
Bomb Load	-
Max Speed	304 mph
Ceiling	30,350 ft
Range	465 miles

CHAPTER 6
BATTLE OF BRITAIN REMEMBERED

During the 1930's, the British Air Ministry commissioned two new monoplane fighters, the Hawker Hurricane and Supermarine Spitfire, both of which were in squadron service by 1938. These aircraft were very different to the comparatively slow and delicate biplanes that the RAF's pilots had flown in the First World War. Fighter tactics were drawn up from theories based upon fighters intercepting lone and unescorted bombers. This was because Britain exceeded the range of German fighters, flying from German bases, so fighter-to-fighter combat was considered to be of secondary importance, not to mention unlikely. Thus in Britain, Fighter Command's pilots flew their monoplane fighters in tight 'vics' of three, practicing carefully coordinated attacks against either lone or small numbers of enemy bombers. Actual combat experience during the Spanish Civil War had already taught the Germans that such tactics were already obsolete.

Hitler had secretly rebuilt his Luftwaffe with new aircraft of the latest monoplane design, including both bombers and fighters. Taking the Blitzkrieg formula into account, German fighter design included features suitable for attacking both fighters and bombers. For example, the Messerschmitt 109, like the Hurricane and Spitfire a fast, single-engine fighter, was not only armed with two 7.9 mm machine-guns, but also two 20 mm cannon. Although the latter had a much slower rate of fire, the effects were devastating. The 109's engine was also fuel injected, meaning that it was unaffected by gravity whilst in a diving attitude. By comparison, the British fighters did not enjoy the benefits of cannon, but were instead armed with eight .303 machine-guns. Also, no thought had been given in England to fuel injection, the British fighters' Rolls Royce Merlin engines relying on the simple float carburetor system, this later giving the German fighter superiority in the dive.

During the Spanish Civil War Germany developed a new formation known as the Schwarm, this comprising four fighters spread out very loosely in a stepped up line abreast similar to the fingers of an outstretched hand, there being as much as 200 collision. When battle was joined the Schwarm would split into the Rotte of two fighting pairs, leader and wingman. Indeed, this remains the basic fighter formation even today. Germany also first used dive-

bombers in Spain, the much-feared Stukas, and medium bombers in support of fast moving armor and infantry.

On May 10th, 1940, German forces attacked Belgium, Holland, Luxembourg and France. In what came as a surprise attack, German armor poured through the supposedly impassable Ardennes forest, effectively and immediately outflanking the Maginot Line in the process. The Allies having been collectively overwhelmed, they were finally evacuated from the beaches around Dunkirk, the Royal Navy and 'Little Ships' rescuing some 330,000 Allied troops. Left behind, however, was all artillery, armor and much other equipment. And the RAF component, the Advanced Air Striking Force, had also suffered grievous losses. Sensibly, British Fighter Command had retained its precious Spitfires for home defense, the more numerous Hurricane squadrons having been sent to fight in the ill-fated French campaign.
Given that the First World War had raged for five years, the fact that France had fallen in a matter of six weeks was completely stunning.

The opportunity to invade England had been an unexpected bonus for Hitler. Although the RAF clearly faced problems across the English Channel, so too did the Germans. Barges suitable to carry an invasion force across the Channel had to be found, converted, and concentrated in and around Calais. Despite the fact that the Luftwaffe had been designed to support fast moving ground forces, however, it now found itself required to operate in a strategic role. German bombers were of a medium capacity, so lacked the performance and bomb carrying capacities of the later four-engine Allied bombers. Also, excellent though the Me 109 was, it was intended for use not as an offensive escort fighter but in a defensive role meaning that its range was too limited, providing just 20 minutes flying time over London. Nevertheless, the Germans had great advantages in experience and enjoyed numerical superiority.

Thirteen German divisions, each some 19,000 strong, were moved to the Channel coast as the vanguard of a landing force comprising 39 divisions. Plans were made for the disembarkation of 125,000 men during the invasion's first three days. The German service chiefs agreed that Operation Sealion(Sealion, the proposed sea borne invasion of England) would only be feasible if the Luftwaffe defeated the RAF, achieving total aerial supremacy prior to the fleet setting sail.
Britain did have one particular advantage: radar, or more correctly 'Radio Direction Finding'. The extra few minutes warning given by this new

detection system would make it possible for the defending fighters to 'scramble' (emergency take-off) and attain an appropriate height and position favorable for interception. By the summer of 1940, the radar chain around the British Isles comprised 22 'Chain Home' stations and 30 'Chain Home Low' stations. Each was positioned to ensure, at least in theory, that every aircraft approaching Britain from the east or south would be detected by at least two stations. Radar therefore became the keystone of Air Defense, with its network of RDF stations, Observer Corps posts and centers, sector operations rooms, radio-telephony transmitters, landlines and ancillary devices. Germany failed to fully understand its significance, which would be a major factor during the Battle of Britain.

For the air defense of Great Britain, Fighter Command divided the British Isles into four Group areas, each with its own commander and headquarters but answerable to Fighter Command HQ (Bentley Priory). London and the southeast was defended by No 11 Group, No 12 Group protected the Midlands and the north, whilst Northern Ireland was the responsibility of 13 Group. No 10 Group, covering the West Country and South Wales, became operational on July 8th, 1940, just in time for the Battle of Britain II. Although each Group Commander had commitments to his own area, he was also obliged to respond to calls for assistance from 11 Group, which would clearly bear the brunt of the fighting. Each Group was then sub-divided into Sectors, each with its own Sector Station, effectively a local HQ comprising both an aerodrome and Sector Operations Room.

The 'System' worked as follows:

- The RDF station would detect an increase in enemy activity over the French coast as a raid assembled.

- This information would be passed by landline to the underground Filter Room at Fighter Command. There the information was sifted by filterers and filter officers, displayed on a gridded map and passed by tellers through closed speech circuits to both the adjacent Command Operations Room and those of the appropriate Groups.

- After incoming aircraft had crossed the coast, the Observer Corps was responsible for tracking their progress. Posts reporting to the Observer Centers which were connected by landline to the Command Operations Room. From the latter were issued orders to local civilian authorities regarding when to sound warning sirens. Tactical control, however, was delegated to the Groups and Sectors who issued orders directly to stations, squadrons and the Gun Operations Room which tied antiaircraft guns into the System.

- In each Group Operations Room, at least one Controller was always on duty, looking down on a huge gridded map showing the Group area colored plaques manipulated by WAAFs, armed with magnetized wands. Facing the Controller across a table was a ‘totalisator’ (or 'tote') which showed at a glance the location and readiness state of each squadron.

- The Group Controller would decide upon the appropriate course of action in respect of each and every threat, and give appropriate orders to Sector HQ and Gun Operations Rooms.

- The Sector Controller would then either bring his squadrons to a state of ‘Readiness’, i.e. ready for immediate take-off, or send them into the air as appropriate. Once the squadrons were airborne, he would provide them with information and instruction until such time as the formation leader sighted the enemy. By that time, the skill of the Sector Controller should theoretically have favorably positioned the squadrons to attack. When the formation leader cried ‘Tally Ho!’, the Controller knew that battle was about to be joined, his part played.

Despite the fact that the main attack would obviously fall upon southern England, not all RAF strength was concentrated in that area. Squadrons were, in fact, dispersed across the country, meaning that not only was the whole country protected but that fresh squadrons were available to be sent south as reinforcements. By the same token, it was possible to withdraw depleted squadrons north to rest and re-fit.
In July 1940, the opposing forces compared as follows:

RAF FIGHTER COMMAND

Spitfires	286
Hurricanes	463
Defiants	37
Blenheims	114
Total:	**900**

LUFTWAFFE

Aircraft in Air Fleets 2, 3 & 5:-	
Fighters:-	
Me 109s	844
Me 110s	250
Bombers: -	
Ju 87s	280
Do 17, Ju 88, He 111s	1,330
Long Range Recce	80
Total:	**2,784**

RAF Fighter Command was therefore outnumbered by nearly 3:1 in purely numerical terms. Naturally, enjoying unparalleled success, the Germans were confident. Working against them, however, were the facts that their personnel were tired, having been flying constant operations since May 10th, and their aircraft were in need of attention. Defying these men and machines was not only Fighter Command, in fact, but also the English Channel, every sortie over England dictating two sea crossings. German airman shot down over England or perhaps even the Channel, were likely to become prisoners. An Allied airman shot down could, conversely, even be back in the air later that same day.

Officially, the Battle of Britain II is deemed to have begun on July 10th. As the battle developed, distinctive phases, dictated by the attacker, would become apparent. The first concerned enemy attacks against Channel bound convoys. Fighter Command was therefore compelled to fly hundreds of sorties per day to protect this vital merchant shipping.

This phase of the Battle of Britain II lasted until August 12th, by which time 30,000 out of nearly five million tons of shipping fell victim to enemy air attacks between Land's End and the Nore. Raids were also mounted by dive-bombers against various Chain Home radar stations, including those at Pevensey, Rye, Dover and Ventnor. Small and therefore difficult to hit, none of these stations were put out of action for more than 24 hours, so Fighter Command was never denied the advantages of radar. During this phase, the Luftwaffe had lost 261 aircraft, Fighter Command 261.

On August 2nd, orders were issued to Luftflotten (Air Fleets) 2, 3 and 5 to destroy Fighter Command. This new phase commenced on August 13th, and concentrated on Fighter Command's airfields in southern England. During this phase, the Germans, flying from northern bases, attacked targets in northern England. To their dismay, however, mistakenly believing RAF fighters to be concentrated in southern England, they were met by Hurricanes and Spitfires in force, due to clever deployment of squadrons. German losses were heavy. Nevertheless, Fighter Command's airfields in 11 Group had taken a pounding and the situation was critical. Reichsmarschal Goering now turned his attention to London and a new phase consequently began on September 7th. Although this was bad news for Londoners, the unexpected respite allowed Fighter Command to return its hard-hit aerodromes to 'top line'. During the 'Battle of the Airfields', the Luftwaffe lost 629 aircraft, Fighter Command 385.

London was, the Germans had decided, the only target likely to force the British to commit large numbers of fighters to defend. On that basis virtually the entire The first in this series of attacks against London came on the afternoon of Saturday, 7th September. Hundreds of bombs crashed down on docklands east of Tower Bridge. As this latest fire of London later illuminated the night sky, the raiders returned in wave after wave. The attack concluded at 0430 a.m. the following day, by which time 1,800 Londoners were dead.

On Sunday, September 15th, the Luftwaffe launched what became its last attempt to gain a decision in daylight over London. Dawn on the great day found most of southern England shrouded with mist, but as the sun climbed higher this quickly evaporated. The fine weather therefore heralded a predictable onslaught. Before 11 a.m., German reconnaissance aircraft had probed the Straits of Dover and the East Coast of Kent. From first light onwards, standing patrols of Spitfires and Hurricanes had been up over the coast from Harwich to Land's End. Each Sector Station kept one squadron at Readiness. At 10.50 a.m., the British radar stations reported an enemy formation assembling SE of Boulogne. Five minutes later all of 11 Group's

squadrons were at Readiness.

At 11.33 a.m., an enemy formation crossed the coast between Dover and Folkestone, being followed three minutes later by two further hostile plots between Dover and South Foreland. The raiders' targets were London's gas works and other industrial objectives. To parry this thrust, squadrons were airborne, reinforced at midday by the five squadrons of 12 Group's so-called 'Duxford Big Wing', led by Squadron Leader Bader. Such was the ferocity of Fighter Command's attack that the enemy apparently bombed at random across southern England. Two bombs fell on Buckingham Palace. Hardly had this first mass attack been dispersed, however, than the radar stations reported further incoming raids. Between 2.10 and 2.34 p.m., eight or more German formations crossed the English coast bound for London. Having lit fires in Woolwich, Barking, Stepney, Stratford Gasworks, West Ham, Penge, and at a petrol depot in West Ham, the Luftwaffe withdrew, constantly harried by the defenders.

Next, 27 He 111s attacked Portland and were intercepted by just six Spitfires, and six RAF fighter squadrons coupled with accurate anti-aircraft fire frustrated an attack on the Supermarine factory near Southampton. This thwarted raid marked an end to the fighting on what has since become annually celebrated in Britain as 'Battle of Britain Day'. Although Fighter Command's pilots claimed a total number of 185 enemy aircraft destroyed, more recent research confirms the actual figure as 58. Nevertheless, Fighter Command lost just 28 aircraft, and was able to sustain such losses for longer still.

On Tuesday, September 17th, British Intelligence intercepted a German signal ordering the dispersal of invasion facilities: Sealion had been postponed indefinitely.

The Battle of Britain did not end, however, with the fires in London on September 15th, although clearly that date represented a climax and it provides an ending to this simulation. Attacks on London continued, during daylight for a while longer yet, although by smaller formations. Successful attacks were made on various targets connected with the British aircraft industry, although on September 30th, KG55's He 111s took a beating during an ill-fated raid on the Westland Aircraft Factory at Yeovil in Somerset. As a result, the He 111 was transferred to the night blitz, which had already started against British cities and which continued right up until May 1941.

Although Britain's cities continued to suffer at night given that nocturnal

defenses remained in their infancy, it was recognized that RAF Fighter Command had won the daylight battle lasting 16 weeks. The British Prime Minister paid tribute to RAF Fighter Command:
“ The gratitude of every home in our island . . . goes out to the British airmen, who, undaunted by odds, unwearied in their constant challenge and mortal danger, are turning the tide of world war by their prowess and devotion. Never in the field of human conflict has so much been owed by so many to so few. ”

Dilip Sarkar has been fascinated by the Battle of Britain since childhood. Over the last 20 years he has compiled a huge archive of memories and photographs from primary sources including surviving veterans and the relatives of casualties. He is now the author of 12 highly acclaimed books on the Battle of Britain and related subjects.

CHAPTER 7
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Rainer Rainman Rohde
Steve Redfern
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Thomas Launder
Todd M. Garner

Battle of Britain Development Group (BDG)

A talented freeware group who continued to develop Rowan's Battle of Britain for more than three years after its release. Battle of Britain 2 "Wings of Victory" development started with the excellent work of BDG.

Programming
AtariBaby
Buddye "Buddye1" Lavender
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KH "viper-" Zeller
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Wolfram "Osram" Kuss

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JRT
Old Dux
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Jose Luis "luke97" Galvan

BDG Manual
Welsey “Wildman” Netcher

BDG Website
GT

Special Thanks
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Dave “Rowan” Whiteside
Ken "KC23" Cook

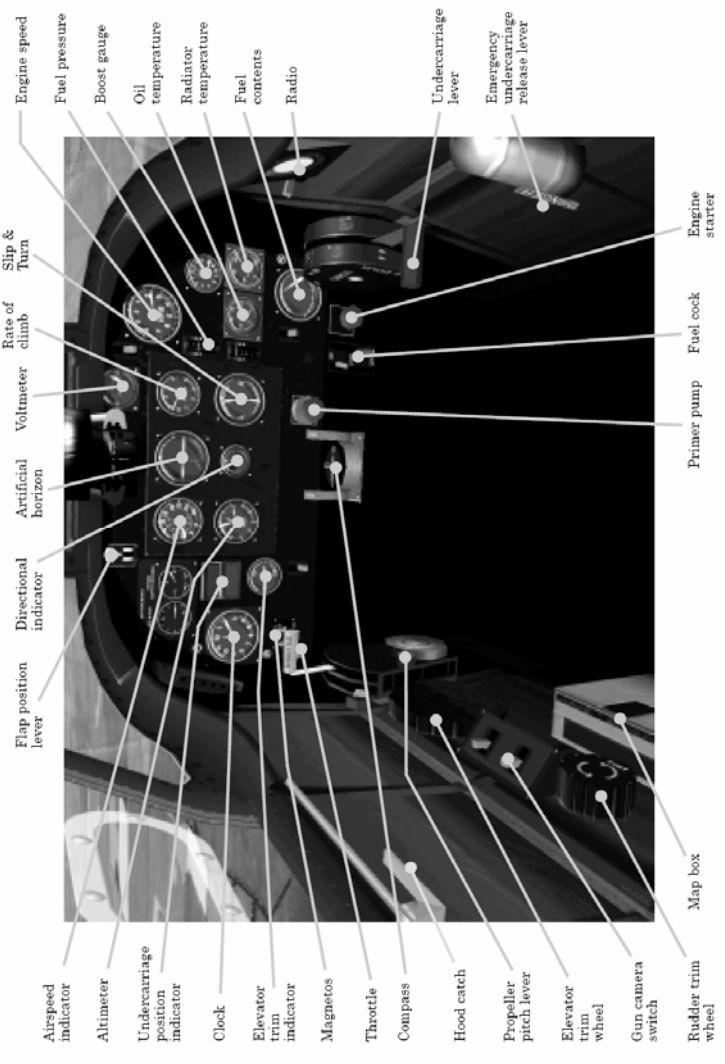
People who worked on previous versions:
Captain Farrel Texture templates
Carlos 'PIPO' Cuevas Translate Manual to Spanish
Eko, Lobo_Mau 3d modelling
Jiri "hyper-" Fojtasek Coder
Julian “Codec” Onions Flight model, vehicle manager foundations
Mark "A.Fokker" Linnemann MP host
RSColonel_131st Original web site
Tailslide, Dragonflyer, Weasel75, Glop Coding and help with CVS
Ursus HiRes cockpits

TECHNICAL SUPPORT

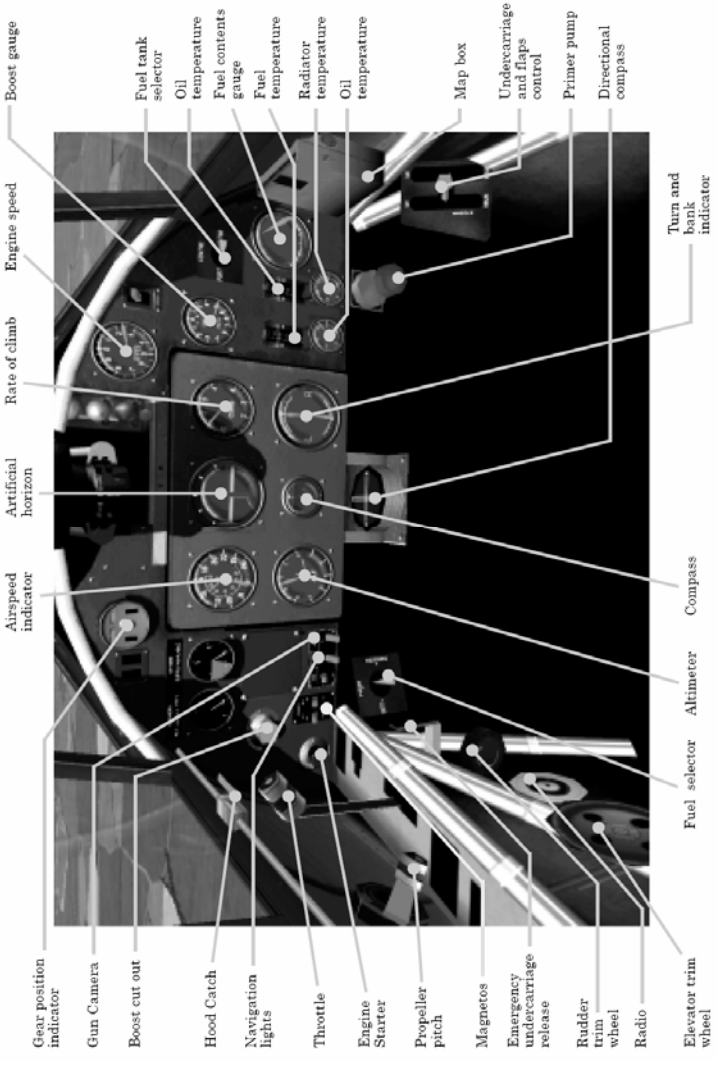
Please visit: www.g2games.com/support

APPENDIX A: COCKPITS

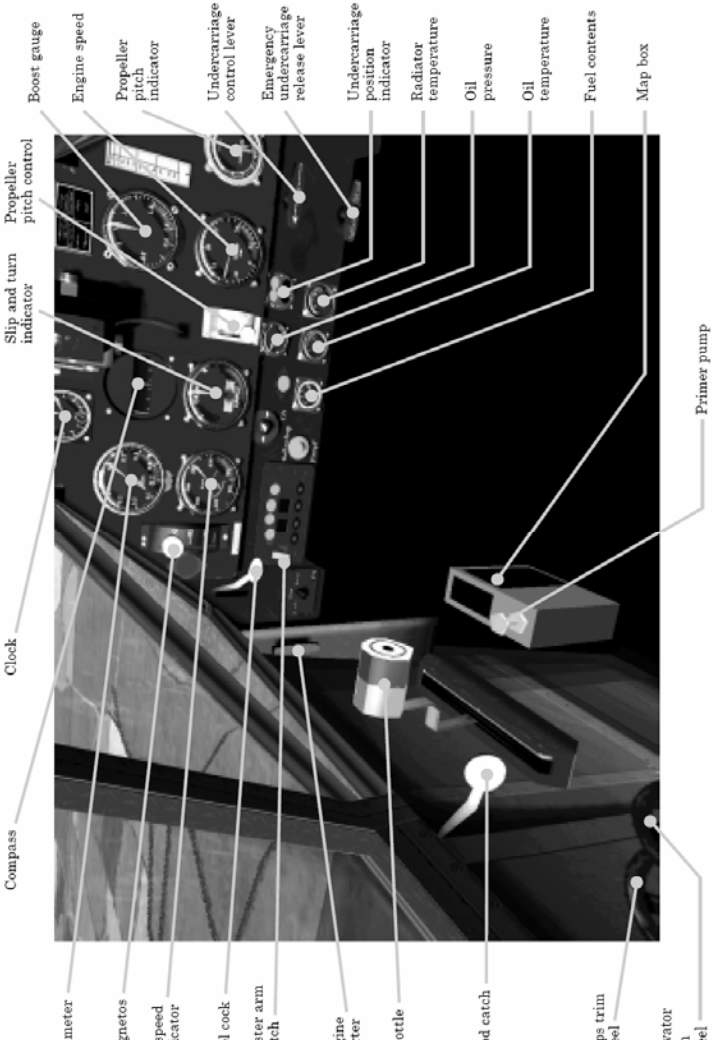
SPITFIRE



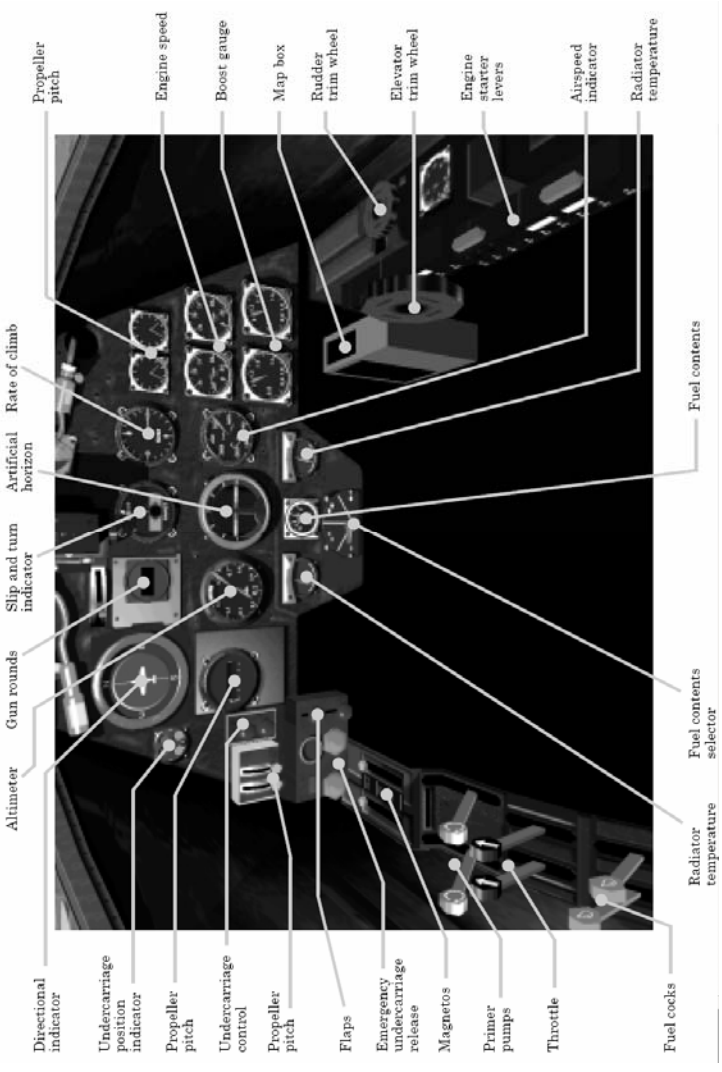
HURRICANE


Boost gauge
Fuel tank selector
Oil temperature
Fuel contents gauge
Fuel temperature
Radiator temperature
Oil temperature
Engine speed
Map box
Undercarriage and flaps control
Primer pump
Directional compass
Rate of climb
Turn and bank indicator
Artificial horizon
Airspeed indicator
Compass
Altimeter
Fuel selector
Gear position indicator
Gun Camera
Boost cut out
Hood Catch
Navigation lights
Throttle
Engine Starter
Propeller pitch
Magnetos
Emergency undercarriage release
Rudder trim wheel
Radio
Elevator trim wheel

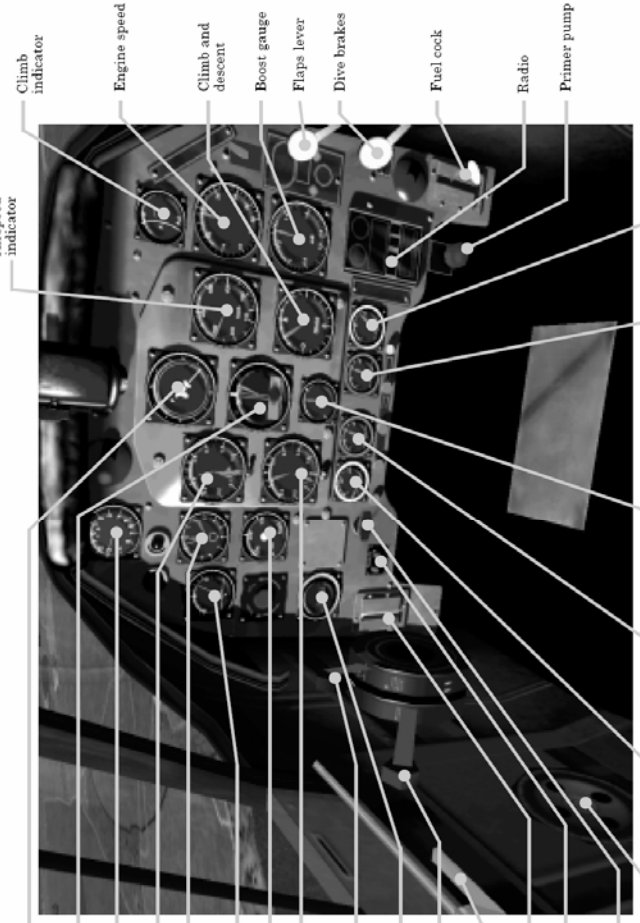
BF109


Boost gauge
Engine speed
Propeller pitch indicator
Undercarriage control lever
Emergency undercarriage release lever
Undercarriage position indicator
Radiator temperature
Oil pressure
Oil temperature
Fuel contents
Map box
Propeller pitch control
Slip and turn indicator
Clock
Compass
Primer pump
Altimeter
Magnetos
Airspeed indicator
Fuel cock
Master arm switch
Engine starter
Throttle
Hood catch
Flaps trim wheel
Elevator trim wheel

BF110


Propeller pitch
Engine speed
Boost gauge
Map box
Rudder trim wheel
Elevator trim wheel
Engine starter levers
Airspeed indicator
Radiator temperature
Rate of climb
Artificial horizon
Slip and turn indicator
Gun rounds
Altimeter
Fuel contents
Fuel contents selector
Radiator temperature
Directional indicator
Undercarriage position indicator
Propeller pitch
Undercarriage control
Propeller pitch
Flaps
Emergency undercarriage release
Magnetos
Primer pumps
Throttle
Fuel cocks

STUKA


Airspeed indicator
Climb indicator
Engine speed
Climb and descent
Boost gauge
Flaps lever
Dive brakes
Fuel cock
Radio
Primer pump
Oil contents gauge
Oil temperature
Propeller pitch
Radiator temperature
Fuel contents gauge
Directional compass
Slip and turn
Dive preset
Altimeter
Clock
Voltmeter
Rate of climb
Radio altimeter
Prop Pitch
Compass
Throttle
Hood catch
Fuel cock lever
Magnetos
Engine starter
Elevator trim wheel