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ENEMY ENGAGED – RAH-66 COMANCHE VERSUS KA-52 HOKUM

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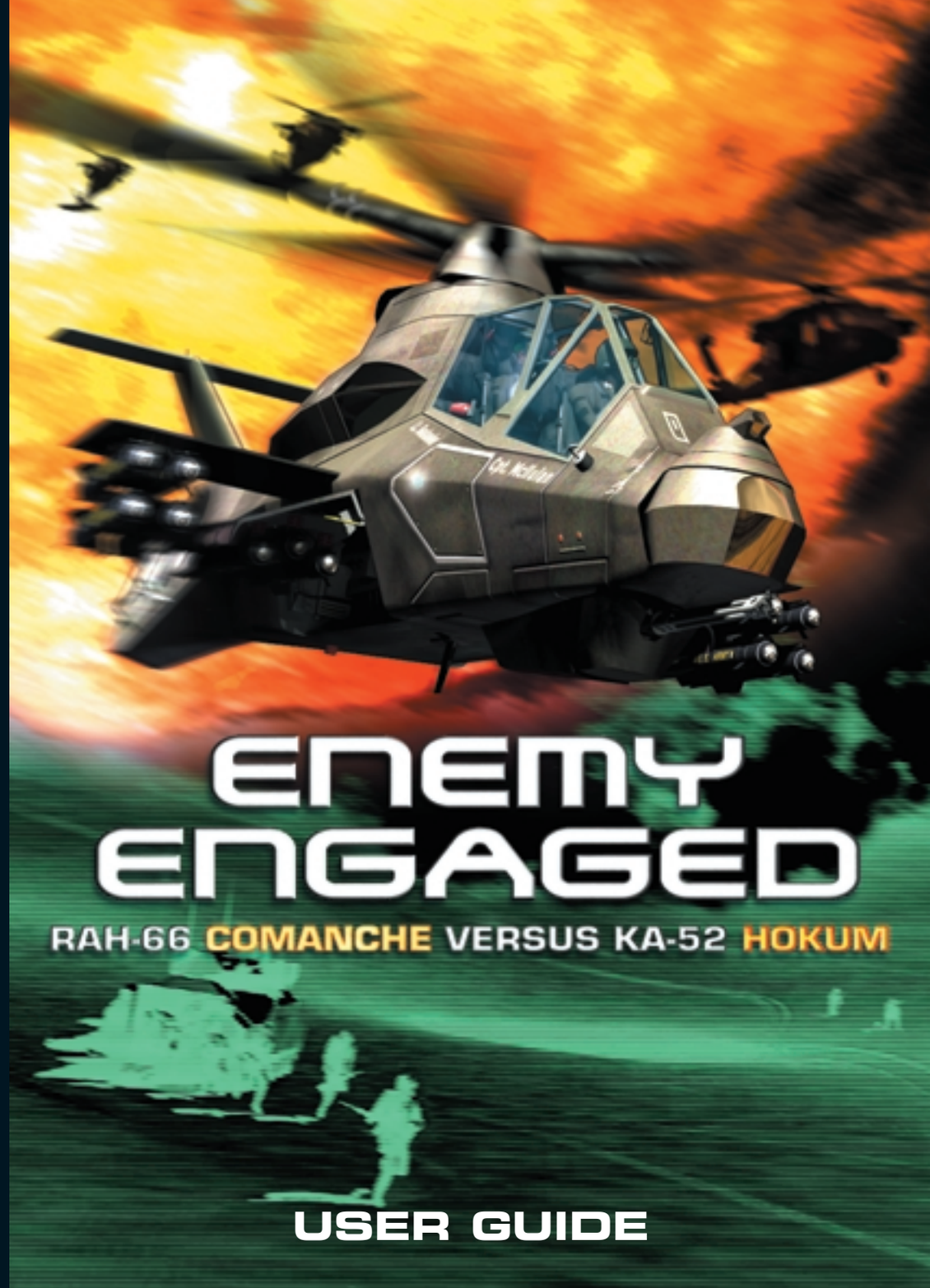

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ENEMY ENGAGED

RAH-66 COMANCHE VERSUS KA-52 HOKUM

www.razorworks.com

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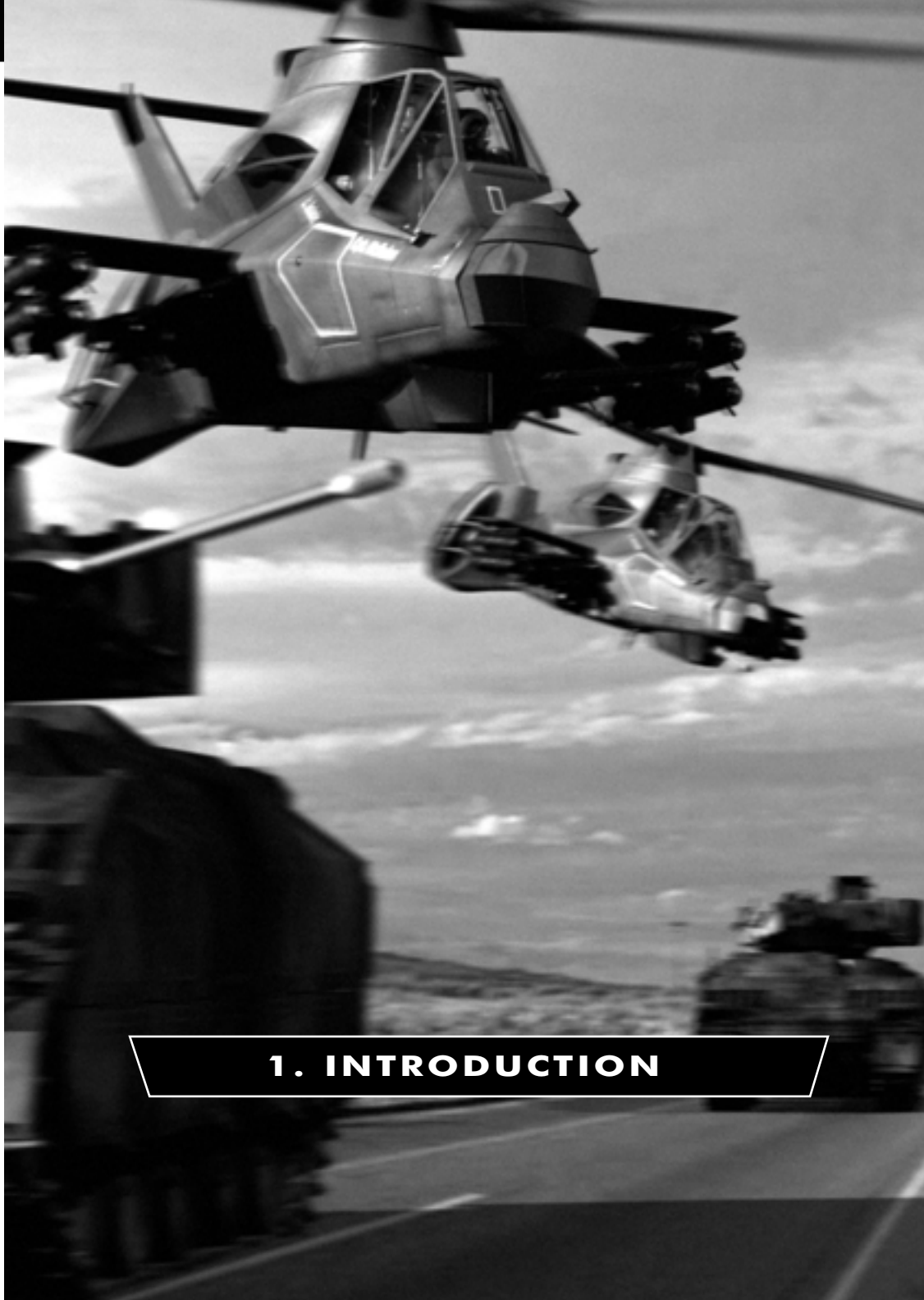


1. INTRODUCTION

Enemy Engaged
RAH-66 Comanche Versus Ka-52 Hokum

Throughout this manual the game title is abbreviated to 'Comanche Hokum'.

Comanche Hokum is a combat flight simulator showcasing two state-of-the-art helicopters; the American RAH-66 Comanche and the Russian Ka-52 Hokum B.

Both of these formidable gunships are capable of day, night and all weather missions and able to operate away from base for extended periods at the front line.

Comanche Hokum provides an accurate simulation of both helicopters including realistic flight dynamics, authentic weapons systems and detailed cockpits, displays and instruments. You can fly as both pilot and co-pilot/gunner and the crew are fully animated to increase the immersion.

There are options to configure the game for both novice and accomplished players. A 'Quick Start' keyboard guide has also been included.

Comanche Hokum features three diverse, real world combat zones, accurately modelled from digital data. The landscapes have rugged terrain ideally suited to low-level helicopter combat and making 'line of sight' tactics a real part of the game play. Each campaign can be played from either standpoint and in multiplayer games you can fly co-operatively or competitively with other players.

The campaign 'engine' is fully dynamic and reactive. There are no scripted events or outcomes. The war rages continuously, even when you are at a base re-arming and re-fuelling. You fly realistic missions with your wingmen and can co-ordinate attacks via radio messages. Your skill and judgement will determine success or failure.

Comanche Hokum features in excess of 60 different aircraft and vehicles all of which are highly detailed and articulated and have realistic payloads and physics.

If you have Apache Havoc installed then Comanche Hokum will allow you to play the Apache Havoc campaigns and to fly the Apache and Havoc gunships.

Getting Started

Installation

Insert your Comanche Hokum CD into your drive. If 'Autorun' is enabled on your system, the Setup program will start automatically. If Autorun is not enabled, from Windows Explorer, click on the autorun.exe icon on the Comanche Hokum CD.

Follow the on-screen instructions. Once all of the files have been copied on to your hard drive, the installation process will create a shortcut for you.

Please note that a Direct3D compatible graphics accelerator card is required to run Comanche Hokum.

Starting

Comanche Hokum requires the full resources of your computer so terminate all other running applications before starting.

The program requires the Comanche Hokum CD in your drive at all times during use.

To start the game, click on the Comanche Hokum shortcut created by the installation program.

If you experience any difficulty running Comanche Hokum then refer to the 'Trouble Shooting' section in the Appendices.

Exiting

To exit Comanche Hokum return to the Main screen and click on the 'EXIT' button.

Alternatively, press Ctrl + X at any time.

Quick Start

To get in the air quickly then follow these steps:-

1. On the Main screen select 'Combat'
2. On the Combat screen select 'Free Flight'
3. On the Session screen select a scenario then 'OK'
4. On the Gunship screen select a gunship then 'SELECT'

You will be transferred to a base and placed in the cockpit of your gunship. You have infinite weapons and fuel and are invulnerable to crashes. The enemy will not fire at you. These options may be changed on the Session screen after selecting the scenario.

Refer to the 'In-Flight' chapter 'Basic Handling' section for the take-off and flight procedures. Use the 'Quick Start' keyboard guide.

Press ↵ to view the map. Press Ctrl + Q to quit.

Strategy Guide

On the Comanche Hokum CD is a Strategy Guide containing useful game play tactics and much more. This is a HTML document and requires a web browser to read it.

Look in the 'Strategy Guides\Comanche Hokum Guide' folder.

Updates

Check www.razorworks.com for latest information and updates.

Compatibility With Apache Havoc

If you have Apache Havoc installed then Comanche Hokum will allow you to play the Apache Havoc campaigns and to fly the Apache and Havoc gunships. Effectively giving Comanche Hokum 6 combat zones and 4 different gunships to fly.

The installed version of Apache Havoc is not upgraded by Comanche Hokum and cannot play the new campaigns.

For full compatibility you must upgrade the installed version of Apache Havoc to version 1.1E. The upgrade patches are supplied on the Comanche Hokum CD in the 'Apache Havoc Patches v1_1e' folder. Simply launch the patch.exe within the language folder that matches your version of Apache Havoc. Then run Apache Havoc once to apply the changes.

Conversion Training From Apache Havoc

If you are familiar with Apache Havoc then Comanche Hokum should be straight forward to get used to. However, you should at least read chapter 2 'Menu Screens' and chapter 3 'In-Flight' in this manual.

The Comanche Hokum keyboard layout is nearly identical to the Apache Havoc keyboard layout. The 'select object to view' keys F5 to F8 have been changed. The cockpits are now fully virtual and there are some key changes. The new keys are documented in the 'In-Flight' chapter.

If you fly the Apache or Havoc gunships from within Comanche Hokum, their cockpits are the same as in Apache Havoc and only the pilot's seat is modelled.

An incoming laser guided missile warning has been added to the Apache Aircraft Survivability Equipment (ASE) MFD page and to the Havoc Threat Warning Display (TWD).

The Havoc TWD uses the right most lamp to indicate a laser guided missile warning. This was previously documented as an early warning radar (EWR) lamp.

The new 'altitude hold' function Alt + H does not apply to the Apache or Havoc gunships.

The Havoc 'Toggle HUD size' key has been changed from Alt + K to Ctrl + K

Comanche Hokum cannot read the Apache Havoc pilot logs.

2. MENU SCREENS

Use the mouse to make selections unless stated otherwise. You can click on 'live' text – that is text which changes colour as you move the mouse over it.

Main Screen

Combat

Choose this option to advance to the Combat screen to select a game type.

Pilots

Choose this option to advance to the Pilots screen where you can select and create pilots and view their logs and medals.

Options

Select this option to change the game settings.

EXIT

Exit the game.

Pilots Screen

Pilot Roster

The pilot roster allows you to Add, Rename and Delete pilots.

Select a pilot by clicking on his name.

Blue Force

Choose Blue Force to display the selected pilot's logs and medals for flying the Comanche (and Apache if Apache Havoc is installed).

Red Force

Choose Red Force to display the selected pilot's logs and medals for flying the Hokum (and Havoc if Apache Havoc is installed).

Medals

Choose Medals to view the selected pilot's medals.

Weapons Log

Choose Weapons Log to view the selected pilot's weapons log.

Flight Log

Choose Flight Log to view the selected pilot's log.

Rank

The selected pilot's rank and date commissioned are displayed.

OK

Return to the Main screen.

Options Screen

Controls

Ensure that you have calibrated your game controllers before launching Comanche Hokum (from the Start menu select Settings then Control Panel then Game Controllers).

Cyclic

Select Keyboard or Joystick for the cyclic stick.

Collective

Select Keyboard or Throttle for the collective lever.

Pedals

Select Keyboard or Rudder Pedals for the pedals.

Device

Cycle through the available game controllers to select the required device.

Reverse Throttle

A collective lever works in the reverse sense to a jet aircraft throttle. Setting this option to on makes the collective work in the same sense as the throttle.

Multiplayer

To create (host) or join multiplayer games you will need to select a service provider (connection method). Some service providers will require additional properties to be entered.

You can join multiplayer games at any time as long as you have chosen an identical service provider to the host.

When connecting to another player via a modem connection, the player who answers the call is automatically assigned the host status. The host must wait in the Multiplayer screen in order to connect to an incoming call.

Connection

Cycle through the connection options (Internet TCP/IP, Modem, Serial, IPX, etc.) to select the required service provider and then enter the required parameters.

Dynamics

The options marked with an asterisk (*) are explained fully in chapter 6 'Ground School'.

*Blade Stall

Set retreating blade stall effect on or off. The imbalance of lift created by this effect will cause the helicopter to roll and the pilot to apply constant cyclic corrections. Novice pilots should turn this effect off.

Cross Couple

Set cross coupling effect on or off. With this option turned on the pilot will notice minimal turning effect upon large collective inputs. Turning the cross coupling effect off will require constant yaw input to maintain heading. Novice pilots should turn this effect on.

*Ground Effect

Set ground effect on or off. The ground effect simulates low altitude air cushioning created by the rotor downwash. Novice pilots should turn this effect off.

Keyboard Assist

Set keyboard assistance on or off. Helicopter flight requires subtle inputs unobtainable from keyboard control. Keyboard assistance implements a damping factor to help provide these inputs and allow smoother flight.

Over-Torque

Set over-torque effect on or off. With over-torque set to off you will not get over-torque warnings when the torque readout exceeds 100% and the gunship will not be damaged. Novice pilots should turn this effect off.

*Vortex Ring

Set the vortex ring effect on or off. You can unintentionally create a vortex ring around your main rotor if you make a sustained high-speed descent vertically or at a steep angle. This is a hazardous situation! Novice pilots should turn this effect off.

Wind

Set wind effects on or off. Novice pilots should turn this effect off.

Realism

Co-Pilot Target ID

Sets the method in which target identifications are reported. Refer to 'CP/G Assistance: Target ID' in the 'Comanche Cockpit' and 'Hokum Cockpit' chapters.

Co-Pilot ECM

Set Co-Pilot operating counter measures on or off. Set to on and the Co-Pilot will take care of releasing chaff and flares and will operate the IR and Radar jammers. You can release extra chaff and flares if required.

Avionics

Select either Novice or realistic avionics. With Novice avionics selected you do not need to operate the targeting devices. Arming a weapon will arm the HIDSS / HUD targeting modes automatically and you can designate targets simply by looking at them. Refer to the 'Comanche Cockpit' and 'Hokum Cockpit' chapters.

Also, with Novice selected your wingmen are initially set to 'Weapons Free' so you do not need to send a radio command to make them fire.

Difficulty

The difficulty option affects the enemy's response time and the amount of weapon damage incurred. This only affects you and not the other entities in the world. In multiplayer games each player retains their own difficulty level. That is, this value is not set globally by the server. Therefore a novice player can compete with more experienced players by adjusting their respective difficulty levels.

At the Easy difficulty setting, the player's weapons do not take account of 'armour penetration angles'. Usually, if a weapon hits the front of a tank, where it is more heavily armoured, then less damage will be inflicted than if the weapon hits the rear or sides of the tank.

Graphics

Terrain Detail

Select 3D terrain detail to suit your processor speed. High detail demands more processor power than Low detail.

Object Detail

Select 3D object detail to suit your processor speed. High detail demands more processor power than Low detail.

Cockpit Detail

Select cockpit detail to suit your processor speed. High detail demands more processor power than Low detail.

Rain Textures

Cockpit rain textures may be set on or off as a matter of preference.

Cockpit Rotors

The main rotor blur effect visible from the cockpit may be set on or off as a matter of preference.

Device Selection

Cycle through the available hardware graphics devices and select the hardware which has the best Direct3D support. Changing device requires you to restart Comanche Hokum.

Screen Resolution

Cycle through the available screen resolutions and click 'Accept' to apply.

Sound

Sound Effects

Set sound effects on or off.

Music

Set music on or off.

Speech

Set all speech on or off.

Co-Pilot Speech

Set Co-Pilot speech on or off.

OK

Exit the Options screen.

Combat Screen

There are three different game types offered in the Combat screen plus a demo mode.

Campaign

Campaign games are large-scale dynamic campaigns based over the entire map. To win the campaign you need to complete all of the given objectives.

Skirmish

Skirmish games are mini-campaigns contained within a small area of the map. Skirmish games provide useful practice before taking on a full campaign and also require much less bandwidth in multiplayer games.

Free Flight

Free Flight games allow you to explore all of the flying areas, practice flying and familiarise yourself with the avionics and weapons systems.

Demo

The demo allows you to watch a campaign in action.

Press Ctrl + Q or Esc to quit the demo.

CANCEL

Return to the Main screen.

Session Screen

The session list shows all of the available games.

New games are listed in white text. If you have selected a multiplayer connection then starting a new game makes you the host of that game.

Existing multiplayer games are listed in amber text. You may join these games at any time.

Saved games are listed in green text. Saved games may be renamed or deleted.

After you have selected a game, the game details and options are displayed.

Select 'OK' when you are ready to continue.

Select 'CANCEL' to return to the Combat screen.

Gunship Screen

From the Gunship screen select which side you want to play the campaign from.

Select 'RAH-66 Comanche' for the Blue Force and 'KA-52 Hokum B' for the Red Force.

If you have Apache Havoc installed then you can choose between flying Comanches and Apaches or Hokums and Havocs in the campaign.

Select 'SELECT' to continue to the Campaign and Mission Planning screen.

Select 'CANCEL' to return to the Session screen.

Campaign and Mission Planning Screen

The Campaign and Mission Planning screen is the focal point of the campaign. From here you get an overview of the campaign and can assess the current situation in order to decide your next mission.

General Layout

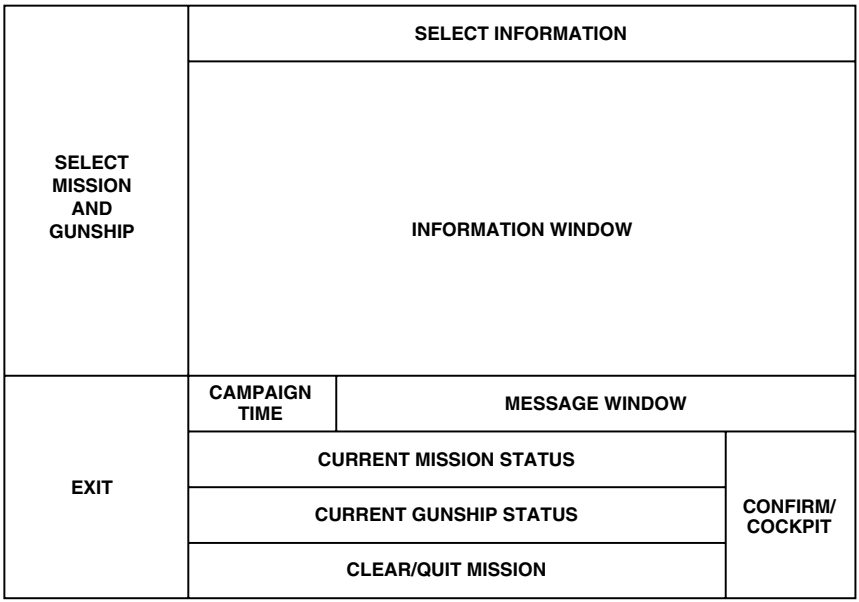


Diagram 2.1: *General layout of the Campaign and Mission Planning screen*

Familiarise yourself with the layout of this screen – try selecting all the options. You will notice that many items react to a 'mouse over' event by displaying additional relevant information as you move the mouse pointer over them. The additional information may be displayed in the message window, on the map or in the current mission and gunship status lines.

Generally you can click on graphical icons and 'live' text – that is text that changes colour as you move the mouse pointer over it.

Selecting a Mission and Gunship

There are several ways of selecting a mission and gunship and you can select them in any order.

For instance, you may prefer to select a mission first simply because you want to fly a particular type of mission. Alternatively you may opt to select a gunship first so that you can fly with other players in a multiplayer game or you want to fly a particular type of gunship if you have Apache Havoc installed.

'Auto-Select'

The easiest way to select a mission and gunship is to use the auto-select function:-

1. Click the 'Auto-Select' text in the current mission status line and a mission will be automatically selected. The mission briefing is displayed in the information window.
2. Click the 'Auto-Select' text in the current gunship status line and a gunship will be automatically selected for the mission. The flight group details are displayed in the information window.
3. Click 'Confirm' then 'Cockpit' to fly the mission.

'Available' and 'OOB' (Order Of Battle)

Select the 'Available' button to list all of the missions or groups available to you.

Select the 'OOB' button to list the 'Order Of Battle' for all of your forces (air, land and sea). You can view missions, groups and bases.

'Unassigned' Missions

Unassigned mission are missions which have not been assigned to a flight group yet. If you select an unassigned mission you then need to select a flight group in order to fly the mission.

Unassigned missions may be taken by computer-controlled (AI) flight groups or by other players in multiplayer games. Unassigned missions will eventually expire (timeout) if they are not taken.

To select an unassigned mission and a gunship:-

1. Click 'Clear' / 'Quit Mission' to clear any previously selected missions or gunships.
2. Select 'Available' and 'Missions'.
3. Unassigned and assigned missions are listed, for example:-

   Unassigned
   [3 x RECON]
   [2 x CAS]
   Assigned
   [1 x SEAD]

4. Click on a mission type to display the missions available, for example:-

   Unassigned
   [3 x RECON]
   RECON #1
   RECON #2
   RECON #3
   [2 x CAS]
   Assigned
   [1 x SEAD]

5. As you move the mouse pointer over the missions, details of the mission are shown in the message window and the current mission status line. The mission is indicated on the map (if it is view).

6. Click on a mission and a full briefing for the mission is displayed in the information window.

7. Click 'Accept' to accept the mission. The 'Groups' button is automatically selected and the flight groups available for this mission are listed. If no flight groups are available then click 'Clear Mission' to start again.

8. Click on a flight group type to expand the groups available, for example:-

   [2 x Recon / Attack Helicopters]
   Freelancer
   Gator
   [1 x Attack Helicopters]

9. As you move the mouse pointer over the flight groups, details of the group are shown in the message window and the current gunship status line. The flight group is indicated on the map (if it is in view).

10. Click on a flight group and the group's details are displayed in the information window.

11. You are normally assigned the flight group leaders gunship (i.e. '1-1 RAH-66 Comanche') but you can select another from the list.

12. Click 'Accept' to accept the gunship.

13. Click 'Confirm' then 'Cockpit' to fly the mission.

'Assigned' Missions

If you have accepted an assigned mission then the flight group is already selected but you can change gunship within the group. Click 'Accept' to the gunship. Click 'Confirm' then 'Cockpit' to fly the mission.

'Completed' Missions

Completed missions are only listed when the 'OOB' option is selected.

Map

There are many maps displayed in various contexts, however, the functionality of all maps is the same.

Mouse Controls

The map reacts to 'mouse over' events. Simply point at icons to find out what they are.

Point to a location on the map and right-click to centre the map around this position.

Point to a location on the map and left-click to 'goto' (that is move your gunship to) this position. This option is only available in Free Flight games.

Keyboard Controls

[→] [←] [↑] [↓] Move map

[±] Zoom in
[–] Zoom out
[+] (numpad) Zoom in
[–] (numpad) Zoom out
[>] Zoom in
[<] Zoom out

[Ctrl] + [±] Increase time acceleration (single player)
[Ctrl] + [–] Decrease time acceleration (single player)
[Ctrl] + [+] (numpad) Increase time acceleration (single player)
[Ctrl] + [–] (numpad) Decrease time acceleration (single player)

[Home] Centre map on player
[C] Centre map on player

[↵] Toggle cockpit/menus

Map Buttons

Maximise

Maximise map.

Minimise

Minimise map.

Zoom In

Zoom in.

Zoom Out

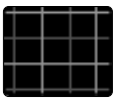
Zoom out.

Side

Toggle ‘side’ map.
The side map indicates the territorial possession of both sides.

Fog

Toggle ‘fog’ map.
The fog map indicates areas in which you have little or no intelligence.



Grid

Toggle the map grid.

Keysites

Toggle keysite icons. Keysites are tactical sites such as airbases, FARPs, ports, oil refineries, etc.

Missions

Toggle mission destinations.

Air Forces

Toggle air force icons.

Ground Forces

Toggle ground force icons.

Sea Forces

Toggle sea force icons.

Air Defences

Toggle air defence icons.

Ground Radar (threat circles)

Toggle air defence radar threat circles.

Track

Depending on the map context the track button does the following:-

1. Group information displayed – track the selected unit.
2. Mission information displayed – does nothing.
3. Base information displayed – does nothing.
4. All other maps – track the player's gunship.

Goto

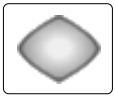
Toggle 'goto' feature. Only available in Free Flight games.

Map Icons

Move the mouse pointer over any map icon and details will be displayed in the message window.

Event

The most recent event log message is displayed in the message window and the event locator is displayed on the map to show the origin of the message. Click on the message window to display the event log in the information window.



Explosions

Explosions are drawn on the map indicating current engagements.

Waypoints

The waypoint route is displayed on the map.

Editing Waypoint Routes

The waypoint route can only be edited once the mission and gunship have been confirmed (by clicking 'Confirm').

To move a waypoint, select it with the mouse pointer and drag it to a new location. The start base, landing base and objective waypoints cannot be moved.

To insert a waypoint, click on the '+' symbol between the two waypoints that you wish to insert a new waypoint.

To delete a waypoint, highlight the waypoint by moving the mouse pointer over the waypoint and press the Delete key. The start base, landing base and objective waypoints cannot be deleted.

Mission Briefing and Debriefing

The mission briefing is displayed in the information window. The details of the mission are listed and a short account of the mission objectives is given.

After a mission is completed (successfully or unsuccessfully) the mission debriefing is displayed in the information window.

To display your briefing or debriefing click the mission name (i.e. 'RECON #2') in the current mission status line.

The mission briefing is available as soon as the mission is complete and not when you have returned to base. At this point you can quit the mission (an AI pilot will fly the gunship back to base) and you can select another mission to fly.

Promotion and Medals

After a mission you may be promoted or be awarded a medal. Details are given in the debriefing.

Sit Rep (Situation Report)

The Sit Rep outlines your campaign objectives and gives an indication of the campaign progress using 'force strength' and 'kills/losses' indicators.

In order to win the campaign your forces must successfully complete all of the campaign objectives.

Some objectives require your forces to capture an enemy installation. To achieve this your forces must weaken the installation via strike missions. Once battle damage assessment has shown the installation to be sufficiently weakened your forces will attempt to insert troops to capture it.

Log (Event Log)

The event log keeps account of all the significant actions that have occurred during the campaign.

The event log is listed with the latest event at the top. Click on any event text to view the location of the message origin.

Payloads

After selecting a gunship you can change the weapon loadout. You can only change the gunship's weapons when you are landed at an airbase, carrier or FARP.

To change weapons cycle through the weapons available for each pylon or select a default weapon loadout (air-to-ground, air-to-air or recon/scout).

You may change the weapon loadout for any of the gunships in your flight group. For gunships other than Apache Longbows, Comanches, Havocs and Hokums you can only select the three default options.

Chat

Use the chat facility to communicate with other players in multiplayer games.

Options

You can change the game options during a campaign, however, some options will be unavailable and are greyed out.

Save

Save a campaign at any time. The saved game will be available on the Session screen.

Enter a filename for the saved game (restricted to 8 characters – there is no need to enter a file extension).

Quit Campaign

To quit the campaign click the 'Exit' button or press Ctrl + Q.

3. IN-FLIGHT

Basic Handling

If you are a novice pilot then it is recommended that you read the 'Ground School' section of the manual to familiarise yourself with the basic principles and handling of a helicopter.

This section will guide you through the flight controls as required for Comanche Hokum and explain the function of the automatic flight systems; 'autopilot', 'altitude hold' and 'hover hold'.

Select a 'Free Flight' mission to practice your flight procedures. Ensure that you select a passive environment and turn the collisions and weapon damage off.

The flight controls are the same for both Comanche and Hokum.

To re-iterate the lesson from Ground School:-

> *"It is worth emphasising that all your control movements ('control inputs') should be as smooth and deliberate as possible. Sudden, violent control inputs are to be avoided whenever possible, but especially in hovering or low-speed flight. Make sure that you know where to find airspeed, altitude and vertical velocity readouts on the Head-Up Display (HUD)."*

Taking off and rising to the hover

1. Release the rotor brake [R]
2. The rotor blades will start to spin and the canopy doors will close
3. When the main rotor RPM has reached 90% the 'RTR RPM' warning light will turn off and the helicopter is ready for take-off
4. Release the wheel brakes [B]
5. Watching the torque value on the head-up display, gently increase the collective to 65-75% [Q]
6. The helicopter will start to climb
7. Climb to an altitude of 100 feet / 30 metres so that the helicopter is out of 'ground effect'
8. Adjust the collective to hold the helicopter in a steady hover [Q] and [A]

Transition from the hover to forward flight

1. Ease the cyclic forward and the helicopter will start to accelerate [↑]
2. The helicopter will lose altitude so gently increase the collective to compensate for this [Q]

Climbing and diving

1. Pull back on the cyclic to climb [↓]
2. The helicopter will climb but lose forward speed
3. Push the cyclic forward to regain forward speed [↑]
4. Raise the collective to climb [Q]
5. The helicopter will climb but gain forward speed
6. To climb without losing or gaining speed you need to simultaneously pull back on the cyclic and raise the collective [↓] and [Q]
7. Push the cyclic forward to dive [↑]
8. The helicopter will lose height but gain forward speed
9. Pull the cyclic back to reduce the dive [↓]
10. Lower the collective to lose height [A]
11. The helicopter will lose height and forward speed
12. To dive without losing or gaining speed you need to simultaneously push forward on the cyclic and lower the collective [↑] and [A]

Turning in forward flight

1. When the helicopter is hovering or flying at low speed (below 60 knots / 110 km/h) use the pedals to turn [Z] and [X]
2. At higher speeds, turning is accomplished by tilting the cyclic left or right to bank the helicopter [←] and [→]
3. If you fly sustained or steeply-banked turns you'll need to raise the collective [Q] or ease back on the cyclic [↓] (with loss of some forward speed) to avoid losing height

---

Slowing to the hover from forward flight

1. Start the manoeuvre by pulling back on the cyclic [↓] to tilt the helicopter backwards
2. Lower the collective to prevent the helicopter from climbing [A]
3. As the helicopter slows, gently raise the collective [Q] to compensate for the diminished main rotor thrust
4. As you approach the hover ease the cyclic forward [↑] to bring the helicopter level, simultaneously raising the collective [Q] to maintain altitude
5. Use the pedals [Z] and [X] as necessary to keep the helicopter straight

Landing

1. From a steady hover, gently lower the collective [A] and the helicopter will begin to lose altitude
2. Watching your vertical speed, adjust the collective [Q] and [A] to maintain a steady rate of descent
3. Just before touchdown reduce the rate of descent to soften the landing
4. After touchdown, bottom the collective [A]
5. Engage the wheel brakes [B]
6. Engage the rotor brake [R]
7. The rotor blades will spin down and the canopy doors will open

---

Taxiing

1. With the rotor blades spun up and the wheel brakes disengaged, increase the collective [Q] to between 25 and 50%
2. To start taxiing, push gently forward on the cyclic [↑]
3. Use the pedals [Z] and [X] to steer the helicopter
4. To slow down, ease back on the cyclic [↓]
5. To stop apply the wheel brakes [B]

Trim

Trim re-centres the cyclic to the currently held position. Trim is useful when flying long distances in a straight line so that you do not need to keep pressure on the cyclic.

Autopilot

The autopilot system will fly the helicopter around the waypoint route and eventually land back at base. Autopilot will not engage the enemy at 'target' waypoints.

[G] Autopilot (engage/disengage)

Autopilot is unavailable if the helicopter control systems are damaged or if the helicopter is out of fuel.

Autopilot cannot be engaged when the helicopter's radar altitude is below 25 metres (approximately 80 ft).

Coming in to land at a base, the helicopter may enter a holding pattern until a landing pad becomes available.

Altitude Hold

The altitude hold system will attempt to hold the helicopter at the current radar altitude, in effect, terrain following for nap of the earth flying.

Altitude hold is unavailable if the helicopter control systems are damaged or if the helicopter is out of fuel.

The radar altitude setting can be increased or decreased by one unit at a time (1 foot Comanche, 1 metre Hokum).

Alt + H Altitude hold (engage/disengage)

Alt + J Decrease altitude hold level

Alt + K Increase altitude hold level

Hover Hold

The hover hold system will attempt to hold the helicopter in a stationary position (station keeping).

Hover hold is unavailable if the helicopter control systems are damaged or if the helicopter is out of fuel.

Hover hold can only be engaged if the horizontal velocity of the helicopter is below 20 knots (approximately 40 Km/h).

Use collective to adjust the hover height and yaw to adjust the heading. Hover hold will disengage with any cyclic input.

Hover hold bleeds off any horizontal velocity and adjusts the collective to zero the vertical velocity. It is not an immediate effect and may take a few moments to stabilise. If you are using a throttle stick then you will have to adjust the collective manually.

Stable hover hold is the same as hover hold except that it maintains altitude automatically for players with throttle sticks.

H Hover hold (engage/disengage)

Shift + H Stable hover hold (engage/disengage)

Missions

Mission Types

The following airborne mission types are contained within Comanche Hokum.

Only missions marked with an asterisk (*) can be flown by the player. You will receive confirmation of a successful mission completion or failure.

*Anti-ship Strike

Anti-ship strike missions are direct airborne assaults against enemy surface ships.

The mission is successfully completed when sufficient enemy ships have been destroyed.

BARCAP (BARCAP)

BARCAP missions are used to defend surface ships from attack. Fighter aircraft fly a circuit (barrier) between the sea force and any potential threat.

*BDA (Battle Damage Assessment)

BDA missions are flown following a strike mission to assess the damage caused. Depending on the information gained subsequent strike or troop insertion missions may be generated.

For successful mission completion the flight group leader must fly to within 500m of the target waypoint and transmit recon data using the 'Transmit Recon' radio message.

*BAI (Battlefield Air Interdiction)

BAI missions are used to strike rear area reinforcements and supplies in order to destroy or delay the enemy's military potential before it can be used against friendly forces.

The mission is successfully completed when sufficient ground forces have been destroyed.

*CAP (Combat Air Patrol)

CAP missions are airborne patrols over a friendly area for the purpose of intercepting and destroying enemy aircraft before they reach their target.

CAP missions last for a predetermined period of time. The mission is successfully completed when this time has elapsed.

*CAS (Close Air Support)

CAS missions are airborne attacks against enemy forces which are in close proximity to friendly forces.

The mission is successfully completed when sufficient enemy ground forces have been destroyed.

---

*Escort

Armed escort missions provide protection for any vulnerable aircraft flying in a hostile area.

The mission is successfully completed when the escorted aircraft reach their destination.

---

*Ground Strike

Ground strike missions are direct airborne assaults against enemy ground installations.

The mission is successfully completed when sufficient enemy ground structures have been destroyed.

OCA Strike (Offensive Counter Air Strike)

OCA strike missions are airborne attacks against landed air units at enemy airbases or FARPs.

OCA Sweep (Offensive Counter Air Sweep)

OCA sweep missions are airborne attacks against enemy aircraft patrolling a target area.

---

*Recon (Reconnaissance)

A recon is mission is undertaken to obtain information about the activities and resources of the enemy.

For successful mission completion the flight group leader must fly to within 500m of the target waypoint and transmit recon data using the 'Transmit Recon' radio message.

Repair

Repair missions are used to deploy engineers and equipment at friendly ground installations in order to repair damage caused by the enemy.

*SEAD Strike (Suppression of Enemy Air Defences)

SEAD missions are used to destroy enemy air defences.

The mission is successfully completed when sufficient enemy air defence units have been destroyed.

Supply

Supply missions are undertaken to deliver supplies to units and installations.

---

*Transfer

Transfer missions are used to move aircraft to where they are most needed.

The mission is successfully completed when the aircraft reach their destination.

Troop Insertion

Troop insertion missions are used to capture an enemy installation once the area has been secured by a previous Strike or SEAD mission.

Radio Messages

You can send radio messages to your flight group, individual wingmen or the local base. Radio messages marked with an asterisk (*) can only be transmitted by the flight group leader.

[→|]	Display radio message menu
[0] to [9]	Select menu option
[Esc]	Exit menu (at any time)
[Ctrl] + [→|]	Repeat radio message (the last message received)
[Shift] + [A]	Attack my target

Any on-screen radio messages displayed in grey text are not available for some reason (i.e. you need to be the flight group leader, the radio message applies to a certain mission type, etc.).

Flight Group and Wingman Commands

Attack My Target

Instructs the selected wingman (or the entire flight group) to attack your current target. Your order will only be carried out if your target is not a friendly target and your wingmen are capable of attacking it. This order cancels 'Weapons Hold'.

If this instruction is sent to a human-controlled wingman, he will receive a text message at the top of the screen showing the sender's name and the target's name, heading and range. The heading and range are calculated from the recipient's position.

Help Me

Instructs the selected wingman (or the entire flight group) to attack your current pursuers. This order cancels 'Weapons Hold'.

*Return To Base (flight group only)

Aborts all current missions. The whole flight group will return to base.

*Weapons Hold

Any flight group members in 'Weapons Hold' state will not fire at anything. 'Weapons Hold' is cancelled by the orders 'Weapons Free', 'Attack My Target' and also if the flight group member is fired at.

*Weapons Free

Cancels 'Weapons Hold' for the selected wingman or the entire flight group.

***Hold Position**

Using the 'Hold Position' command, wingmen can be instructed to remain in their current position hovering at low altitude. The following conditions apply:-

1.This command cannot be issued to wingmen who are landing or landed.

2. If the wingman is taking off when the 'Hold Position' command is issued then he will remember the position he was at when the command was given and return to wait at that position once he has completed taking off.

3. If the wingman picks up a target, or is given a target by either 'Attack My Target' or 'Help Me' commands, and is in 'Weapons Free' state, then he will continue attacking his targets and return to his ordered hold position once all his targets are destroyed or a 'Weapons Hold' command is issued.

The 'Hold Position' command will be cancelled by any of the following events:-

1. A 'Rejoin Formation' command is issued.
2. The flight leader reaches his final waypoint.
3. The flight leader is killed.
4. The player releases control of the flight leader (i.e. quits).

***Rejoin Formation**

Cancels a 'Hold Position' command and allows the wingman to proceed as normal.

***Bob-Up**

Used to co-ordinate ground attacks. If your wingman is in 'Weapons Hold' state, then he will remain masked at his cover position until you give the order to 'bob-up'. Upon receiving this command he will increase altitude until he has sufficient line of sight to the target, fire, and then re-mask. A wingman in 'Weapons Free' state will bob-up and fire automatically. This option is only available to wingmen who are masked at their cover positions and waiting for your command.

***Formation List (flight group only)**

Select the new flight formation and the wingmen will re-position themselves.

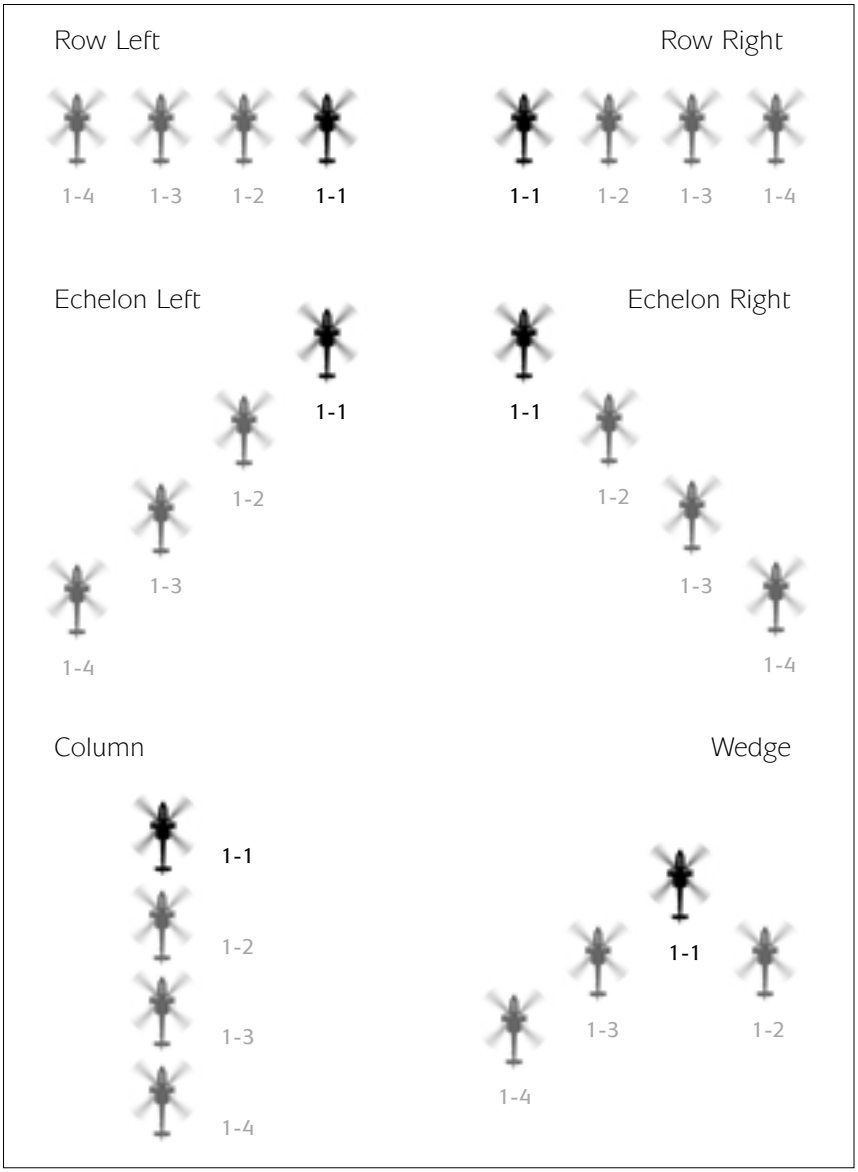


Diagram 3.1: *Flight group formations ('1-1' is the flight group leader)*

Request Target List (other players only)

Only available if the selected wingman is human-controlled. The contents of the selected wingman's target list are added to your own target list.

Keyboard Message (other players only)

Only available if the selected wingman is human-controlled. Type in your own message using the keyboard, press [↵] when finished to send it, or press [Esc] at any time to cancel.

LOCAL BASE

Request Airstrike

Creates a strike task depending on what you are targeting:-

1. Targeting an enemy structure will create a ground strike mission.
2. Targeting an enemy SAM or AAA will create a SEAD mission.
3. Targeting an enemy frontline ground unit will create a Close Air Support mission.

Request Artillery

Requests an artillery strike against the area surrounding your current target. The request will be carried out if the target is valid and there is a friendly artillery unit within range.

Request Assistance

Scans the area for any friendly airborne units and instructs them to intercept your current pursuers.

Transmit Recon

Only available when your current waypoint requires transmission of reconnaissance data. If you are within 500m of your recon target then select this option to complete the mission.

Views

Cockpit Views

In Comanche Hokum both pilot and co-pilot cockpits are included and you may assume either crew role by switching seats. The cockpits are 'virtual' and may be panned as though you are rotating the pilot's head. There are also some close-up views of the displays.

The crew themselves are fully animated to increase the immersion of the game. There is a special 'Crew camera' to observe them with.

Esc Switch pilot/co-pilot seat

Alt + → ← ↑ ↓ Pan view

F1 Forward view
F2 Instrument view
F3 Left MFD view, press again for instrument view
F4 Right MFD view, press again for instrument view
Shift + F2 Hokum HUD view, press again for forward view

Alternative keys:-

Shift + ↑ Pilot's seat
Shift + ↓ Co-pilot's seat
Shift + ← Left MFD view, press again for instrument view
Shift + → Right MFD view, press again for instrument view

Ctrl + ↑ Forward view
Ctrl + ↓ Instrument view
Ctrl + ← Look left
Ctrl + → Look right

Cockpit Graphics

The cockpit graphics detail is selected using the Options Screen 'Graphics' menu. The cockpit detail can also be changed in-flight:-

Ctrl + F4 Increase cockpit detail
Ctrl + F3 Decrease cockpit detail

You can fly without cockpit graphics but this leaves you with no points of reference and it is easy to get disorientated. Alternatively there is a 'glass' cockpit option:-

Ctrl + F1 Toggle cockpit graphics
Ctrl + F2 Toggle glass cockpit

The blurred main rotor blades visible from the cockpit can be switched off in the Options Screen 'Graphics' menu. The blurred main rotors can also be toggled in-flight:-

Alt + R Toggle blurred main rotor blades

Padlock Views

Padlock views automatically rotate the pilot's (or co-pilot's) head in order to track various items:-

1 Padlock target
2 Padlock wingman
3 Padlock air threat
4 Padlock ground threat
5 Padlock incoming missile
6 Padlock waypoint
0 Unpadlock

Padlock Target

Padlocks the current target.

Padlock Wingman

Wingmen are other helicopters in your flight group. The wingmen are padlocked in group order (i.e. 'Phantom 1-1' then 'Phantom 1-2' and so on). Press 2 again to cycle through the wingmen.

Padlock Air Threat

Air threats are any aircraft which are targeting your gunship. The nearest air threat is padlocked first. Press 3 again to padlock other air threats.

Padlock Ground Threat

Ground threats are any ground vehicles which are targeting your gunship. The nearest ground threat is padlocked first. Press 4 again to padlock other ground threats.

Padlock Incoming Missile

The nearest missile is padlocked first. The nearest missile is defined in terms of 'time to impact' as opposed to actual distance. Press 5 again to padlock other incoming missiles.

Padlock Waypoint

Padlocks the current waypoint.

Unpadlock

Unpadlock cancels any padlock view.

External Views

Selecting external views is split into two operations; selecting the object to view and selecting the camera to view with. There is no given order in which these operations have to occur.

Player's Shortcuts

To quickly locate objects associated with the player:-

F5 Player's gunship
F6 Player's target
F7 Player's weapon
F8 Player's padlock

Player's Gunship

Select the player's gunship. External views of the player's gunship show the head-up display (HUD). This can be toggled on or off by pressing Alt + F2

Player's Target

Select the player's target.

Player's Weapon

Select the player's weapon. Only viewable weapons can be selected – i.e. not cannon shells – and if no weapon has been fired then the Weapon camera will be primed for when a weapon is fired.

Player's Padlock

Select the player's padlock. This does not apply to waypoints.

Select Object To View

In Comanche Hokum there are many objects (aircraft, ground vehicles and ships) involved in each campaign. In order to quickly locate any specific object use the 'Select Object To View' menu simply referred to as the 'Object' menu.

F12 Toggle Object menu

View

Select the main group of objects to view:-

Alt + F5 View all
Alt + F6 View wingmen
Alt + F7 View players
Alt + F8 View available gunships

View All

View all objects. Resets all Object menu options to 'All'.

View Wingmen

View wingmen only.

View Players

View other player's gunships only (in multiplayer games).

View Available Gunships

View available gunships only. In Comanche Hokum it is possible to change gunship in-flight. Press Alt + F8 to view available gunships only. Press Ctrl + F8 to cycle the available gunships. Press U to fly the gunship.

Range

View objects within a given range of the player's gunship. If the player has not selected a gunship then this option will be set to 'All'.

Alt + ± Increase view range
Alt + – Decrease view range

Alternatively (for Japanese keyboards):-

Alt + + (Numpad) Increase view range
Alt + – (Numpad) Decrease view range

Side

Select 'side' of objects to view.

Ctrl + F5 next side
Ctrl + F5 previous side

Category

Select 'category' of objects to view.

Shift + F7 next category
Shift + F6 previous category

Type

Select 'type' of objects within a category to view.

Ctrl + F7 next type
Ctrl + F6 previous type

Object

Select object to view. The number of objects available is shown in parenthesis.

Ctrl + F8 next object
Shift + F8 previous object

Short Object Menu

There is a shortened form of the Object menu displayed on the third line of the 'External View Text' (see below). This shows the current Object menu settings. When you become accustomed to selecting an object to view you will probably no longer require the full Object menu.

Select Camera

Any camera can be selected for any object:-

F9 Chase camera (pan and zoom)
Shift + F9 Reset chase camera position behind object
Alt + F9 Toggle lock/unlock chase camera to object

F10 Fly-by camera
Shift + F10 Drop camera
Ctrl + F10 Static camera (pan)
Alt + F10 Weapon camera (only viewable weapons can be selected – i.e. not cannon shells – and if no weapon has been fired then the Weapon camera will be primed for when a weapon is fired)

F11 Auto-action camera (seeks out action within the limits of the Object menu settings and uses a mix of cameras)
Shift + F11 Cinematic camera (cinematic camera moves)
Ctrl + F11 Crew camera (press again to cycle the camera positions for the selected crew member)

Alt + → ← ↓ ↑ Pan view
Alt + < Zoom out
Alt + > Zoom in

External View Text

The external view text displayed at the bottom of the screen may be toggled on or off by pressing Ctrl + F12.

Inset Target

If an object is tracking a target then an 'inset' view of the target can be displayed in the top right corner of the screen.

Alt + F12 Toggle inset target

High Resolution Support

The screen resolution for Comanche Hokum is selected using the Options Screen 'Graphics' menu. The screen resolution can also be changed in-flight:-

Shift + F4 Increase screen resolution
Shift + F3 decrease screen resolution
Shift + F1 set screen resolution to 640x480

The screen resolution can be set to any supported 'square aspect ratio' setting between 640x480 and 1600x1200. Square aspect ratio simply means that the pixels are square.

When you change the screen resolution the new setting appears momentarily in the top centre of the screen (width x height).

If increasing the screen resolution leaves you looking at a blank screen it is likely that the screen resolution has exceeded the refresh rate of your monitor. If this happens you should decrease the screen resolution.

Some 3D cards are able to switch to higher screen resolutions but may exhibit some texture mapping problems. If this happens you should decrease the screen resolution.

If the program crashes whilst attempting to switch to an unsupported screen resolution then re-run the program using the /3dreset command line option to set the screen resolution to 640x480. Refer to 'Trouble Shooting'.

The screen resolution that you select becomes the default setting for subsequent games or until you change it again.

Note that changing the screen resolution may take a few seconds and may cause the screen to glitch.

Screen Shots

To take a screen shot in-flight press Print Screen. This will write a TGA file to the COHOKUM\SCRNSHOT\LARGE folder. Up to 1000 screen shots may be taken before the folder requires clearing.

Controls

Standard Joystick Configuration

Stick	Cyclic
Hat switch (POV)	Pan view
Button 1	Fire weapon
Button 2	Select weapon
Button 3	Select target
Button 4	Padlock/unpadlock target

Programmable Joystick Configurations

Programmable joystick configuration files are located in the 'Joystick' folder on the Comanche Hokum CD.

'Sticky' Keys

Occasionally you may experience problems with 'sticky' keys.

For example, the torque value may continue to rise or fall even though you have released the collective keys. Pressing and releasing the appropriate key will solve the problem (press Q if the torque value is continuously rising, or press A if the torque value is continuously falling).

Game

Ctrl + X	Exit game
Ctrl + Q	Quit mission/campaign
P	Pause (single player)
Ctrl + ±	Increase time acceleration (single player)
Ctrl + –	Decrease time acceleration (single player)

Alternatively (for Japanese keyboards):-

Ctrl + + (Numpad)	Increase time acceleration (single player)
Ctrl + – (Numpad)	Decrease time acceleration (single player)

↵	Toggle cockpits/menus
Ctrl + I	Toggle in-flight intelligence messages
Ctrl + R	Rearm, refuel and repair (cheat)
Print Screen	Take screenshot

Flight Controls

Cyclic, Collective, Tail Rotor

←	Cyclic left
→	Cyclic right
↑	Cyclic up
↓	Cyclic down
Q or +	Increase collective
A or −	Decrease collective
Z	Tail rotor left
X	Tail rotor right
T	Trim cyclic
Shift + T	Clear trim

Autopilot

G	Autopilot (engage/disengage)
Alt + H	Altitude hold (engage/disengage)
Alt + J	Decrease altitude hold level
Alt + K	Increase altitude hold level
H	Hover hold (engage/disengage)
Shift + H	Stable hover hold (engage/disengage)

Miscellaneous

R	Rotor brake (engage/disengage)
B	Wheel brake (engage/disengage)
Ctrl + G	Gear (raise/lower)
Alt + E	Eject (Hokum)

Cockpit

Warnings

M	Acknowledge master caution
Ctrl + F	Fire extinguishers (once per mission)

Radio Messages

[→]	Display radio message
[Ctrl] + [→]	Repeat radio message
[Shift] + [A]	Attack my target

Navigation

[W]	Select next waypoint (flight group leader)
[Shift] + [W]	Select previous waypoint (flight group leader)

Night Flying

[N]	Night vision (on/off) – PNVS (Comanche) / NVG (Hokum)
[V]	Navigation lights (on/off)

Wipers

[Y]	Wipers (on/off) (Hokum)
[Alt] + [Y]	Toggle intermittent wipe (Hokum)

HIDSS (Comanche) / HUD (Hokum)

[K]	Select next HIDSS (Comanche) / HUD (Hokum) colour
[Shift] + [K]	Select previous HIDSS (Comanche) / HUD (Hokum) colour
[O]	Engage bob-up
[Ctrl] + [O]	Disengage bob-up

Multi-Function Displays (MFDs)

[E]	Increase TSD and ASE/TWD range
[Shift] + [E]	Decrease TSD and ASE/TWD range
[D]	Select next TSD declutter level
[Shift] + [D]	Select previous TSD declutter level
[Ctrl] + [A]	Toggle ASE/TWD auto-page

Cycle MFD Pages

[[	Select next left MFD page
[Shift] + [[	Select previous left MFD page
[Ctrl] + [[	Left MFD on/off
[]	Select next right MFD page
[Shift] + []	Select previous right MFD page
[Ctrl] + []	Right MFD on/off
[Alt] + [[	Left side display on/off (Comanche)
[Alt] + []	Right side display on/off (Comanche)

MFD Page Shortcuts

Ctrl + 1 to 0	Select page for left MFD
Alt + 1 to 0	Select page for right MFD
1	Ground radar
2	Air radar
3	TADS (Comanche) / EOS (Hokum)
4	TSD
5	ASE (Comanche) / TWD (Hokum)
6	Weapon
7	System
8	Engine
9	Flight
0	Mission

Weapons and Countermeasures

←	Select next weapon
Shift + ←	Select previous weapon
Alt + ←	Select gun
Ctrl + ←	Weapons safe
Spacebar	Fire weapon
S	Increase rocket salvo size
Shift + S	Decrease rocket salvo size
L	Hellfire LOBL/LOAL toggle (Comanche)
C	Release chaff
F	Release flare
J	Radar jammer (on/off)
I	Infra-red jammer (on/off)
Ctrl + C	Auto-countermeasures (on/off)

Targeting

Select Target Acquisition System

Insert	Ground radar
Home	Air radar
Page Up	HIDSS (Comanche) / HMS (Hokum)
Delete	FLIR
End	DTV (Comanche) / LLLTV (Hokum)
Page Down	Periscope (Hokum)

Alternatively (for programmable joysticks):-

Shift + 1	Ground radar
Shift + 2	Air radar
Shift + 3	HIDSS (Comanche) / HMS (Hokum)
Shift + 4	FLIR
Shift + 5	DTV (Comanche) / LLLTV (Hokum)
Shift + 6	Periscope (Hokum)

Radar Controls (use numeric keypad)

4	Scan left
5	Scan centre
6	Scan right
8	Increase scan size
2	Decrease scan size
+	Increase range
–	Decrease range
9	Increase target priority (ground radar)
3	Decrease target priority (ground radar)
1	Engage auto-target
7	Toggle allied aircraft / all aircraft (air radar)
*	Toggle single / continuous sweep
/	Activate single radar sweep
Enter	Lock/unlock target
Ctrl + Enter	Padlock/unpadlock target
0	Select next target
Shift + 0	Select previous target
Ctrl + Delete	Switch radar off

TADS (Comanche) / EOS (Hokum) Controls (use numeric keypad)

4	Pan left
5	Pan centre
6	Pan right
8	Pan up
2	Pan down
+	Increase zoom
–	Decrease zoom
Enter	Lock/unlock target
Ctrl + Enter	Padlock/unpadlock target
0	Select next target
Shift + 0	Select previous target
Ctrl + Delete	Switch TADS / EOS off

HIDSS (Comanche) / HMS (Hokum) Controls (use numeric keypad)

Alt + 4 6 8 2	Pan virtual cockpit
Enter	Lock/unlock target
Ctrl + Enter	Padlock/unpadlock target
0	Select next target
Shift + 0	Select previous target
Ctrl + Delete	Switch HIDSS / HMS off

Cockpit Views

Main Cockpit Views

F1	Forward view
F2	Instrument view
F3	Left MFD view, press again for instrument view
F4	Right MFD view, press again for instrument view
Shift + F2	Hokum HUD view, press again for forward view
Esc	Switch pilot/co-pilot seats
Ctrl + ←	Look left
Ctrl + →	Look right
Ctrl + ↑	Forward view
Ctrl + ↓	Instrument view
Shift + ←	Left MFD view, press again for instrument view
Shift + →	Right MFD view, press again for instrument view
Shift + ↑	Pilot's seat
Shift + ↓	Co-pilot's seat

Virtual Cockpit

Alt + ←	Pan left
Alt + →	Pan right
Alt + ↑	Pan up
Alt + ↓	Pan down

Padlock Views

1	Padlock target
2	Padlock wingman, press again to cycle wingmen
3	Padlock air threat, press again to cycle air threats
4	Padlock ground threat, press again to cycle ground threats
5	Padlock incoming missile, press again to cycle incoming missiles
6	Padlock waypoint
0	Unpadlock

Cockpit Detail

Ctrl + F1	Toggle cockpit graphics
Ctrl + F2	Toggle glass cockpit
Ctrl + F3	Decrease cockpit detail
Ctrl + F4	Increase cockpit detail
Alt + R	Toggle blurred rotors

High Resolution Support

Shift + F1	640*480 resolution
Shift + F4	Increase resolution
Shift + F3	Decrease resolution

External Views

Pan And Zoom

Alt + ←	Pan left
Alt + →	Pan right
Alt + ↑	Pan up
Alt + ↓	Pan down
Alt + <	Zoom out
Alt + >	Zoom in

Select Object To View

F5	View player's gunship
F6	View player's target
F7	View player's weapon
F8	View player's padlock
F12	Toggle 'Select Object To View' menu
Ctrl + F5	View next side
Shift + F5	View previous side
Ctrl + F6	View next category
Shift + F6	View previous category
Ctrl + F7	View next type
Shift + F7	View previous type
Ctrl + F8	View next object
Shift + F8	View previous object
Alt + F5	View all
Alt + F6	View wingmen
Alt + F7	View players
Alt + F8	View available gunships

Alt + ±	Increase view range
Alt + –	Decrease view range

Alternatively (for Japanese keyboards):-

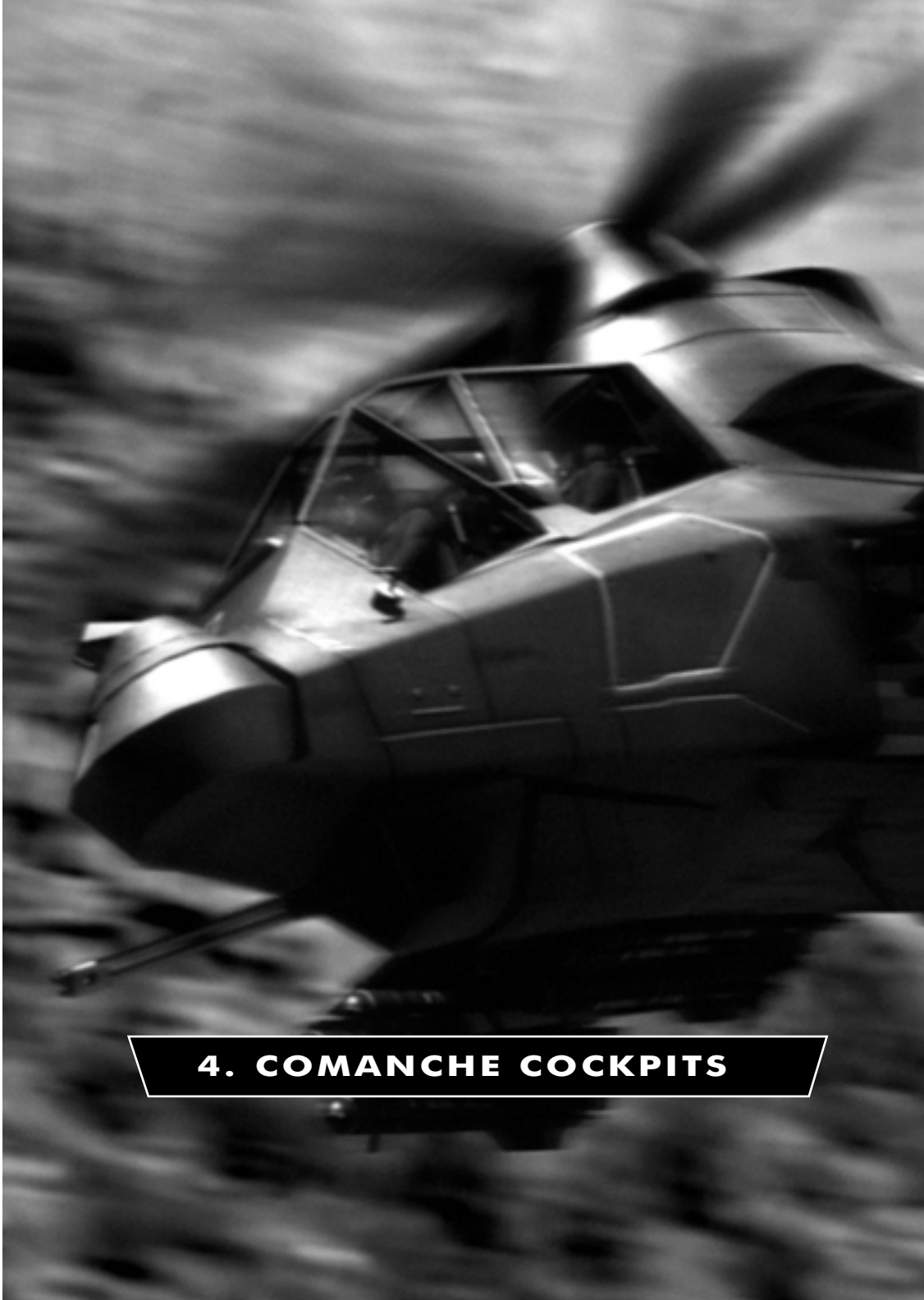
Alt + + (Numpad)	Increase view range
Alt + – (Numpad)	Decrease view range

Select Camera

F9	Chase camera
Shift + F9	Reset chase camera position
Alt + F9	Lock/unlock chase camera
F10	Fly-by camera
Shift + F10	Drop camera
Ctrl + F10	Static camera
Alt + F10	Weapon camera
F11	Auto-action camera
Shift + F11	Cinematic camera
Ctrl + F11	Crew camera

Miscellaneous

Alt + F2	Toggle external view HIDSS (Comanche) / HUD (Hokum)
Ctrl + F12	Toggle external view object text
Alt + F12	Toggle external view inset target
U	Fly external view gunship (available gunship only)



4. COMANCHE COCKPITS

Diagram 4.1: *Pilot's cockpit (front seat)*

Diagram 4.2: *Stepped cockpit configuration (pilot at the front)*

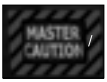
Instrument Panel

The Comanche has two identical cockpits in a stepped configuration. The pilot sits in the front seat and the co-pilot (CP/G) sits in the rear seat. You can assume either of the crew roles.

Each cockpit has two 'main' multi-function displays (MFDs) and two 'side' displays. There are some indicator lights but there are no traditional instruments for backup.

Refer to the In-flight 'Views' section for details of the cockpit views.

Master Caution Light



The master caution light flashes, accompanied by an audible warning, to indicate that there is a problem. The problem will be indicated by the warning lights or Upfront Display. To acknowledge the caution press M. This extinguishes the master caution light and silences the audible warning.

Engine Ignition Lights

L ENG	Left engine ignition
APU	APU ignition
R ENG	Right engine ignition

Fire Warning Lights

The fire warning lights indicate if either engine or the auxiliary power unit (APU) is on fire. In case of a fire use the fire extinguisher. The fire extinguisher can only be used once per mission.

L ENG	Left engine ignition
APU	APU ignition
R ENG	Right engine ignition

Ctrl + F Activate fire extinguisher

Fire Extinguisher Lights

The fire extinguisher lights indicate if the fire extinguishers have been used.

Warning Lights

TRQ	Engine over torque
RTR RPM	Low main rotor RPM
FUEL LOW	Low fuel level (<25% maximum fuel level)
HYD PRESS	Low hydraulic pressure
OIL PRESS	Low or high engine oil pressure
OIL TEMP	High engine oil temperature

Status Lights

RTR BRK	Rotor brake engaged
WHL BRK	Wheel brake engaged
NAV LTS	Navigation lights on
HOV HLD	Hover-hold active
ALT HLD	Altitude-hold active
AUT PLT	Auto-pilot active
RDR	Radar active
LSR	Laser active
RDR JAM	Radar jammer active
IR JAM	Infra-red jammer active
AUT C/M	Auto-countermeasures active
AUT ASE	ASE auto-paging active

Gear (Undercarriage) Lights

The small green/red lights indicate if the gear is fully down (green) or fully up (red). The white lights indicate that the gear is in transition (raising or lowering). The GEAR FAIL light indicates a gear failure.

Ctrl + G Raise/lower gear

Stealth Configuration Indicator

The stealth configuration indicator shows how 'stealthy' the Comanche is. For maximum stealth select a weapons load which does not require the stub wings, raise the gear and unarm the weapons to retract the stowable gun and close the bay doors.

Upfront Display

The upfront display shows system messages.

Multi-Function Displays (MFDs)

Each cockpit has two 'main' multi-function displays (MFDs) and two 'side' displays. Each main MFD can display one of ten selectable pages:-

Ground Radar
Air Radar
Target Acquisition and Designation Sight (TADS)
Tactical Situation Display (TSD)
Aircraft Survivability Equipment (ASE)
Weapon*
System*
Engine*
Flight*
Mission

The side display pages are fixed and duplicate the main MFD pages indicated by the * above.

The pages can be cycled through on each main MFD:-

[Select next left main MFD page
Shift + [Select previous left main MFD page
] Select next right main MFD page
Shift +] Select previous right main MFD page

The displays can be switched on and off:-

Ctrl +] Switch left main MFD on and off
Ctrl +] Switch right main MFD on and off
Alt +] Switch left side display on and off
Alt +] Switch right side display on and off

There are shortcut keys to select any page on either MFD.

Left MFD:-

Ctrl + 1 Ground Radar
Ctrl + 2 Air Radar
Ctrl + 3 Target Acquisition and Designation Sight (TADS)
Ctrl + 5 Aircraft Survivability Equipment (ASE)
Ctrl + 6 Weapon
Ctrl + 7 System
Ctrl + 8 Engine
Ctrl + 9 Flight
Ctrl + 0 Mission

Right MFD:-

Alt + 1 Ground Radar
Alt + 2 Air Radar
Alt + 3 Target Acquisition and Designation Sight (TADS)
Alt + 5 Aircraft Survivability Equipment (ASE)
Alt + 6 Weapon
Alt + 7 System
Alt + 8 Engine
Alt + 9 Flight
Alt + 0 Mission

Ground Radar MFD

See the 'Acquiring Targets' section.

Air Radar MFD

See the 'Acquiring Targets' section.

Target Acquisition and Designation System (TADS) MFD

See the 'Acquiring Targets' section.

Tactical Situation Display (TSD) MFD

The Tactical Situation Display shows navigation information, targets, anti-aircraft threats and air threats and is essential during combat situations.

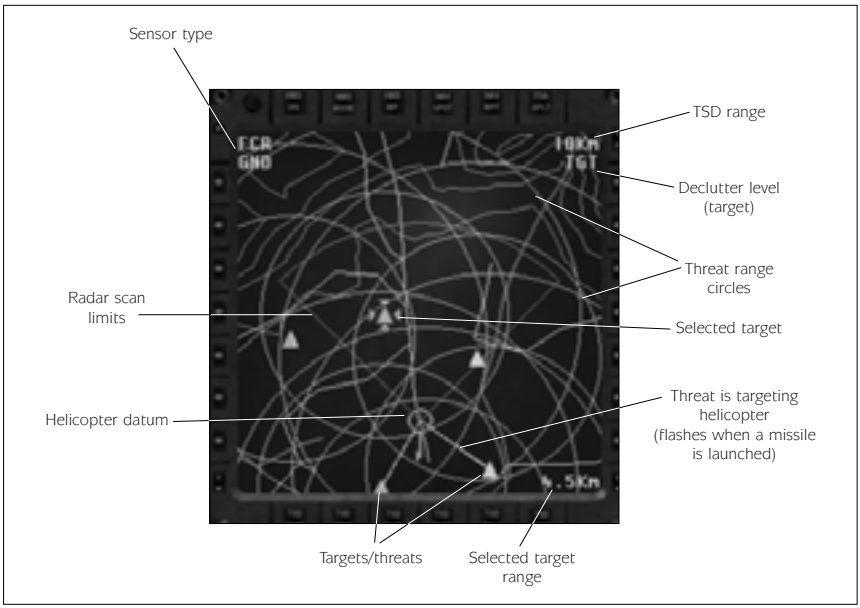


Diagram 4.3: *TSD MFD (target declutter)*

Helicopter Datum

The TSD shows a plan view of the battlefield with the helicopter located at the bottom of the display.

Declutter Level

The TSD has 3 declutter levels:-

ALL	Display both target and navigation information
TGT	Display target information only
NAV	Display navigation information only
D	Next TSD declutter level
Shift + D	Previous TSD declutter level

TSD Range

The TSD range is selectable between 2, 5, 10 and 25Km. This also changes the range of the ASE display.

E	Next TSD range
Shift + E	Previous TSD range

Sensor Type

NO ACQ	No sensor is active
FCR/GND	Ground radar
FCR/AIR	Air radar
TADS/FLIR	TADS forward-looking infrared
TADS/DTV	TADS daylight TV

Radar Scan Limits

The scan limits of the active ground or air radar.

Targets

Targets are displayed using the radar symbology (see the 'Acquiring Targets' section). Target symbols are displayed using two different colours for clarity. The selected target is marked by a cursor and it's range is shown in the lower right corner of the display.

Threats

Threat range circles are drawn around enemy anti-aircraft units. If the helicopter is inside the circle then you are in range of enemy fire. If a threat (anti-aircraft or airborne) is targeting the helicopter then a line is drawn between the threat and the helicopter datum. When this line flashes a missile has been launched.

Waypoint Route

The waypoint route shows the planned mission route. Information for the current waypoint is shown in the lower left corner of the display.

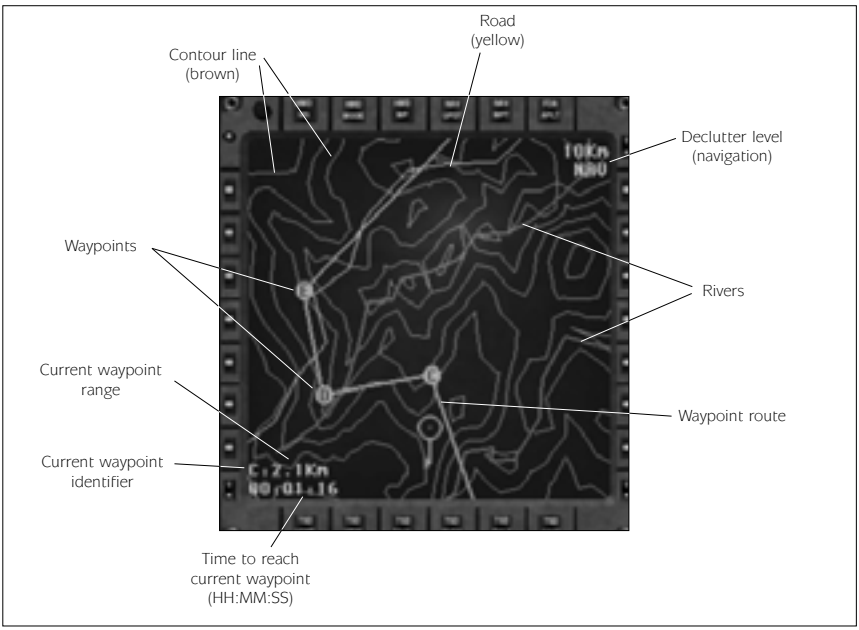


Diagram 4.4: *TSD MFD (navigation declutter)*

Aircraft Survivability Equipment (ASE) MFD

The Aircraft Survivability Equipment display shows anti-aircraft, airborne and missile threats. It also shows if jamming is active and the number of chaff and flares remaining.

The ASE MFD 'auto-pages' when a threat engages the helicopter. The auto-paging can be disabled.

Ctrl + A Toggle ASE auto-page

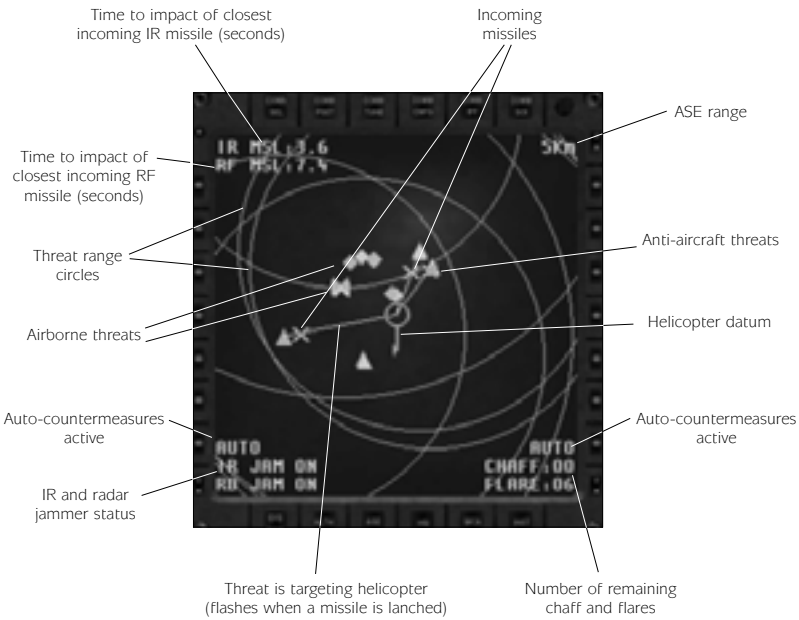


Diagram 4.5: *ASE MFD*

Helicopter Datum

The ASE shows a plan view of the battlefield with the helicopter located centrally.

ASE Range

The ASE range is selectable between 2, 5, 10 and 25Km. This also changes the range of the TSD display.

E next ASE range

Shift + E previous ASE range

Threats

Threat range circles are drawn around enemy anti-aircraft units. If the helicopter is inside the circle then you are in range of enemy fire. If a threat (anti-aircraft or airborne) is targeting the helicopter then a line is drawn between the threat and the helicopter datum. When this line flashes a missile has been launched. Threats are displayed using the radar symbology (see the 'Acquiring Targets' section). Target symbols are displayed using two different colours for clarity.

The ASE will not indicate threats from infantry tracking the helicopter with shoulder launched IR guided missiles. The launched missile, however, will be indicated.

Incoming Missiles

Incoming missiles are shown as 'X's. The time to impact for the closest incoming missile is shown (in seconds) in the upper left corner of the display. There are separate readouts for infra-red (IR), radar (RF) and laser (LS) guided missiles.

Jammers

The status of the infra-red and radar jammers is shown in the lower left corner of the display. 'AUTO' indicates that auto-countermeasures are active.

Chaff And Flares

The number of remaining chaff and flares is shown in the lower right corner of the display. 'AUTO' indicates that auto-countermeasures are active.

Weapon MFD

The Weapon MFD displays a schematic diagram of the weapons configuration as viewed from behind the helicopter. The selected weapon is highlighted.

'GUN'	20mm Gatling gun
'AAM'	AIM-92 Stinger IR guided air-to-air missiles
'AGM (RF)'	AGM-114L Longbow Hellfire radar guided anti-tank missiles
'AGM (LSR)'	AGM-114K Hellfire II laser guided anti-tank missiles
'RKT (HE)'	Hydra 70 M255 70 mm high explosive unguided rockets
'RKT (MP)'	Hydra 70 M261 70 mm multi-purpose unguided rockets

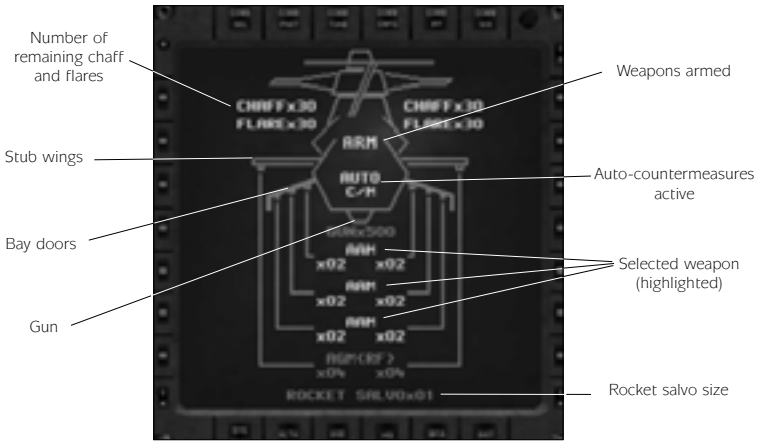
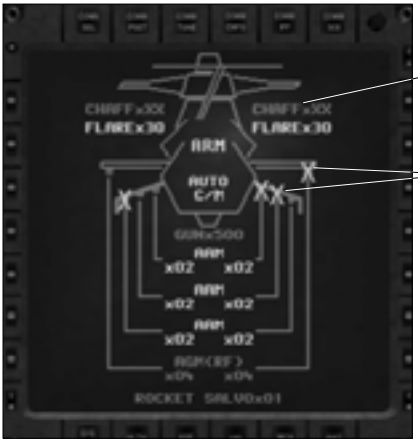


Diagram 4.6: *Weapon MFD*



Damaged chaff dispensers

Damaged hard points

Diagram 4.7: *Weapon MFD showing damaged hardpoints*

System MFD

The System MFD displays the status of important helicopter components.

Diagram 4.8: *System MFD*

Engine MFD

The Engine MFD page displays values for both engines and also monitors the fuel level.

'TG'	Temperature
'TQ'	Torque
'NP'	Engine RPM
'NR'	Rotor shaft RPM

The fuel weight is measured in pounds (LB).

Diagram 4.9: *Engine MFD*

Flight MFD

The Flight MFD duplicates the flight and navigation information from the HIDSS navigation display mode. Refer to the 'Helmet Integrated Display and Sight System' section.

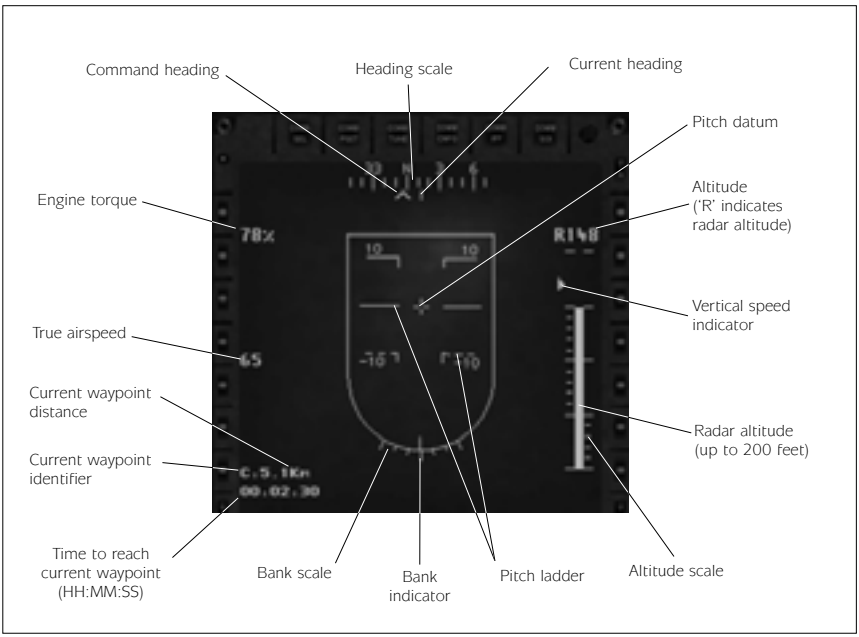


Diagram 4.10: *Flight MFD*

Mission MFD

The Mission MFD shows information about the flight group, mission and mission clock.

Flight Group

The company name is displayed followed by a list of the flight group members. The callsign for each member is displayed. The '>' symbol indicates the group leader. Player's rank and names are shown.

The current flight group formation is displayed. The group leader can change the formation via a radio message (refer to the In-flight 'Radio Messages' section).

Mission

TYPE: Mission type (refer to the In-flight 'Missions' section).

OBJECT: Mission objective

<x,y grid reference> range bearing

STATUS: Mission status

START: Mission start point

<x,y grid reference> range bearing

END: Mission end point

<x,y grid reference> range bearing

COUNT: Mission kills and losses

TIME: MT=HH:MM:SS elapsed mission time

MD=HH:MM:SS estimated mission duration

Mission Clock

The mission clock indicates the time of day.

Diagram 4.11: *Mission MFD*

Helmet Integrated Display and Sight System (HIDSS)

The Comanche pilot's helmet has a built-in display system known as the HIDSS. It is used much like a conventional 'head up display' but has the advantage of always being in the pilot's view. If you select a Crew View Ctrl + F11 which shows a close-up of the pilot's face then you can see the HIDSS projected on to the lenses.
The TADS and PNVS (Pilot Night Vision Sensor) optical units are slaved to the HIDSS so that they 'look' where the pilot is looking. The HIDSS can be used to acquire targets simply by looking at them.
The HIDSS display colour can be cycled to make it easier to read when the outside conditions change.

K	Select next HUD colour
Shift + K	Select previous HUD colour

The HIDSS has two display modes; 'navigation' and 'combat'

HIDSS In Navigation Mode

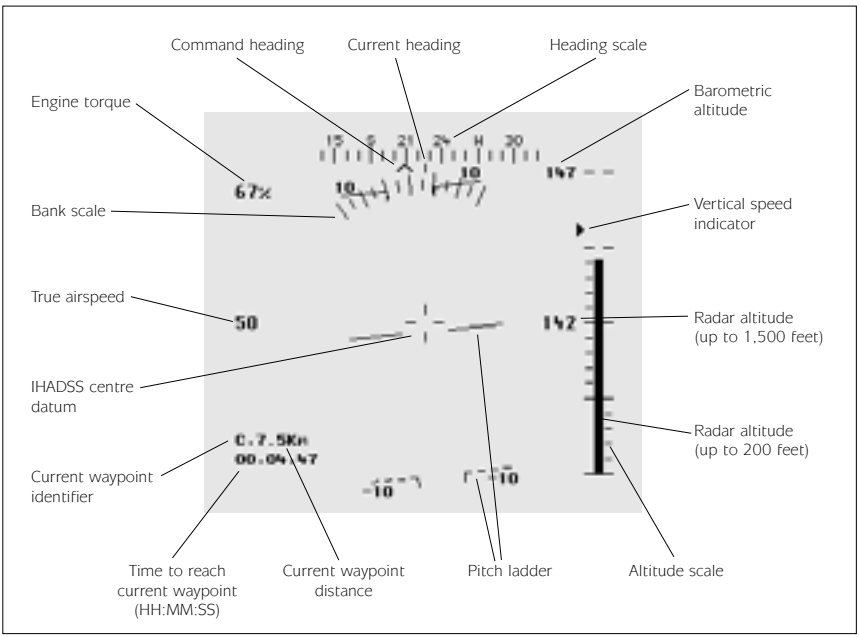


Diagram 4.12: *HIDSS in navigation mode*

HIDSS Centre Datum

Indicates the centre of the display.

Heading Scale and Command Heading

The heading scale is calibrated every 30 degrees. The command heading indicates the direction to the next waypoint.

Pitch Ladder

The pitch ladder indicates the helicopter's pitch and bank attitude. Pitch bars are calibrated every 10 degrees. Solid lines are draw above the horizon and dashed lines are drawn below the horizon.

Bank Scale

The bank scale indicates the helicopter's bank angle up to 30 degrees.

True Airspeed

True airspeed in knots.

Barometric Altitude

Digital readout of the barometric altitude (height above sea level) in feet.

Radar Altitude

Digital readout of the radar altitude (height above ground) in feet. This value is valid up to 1,500 feet.

The analogue radar altitude bar is valid up to 200 feet and is read against the altitude scale.

Vertical Speed Indicator

When the vertical speed indicator is above the altitude scale centre line the helicopter is climbing. When it is below the centre line the helicopter is sinking. The full scale deflection of the vertical speed indicator is +/-1,000 feet per minute.

Engine Torque

Digital readout of the engine torque.

Current Waypoint

The current waypoint identifier, distance and time to reach (hours:minutes:seconds) are shown in the lower left corner of the display.

HIDSS In Combat Mode

See the 'Acquiring Targets' and 'Weapons' sections.

Bob-up Overlay

The bob-up overlay is useful for 'station-keeping' during bob-up or bob-sideways manoeuvres.

The symbology comprises an octagonal 'hover position' box, a bob-up command heading and a velocity vector.

The HIDSS display represents a 200m x 200m overhead view around the original bob-up position and the octagonal hover position box represents the helicopters rotor blades. As the helicopter drifts from the bob-up position so the hover position box will drift from the display centre. To keep 'on-station' fly towards the hover position box. The velocity vector will assist you to do this. The velocity vector is calibrated up to 10 knots.

The bob-up command heading appears on the heading strip and records the heading when the bob-up overlay was engaged.

The bob-up overlay can be engaged with the display in either navigation or combat modes.

The bob-up overlay will disengage automatically if the helicopter drifts more than 500 metres from the original bob-up position.

O	Engage bob-up overlay (press again to re-centre)
Ctrl + O	Disengage bob-up overlay

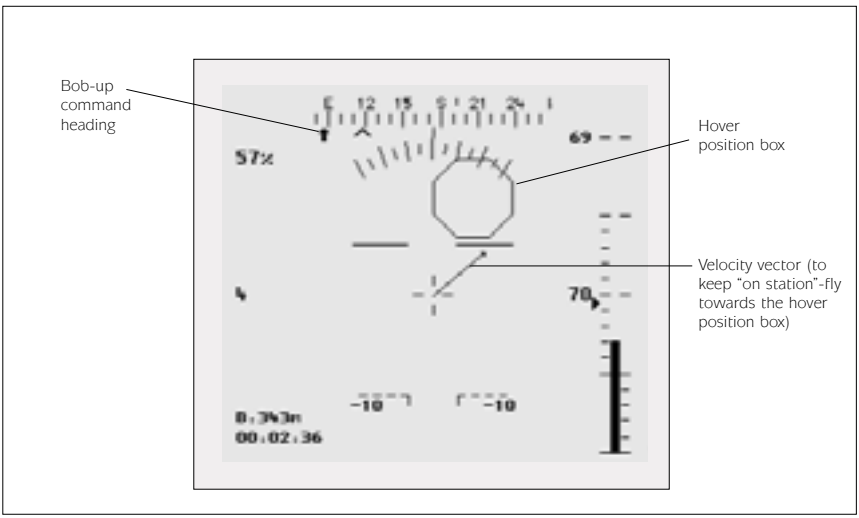


Diagram 4.13: *Bob-up overlay*

Acquiring Targets

The Comanche has 3 target acquisition systems:-

1. a mast-mounted Fire Control Radar (FCR) which can be used to scan for ground targets or airborne targets
2. a Target Acquisition and Designation Sight (TADS) with Forward-Looking Infra-Red (FLIR) and Daylight TV (DTV) channels plus a laser designator/range-finder.
3. a Helmet Integrated Display and Sight System (HIDSS)

All three systems are integrated and a target acquired with one system may be passed to another system as long as it falls within the targeting restraints of that system. Any target which has been acquired is kept on a target list and all of the target acquisition systems are able to cycle through this list.

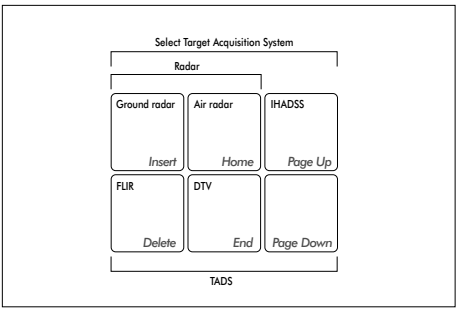


Diagram 4.14: *Select target acquisition system*

Novice and Realistic Avionics

There is an option to select either 'Novice' or 'Realistic' avionics. This is selected in the Options Screen 'Realism' menu.

Novice

The Novice avionics option simplifies the target acquisition systems. With this option selected only the HIDSS system is available and this is automatically engaged whenever you arm a weapon.

The performance of the HIDSS is exaggerated in this mode and you will never get a HIDSS failure.

Realistic

The Realistic avionics option allows use of all the target acquisition systems as described below.

CP/G Assistance: Target ID

The Co-pilot/Gunner (CP/G) can assist you to identify targets. There are 3 levels of assistance; 'Novice', 'Realistic' and 'Off'. This is selected in the Options Screen 'Realism' menu.

Novice

The CP/G identifies the target immediately and reports them using simplistic names such as 'Enemy Tank' and 'Allied Aircraft'.

Realistic

The CP/G attempts to make a visual identification (using the TADS where possible). It may take the CP/G a few moments to make the identification depending on the target range and adverse weather conditions. During this time the message 'CP/G IDENTIFYING...' is displayed instead of the target name. If there is no line of sight to the target then no identification can be made. If you have selected an inappropriate TADS system (you cannot use FLIR in heavy rain or DTV at night) the message 'LOW LIGHT' is displayed in place of the target name. In this case select a more suitable system. Once the identification is made the NATO reporting name is given for the target and you must decide if it is an allied or enemy target.

Off

The CP/G gives you no help whatsoever. Once a target has been selected then use the TADS systems to make the identification yourself. The 'Recognition Guide' will assist you in spotting key recognition features.

Fire Control Radar

The Fire Control Radar scans for targets and a symbolic image of the returns is shown on the MFD display. The radar can only acquire targets to which it has line of sight (LOS). If an acquired target masks behind buildings or terrain features the radar will still display the target but the target category symbol will change. If the target was moving the radar will attempt to interpolate the target's new position. Target symbols are displayed using two different colours for clarity.

Target Categories	LOS	No LOS
Wheeled vehicle	●	○
Tracked vehicle	⬓	⬒
Air defence unit	▲	△
Aircraft	◆	◇
Helicopter	⧓	⧖
Ship	⧗	⧖
Structure	■	□

Using radar will alert enemy targets of your presence and may attract hostile fire. Ensure that you switch the radar off when you have finished using it!

Ground Radar

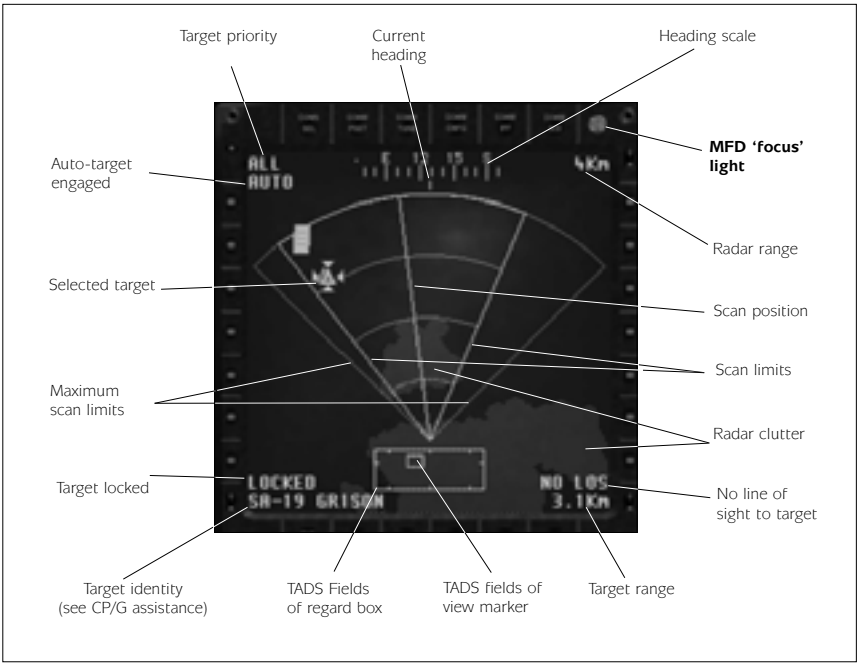


Diagram 4.15: *Ground radar display*

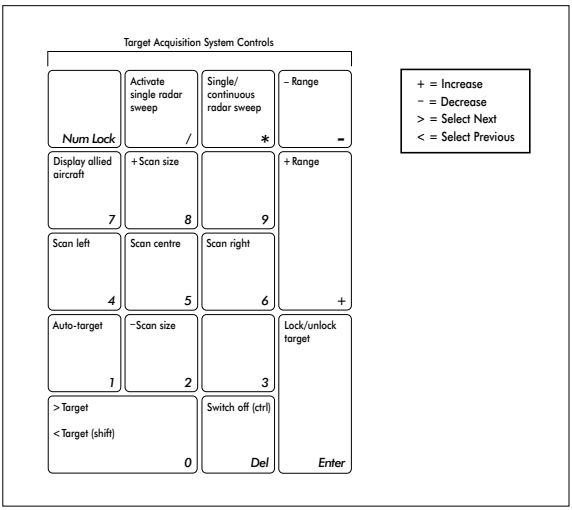


Diagram 4.16: *Ground radar controls*

The ground radar can acquire battlefield targets and low slow flying helicopters. It can categorise targets but cannot differentiate between allied and enemy. The ground radar sweep is limited to a 90 degree arc ahead of the helicopter.

The ground radar shows cities and other built up areas as 'radar clutter'. It is only possible to target certain strategic and tactical structures such as bridges and hardened aircraft shelters.

At the bottom of the ground radar display is the TADS field of regard box and the field of view marker. As you cycle through the targets you will see the CP/G moving the field of view marker on to the target. In realistic target ID assistance mode the CP/G cannot identify the target until the marker is on the target. Therefore if you are flying erratically the CP/G will be unable to make an identification.

Range

Select ground radar range (500m, 1, 2, 4 or 8Km).

Scan size

Adjust the radar scan arc size. Minimising the arc size will reduce your visibility to enemy targets and will increase the scan rate.

Scan direction

Adjust the radar scan direction left or right of centre.

Scan centre

Centre the radar scan.

Single/continuous radar sweep

Toggle between single sweep and continuous sweep.

Activate single radar sweep

Activate radar sweep in single sweep mode. Use single sweep mode to reduce your visibility to enemy targets.

Target priority

Adjust the target priority (ALL, LOW, MEDIUM or HIGH) to declutter the radar. The ground radar priority for each target is given in the 'Recognition Guide'. Generally any target which can fire at the helicopter is high priority, other armour and battlefield targets are medium priority and soft targets are low priority.

Next/previous target

Cycle forwards or backwards through the targets.

Auto-target

Toggle auto-target mode. In auto-target mode the ground radar automatically assesses the highest threat target. This will only select targets of the selected priority.

Lock/unlock target

Lock the current target to prevent the auto-target system from selecting another target.

Switch off

Switch the ground radar off.

MFD 'Focus' Light

The focus light indicates that this MFD page is being used by the selected target acquisition system.

Air Radar

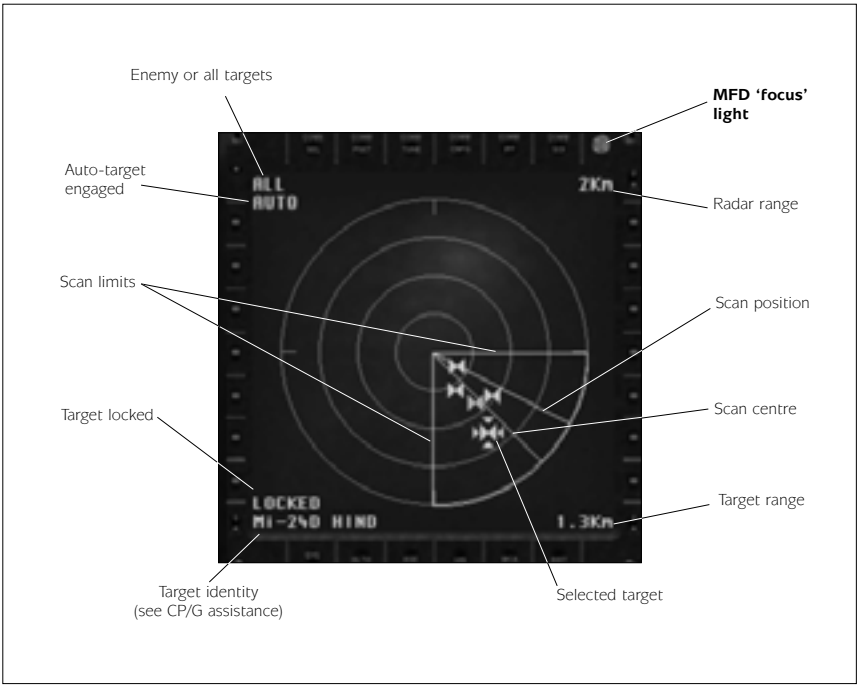


Diagram 4.17: *Air radar display*

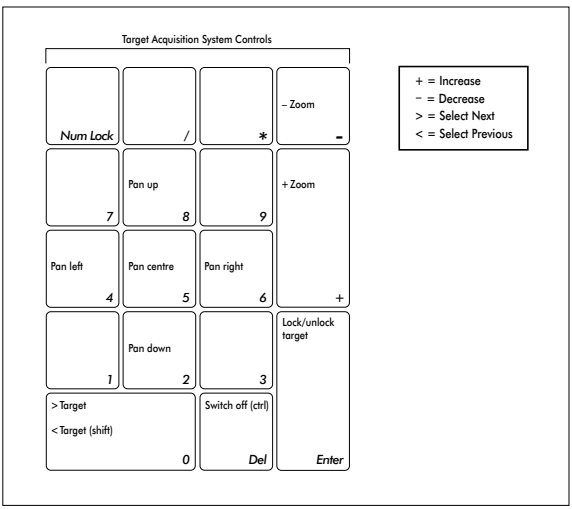


Diagram 4.18: *Air radar controls*

The air radar can acquire airborne targets. It can categorise targets and identify between allied and enemy. The air radar can sweep through 360 degrees.

Air radar contacts will 'timeout' unless they are reswept.

Range

Select air radar range (500m, 1, 2, 4 or 8Km).

Scan size

Adjust the radar scan arc size. Minimising the arc size will reduce your visibility to enemy targets and will increase the scan rate.

Scan direction

Adjust the radar scan direction left or right of centre.

Scan centre

Centre the radar scan.

Single/continuous radar sweep

Toggle between single sweep and continuous sweep.

Activate single radar sweep

Activate radar sweep in single sweep mode. Use single sweep mode to reduce your visibility to enemy targets.

Display allied aircraft

Toggle display ALL aircraft targets or ENEMY targets only.

Next/previous target

Cycle forwards or backwards through the targets.

Auto-target

Toggle auto-target mode. In auto-target mode the air radar automatically assesses the highest threat target.

Lock/unlock target

Lock the current target to prevent the auto-target system from selecting another target.

Switch off

Switch the air radar off.

MFD 'Focus' Light

The focus light indicates that this MFD page is being used by the selected target acquisition system.

Target Acquisition and Designation Sight (TADS)

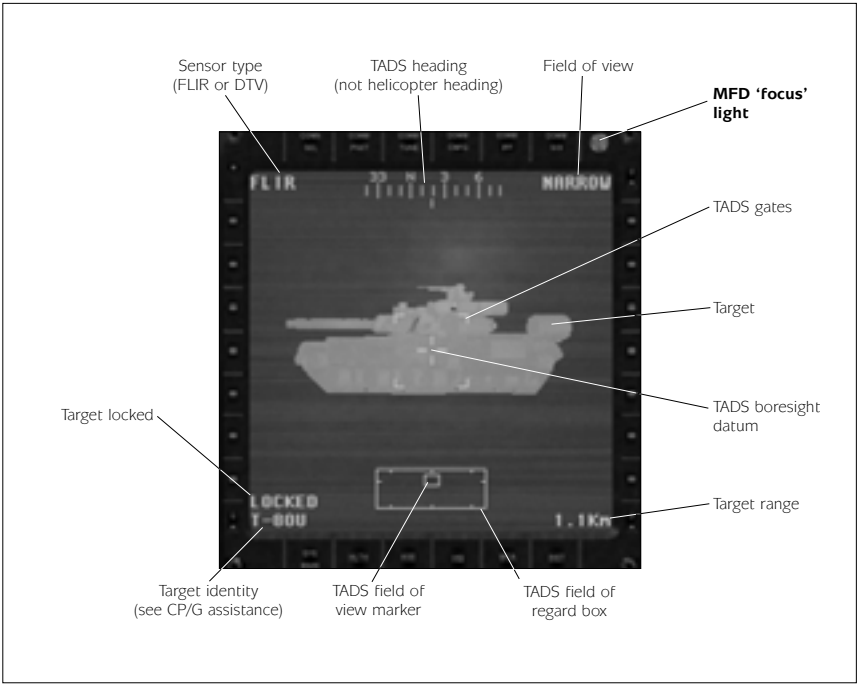


Diagram 4.19: *TADS display*

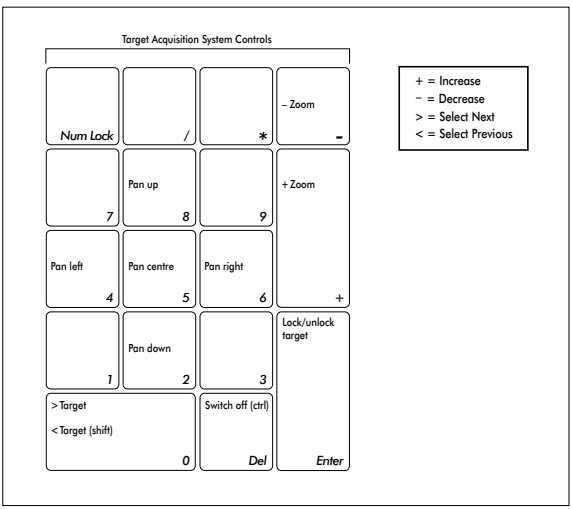


Diagram 4.20: *TADS controls*

The TADS system is located at the front of the helicopter in the nose turret. The unit can move +/-120 degrees in azimuth (left or right) and from +30 to –60 degrees in elevation (up or down). The system comprises a Forward-Looking Infra-Red (FLIR) channel, a Daylight TV (DTV) channel and a laser designator/range finder. The image from the TADS system is displayed in an MFD.

The TADS system is used to locate, identify and designate targets. If you have selected no target ID assistance then you can use TADS to identify targets before firing. Using TADS is more stealthy than using the radar as enemy targets are less likely to know that they are being targeted

To locate targets select the widest field of view available and slew the TADS in the direction of the area of interest. Targets are brighter than the surrounding terrain. When you have located a target, zoom in by reducing the field of view. When the TADS is aimed directly towards the target the TADS gates appear and you can lock the target to keep it centred in the display and make an identification. TADS is especially useful for finding enemy armour lurking in the tree-lines.

It is very difficult to use the TADS system when the helicopter is moving. You are recommended to use this system when the helicopter is in a steady hover. Use the auto-hover facility [H].

If the light conditions are inappropriate for the selected sensor then a "LOW LIGHT" appears on the TADS display.

Forward-Looking Infra-Red (FLIR)

The FLIR has 3 fields of view; wide, medium and narrow. The FLIR is ineffective in adverse weather conditions.

Daylight TV (DTV)

The DTV only has a narrow field of view. The DTV is ineffective at night.

Zoom

Select TADS field of view (WIDE, MEDIUM or NARROW).

Pan

Pan the TADS left, right, up and down. On an external view of the Comanche you can see the TADS housing move as you steer it.

Pan Centre

Centre the TADS pan.

Next/previous target

Cycle forwards or backwards through the targets.

Lock/unlock target

Lock the current target to prevent the auto-target system from selecting another target.

Switch off

Switch the TADS system off.

MFD 'Focus' Light

The focus light indicates that this MFD page is being used by the selected target acquisition system.

Helmet Integrated Display and Sight System (HIDSS)

The HIDSS enables the pilot to acquire targets simply by looking at them. Effectively the radar and TADS are slaved to the HIDSS. At night-time the Pilot Night Vision Sensor (PNVS) must be used. To activate PNVS press the [N] key.

The HIDSS display moves with your head and remains in the centre of the screen. You can pan your view using the virtual cockpit keys. The functionality of these keys is duplicated on to the numeric keypad arrow keys when HIDSS mode is selected.

To find targets with HIDSS first select HIDSS mode [Page Up] and make sure that you have a weapon selected [←]. HIDSS will boresight targets near to the display datum. When a target is seen the target marker will appear.

You can 'padlock' the target by pressing either [Ctrl] + [Enter] or [1]. Press either [Ctrl] + [Enter] or [0] to unpadlock the target.

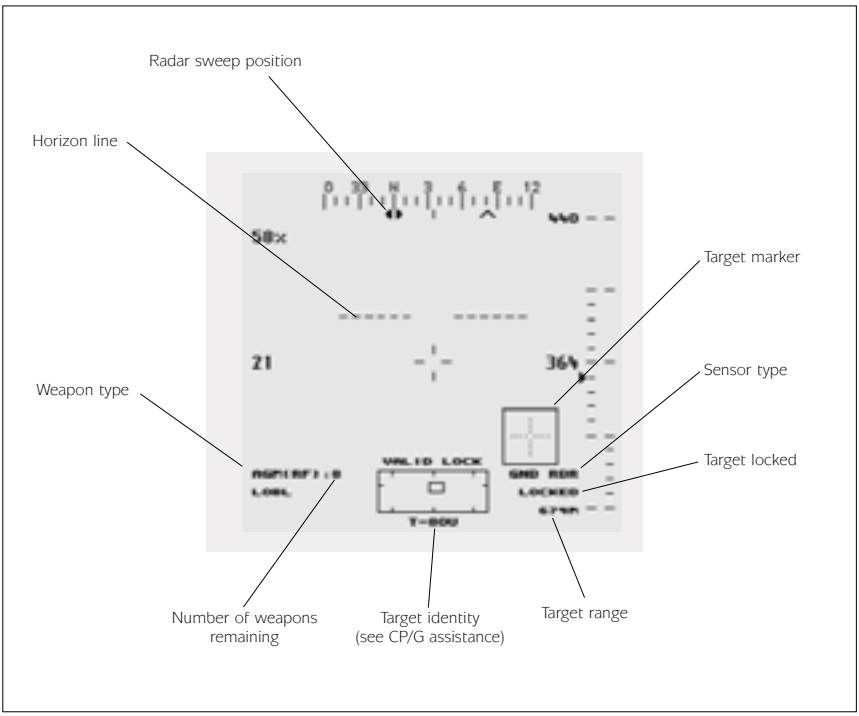


Diagram 4.21: *HIDSS display in combat mode – weapons are covered in more detail in the Weapons section*

The weapon type indicates the selected weapon:-

'Gun'	20mm Gatling gun
'AAM'	AIM-92 Stinger IR guided air-to-air missiles
'AGM(RF)'	AGM-114L Longbow Hellfire radar guided anti-tank missiles
'AGM(LSR)'	AGM-114K Hellfire II laser guided anti-tank missiles
'RKT(HE)'	Hydra 70 M255 70 mm high explosive unguided rockets
'RKT(MP)'	Hydra 70 M261 70 mm multi-purpose unguided rockets

The sensor type indicates the active target acquisition system:-

'GND RDR'	Ground radar
'AIR RDR'	Air radar
'FLIR'	Forward-Looking Infra-Red
'DTV'	Daylight TV
'HIDSS'	HIDSS

The target lock type indicates if the weapon has a valid lock else the reason for lock failure:-

'NO ACQUIRE'	No target acquisition system is active
'NO WEAPON'	No weapon is selected
'NO TARGET'	No target has been designated
'INVALID TARGET'	The target is unsuitable for the weapon
'SEEKER LIMIT'	The target exceeds the weapon seeker limit
'NO LOS'	No line of sight to the target
'NO BORESIGHT'	The target must be ahead of the helicopter for unguided rockets
'MIN RANGE'	The target is too near
'MAX RANGE'	The target is too far
'VALID LOCK'	The lock is good

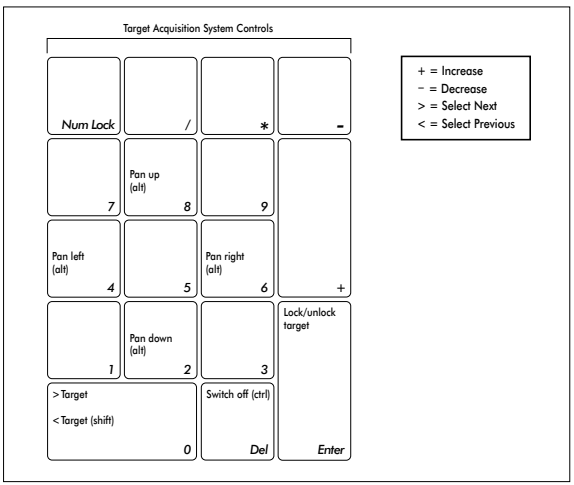


Diagram 4.22: *HIDSS controls*

Pan

Pan the HIDSS left, right up and down (use with Alt to pan the virtual cockpit view).

Next/previous target

Cycle forwards or backwards through the targets.

Lock/unlock target

Lock the current target to prevent the HIDSS from selecting another target.

Switch off

Switch the HIDSS target acquisition mode off.

Weapons

The Comanche is 'mission agile' and is configurable from a low observable scout to an attack/precision strike gunship.

The Comanche carries its weapons internally, mounted on bay doors either side of the fuselage. Optional stub wings can be fitted to carry more weapons.

When the stub wings are fitted the Comanche loses its stealth capabilities and so the stub wings should not be used for low observable missions.

Selecting any internal weapon will automatically open the bay doors.

Selecting a weapon automatically switches the HIDSS display to combat mode. Making the weapons safe returns the HIDSS display to navigation mode.

←	Select next weapon
Shift + ←	Select previous weapon
Ctrl + ←	Weapons safe

To fire a weapon press the Spacebar. If the weapon fails to launch check the lock failure status on the HIDSS display.

Low observable ***Integral armement*** ***Attack/precision strike***

Diagram 4.23: *The Comanche is configurable from a low observable scout to an attack/precision strike gunship*

20 mm Gatling Gun

The Comanche is equipped with a stowable three-barrel M197 20 millimetre Gatling gun loaded with 500 rounds of ammunition.

The gun automatically tracks the selected target and can be rotated +/-120 degrees in azimuth (left or right) and from +10 to -60 degrees in elevation (up or down).

The Gatling gun can be used against ground or air targets.

Type	20 mm Gatling gun
Rate of fire	750 rounds per minute
Maximum range	1,600 metres
Muzzle velocity	884 metres per second
Weight	0.257 Kg

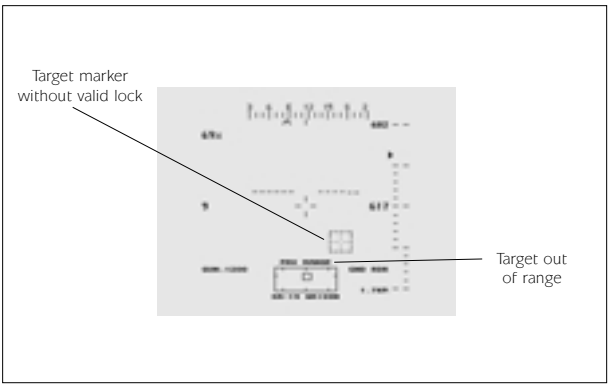


Diagram 5.24: *HIDSS display for the gun showing an out of range target*

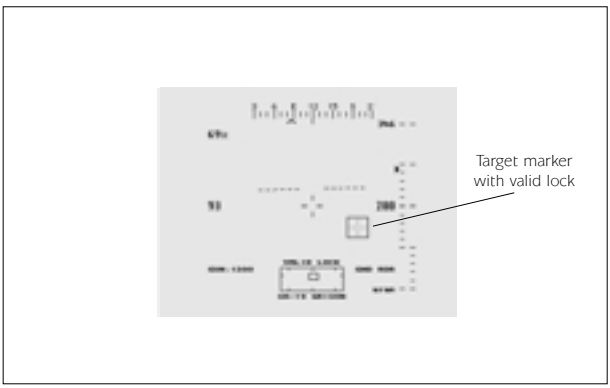


Diagram 5.25: *HIDSS display for the gun showing a valid target lock*

AIM-92 Stinger

The Comanche carries Stinger short-range air-to-air guided missiles. A maximum of 12 can be carried internally on the bay doors and a maximum of 16 can be carried on the stub wings – 28 Stingers in total.

The Stinger is a heat seeking missile and is effective against airborne targets. If a ground target is selected then "INVALID TARGET" is displayed on the HIDSS display.

Enemy targets will use flares and IR jammers to distract this missile.

Type	short-range air-to-air
Guidance	infra-red homing (fire-and-forget)
Maximum range	5,000 metres
Cruise speed	Mach 2.0
Seeker field of view	80°
Weight	13.6 Kg

When the Stinger is seeking for a target a pair of dashed concentric circles move around the HIDSS display to indicate the seeker head position. When a valid lock on has been achieved the dashed circles become solid and indicate the target position. Also a tone is emitted to indicate the valid lock.

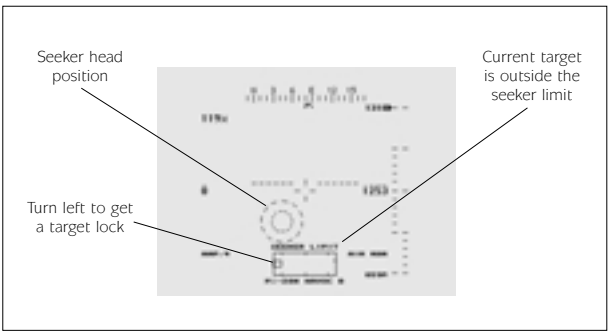


Diagram 4.26: *HIDSS display for a Stinger seeking a target*

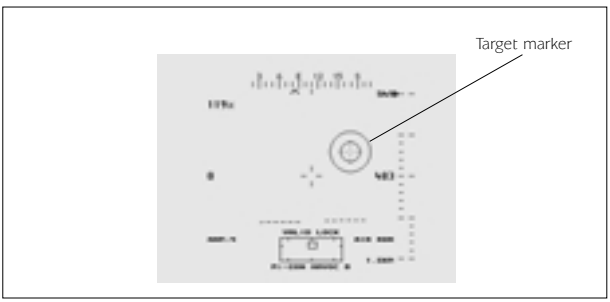


Diagram 4.27: *HIDSS display for a Stinger showing a valid target lock*

Hellfires

The Comanche carries Hellfire short-range anti-tank guided missiles. A maximum of 6 can be carried internally on the bay doors and a maximum of 8 can be carried on the stub wings – 14 Hellfires in total.

There are two types of Hellfire missile; the AGM-114L Longbow Hellfire and the AGM-114K Hellfire II. Hellfires are effective against armoured battlefield targets but may also be used against slow moving airborne targets.

The AGM-114L Longbow Hellfire is an active radar guided missile. This is fire and forget missile. When the missile has been launched you can select another target and launch another missile.

The AGM-114K Hellfire II is a semi-active laser guided missile. The missile requires a the target to be 'painted' with laser.

Hellfire missiles can be launched in one of two modes; lock on before launch (LOBL) and lock on after launch (LOAL). The lock on mode is toggled with the [L] key.

In LOBL mode the missile requires a line of sight to the target. If a radar guided Hellfire is used then the helicopter can mask behind cover after the missile is launched. If a laser guided Hellfire is used then the target must be laser designated throughout the missiles flight. The missile's time to target (in seconds) is shown in the lower left corner of the IHADSS display. If more than one missile is launched then the flight time of the most recently launched missile is shown.

In LOAL mode the missiles can be launched from behind cover. The missile follows a high launch profile. When a target is selected the missile steers towards it but only if the target is within the missile's seeker limits. With radar guided Hellfires it is not necessary for the helicopter to unmask but with laser guided missiles it is necessary to unmask in order to designate the target.

Hellfire 'LOAL' Deployment

When Hellfire missiles are deployed in lock-on after launch 'LOAL' mode they follow a high launch profile. That is, they zoom climb to about 300m before pitching over so that they can 'see' ground targets.

The initial zoom climb uses energy and shortens the effective range of the missile. The missile cannot see ground targets until it has pitched over and is looking towards the ground. This increases the minimum range of the missile.

The target lock type will show a 'VALID LOCK' in LOAL mode if the target range is between 1.5 Km and 5.0 Km. These are a guideline only. Other factors have to be considered such as the height difference (between the helicopter and the target) and the target azimuth error (the horizontal angular error between the display centre and the target).

Type	short-range anti-tank guided missile (ATGM)
Guidance	active radar (AGM-114L) semi-active laser (AGM-114K)
Maximum range	8,000 metres
Cruise speed	Mach 1.3
Seeker field of view	60°
Weight	45.0 Kg

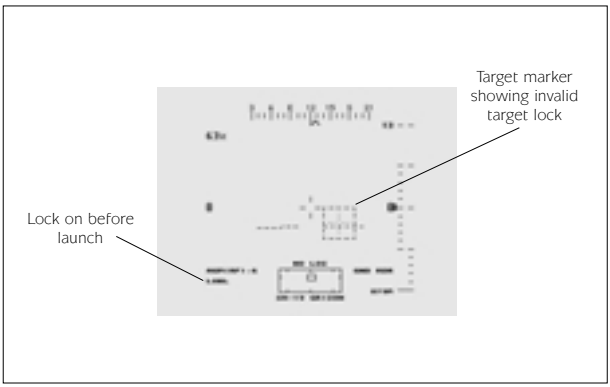


Diagram 4.28: *HIDSS display for a Hellfire missile in LOBL launch mode showing an invalid target lock*

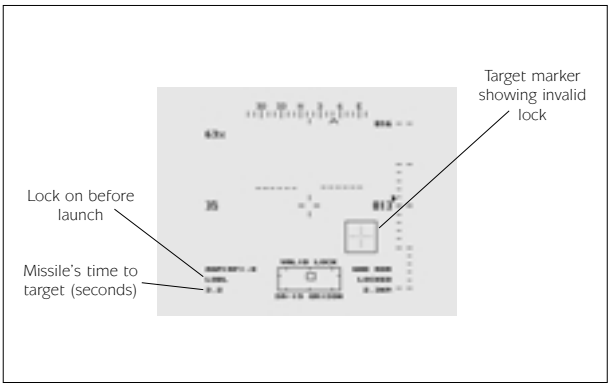


Diagram 4.29: *IHIDSS display for a Hellfire missile in LOBL launch mode showing a valid target lock*

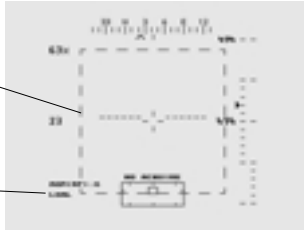


Diagram 4.30: *HIDSS display for a Hellfire missile in LOAL launch mode showing an invalid target lock*

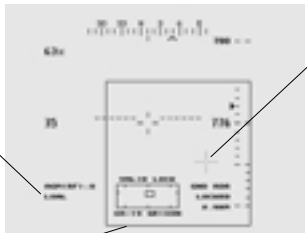


Diagram 4.31: *HIDSS display for a Hellfire missile in LOAL launch mode showing a valid target lock*

Hydra 70 Rockets

The Comanche carries Hydra 70 mm folding-fin aerial rockets (FFARs). These rockets are unguided so it is necessary to boresight the target by steering the helicopter towards it. Use the forward cockpit view [F1].

Hydra rockets can only be carried on the stub wings and they are mounted in pods of 19 giving a maximum capacity of 38.

Rockets can be fired in salvos to increase the damage area and kill probability.

[S]	Increase salvo size
[Shift] + [S]	Decrease salvo size

There are two types of warheads; the M255 high explosive (HE) warhead and the M261 multi-purpose sub-munition (MPSM) warhead.

The M255 HE warhead is effective against soft battlefield targets and helicopters. The M261 MPSM warhead is effective against armoured vehicles.

The rocket pods have automatic adjustable elevation (from +4.9 degrees to -15.0 degrees). It is only necessary to line the helicopter's heading up with the target if the elevation is within limits. This makes using rockets in the Comanche far easier than in the Hokum and the kill probability is increased.

The rocket pods will not elevate at speeds in excess of 100 knots. If the helicopter's speed is above this limit the rockets must be boresighted manually as in the Hokum.

Type	folding-fin aerial rocket
Maximum range	5,000 metres
Weight	6.0 Kg

The HIDSS display shows the target marker and an 'I-beam'. It is necessary to line up the target marker with the I-beam in order to get a valid lock. With airborne targets the I-beam must be lined up with the computed intercept point instead.

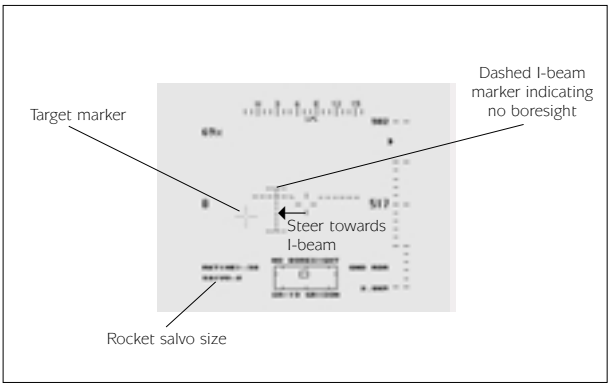


Diagram 4.32: *HIDSS display for unguided rockets showing I-beam not lined up with ground target*

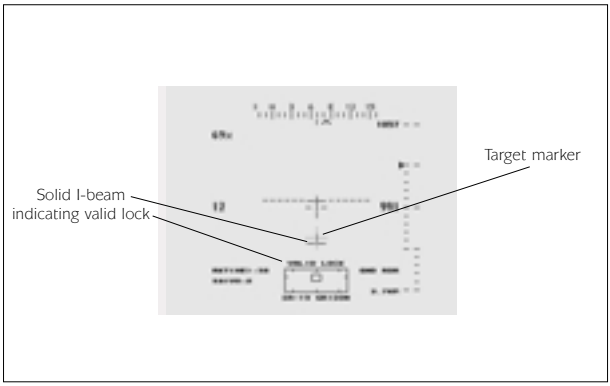


Diagram 4.33: *HIDSS display for unguided rockets showing I-beam lined up with ground target*

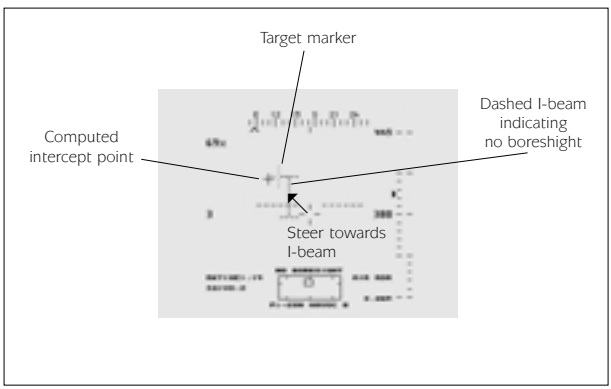


Diagram 4.34: *HIDSS display for unguided rockets showing I-beam not lined up with air target intercept point*

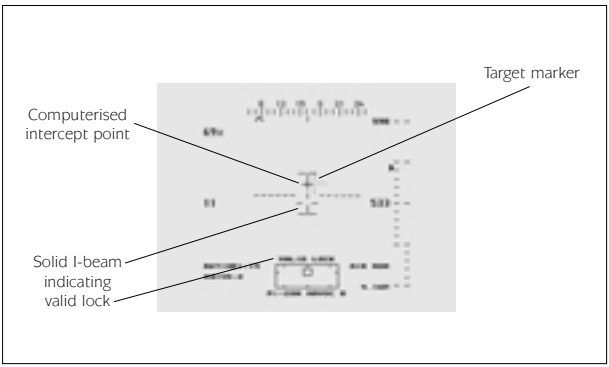


Diagram 4.35: *HIDSS display for unguided rockets showing I-beam lined up with air target intercept point*

Countermeasures

When the ASE display indicates a radar or infra-red threat then the following countermeasures may be used to increase survivability.

Radar Jammer

The radar jammer is used to fool enemy radar of the helicopter's position by creating spurious targets.

J radar jammer on/off

IR Jammer

The IR jammer pumps out intense IR radiation to confuse the seeker head of an incoming IR missile to break lock.

I IR jammer on/off

Chaff

Chaff comprises millions of strips of aluminised Mylar film which when released generate a cloud of radar signature to fool incoming radar guided missiles.

C release chaff cartridge

Flares

Flares are hot pyrotechnic cartridges used to create false targets for incoming IR missiles.

F release flare cartridge

The disadvantage of electronic countermeasures (ECM) such as the radar and IR jammers is that they unmask the helicopter and increase its visibility. They should be used as required.

The disadvantage of chaff and flares is that they run out! The Comanche carries 60 of each.

Automatic Countermeasures

The Co-pilot/Gunner can assist you with operating the countermeasures.

This option is selected in the Options Screen 'Realism' menu and can also be changed in-flight.

Ctrl + C automatic countermeasures on/off.

Pilot Night Vision Sensor (PNVS)

The Comanche pilot has night vision sensor to aid flying at night.

N PNVS on/off

Windshield Wipers

The Comanche is not fitted with windshield wipers as they would spoil the stealth characteristics of the helicopter. In wet weather conditions concealed air blowers automatically engage to clear the windshield.

5. HOKUM COCKPITS

Diagram 5.1: *Cockpit view (pilot left, co-pilot right)*

Diagram 5.2: *Side-by-side cockpit configuration*

Instrument Panel

The Hokum has a side-by-side cockpit configuration. The pilot sits in the left (port) seat and the co-pilot (CP/G) sits in the right (starboard) seat. You can assume either of the crew roles.

Each pilot has two multi-function displays (MFDs). The indicator lights and backup instruments are located on the central console. The co-pilot has binoculars for the ventrally mounted periscope.

Refer to the In-flight 'Views' section for details of the cockpit views.

Airspeed Indicator

The airspeed indicator shows the indicated airspeed of the helicopter and also the sideslip (sideways velocity).

Indicated Airspeed	
Scale	km/h * 10
Full scale deflection	-50 to 450 km/h

Sideslip	
Scale	km/h * 10
Full scale deflection	+/-100 km/h

Barometric Altimeter

The barometric altimeter shows the barometric altitude (height above sea level).

Barometric Altitude	
Large needle scale	metres X 100 (one revolution = 1,000 metres)
Small needle scale	metres X 1,000 (one revolution = 10,000 metres)

Vertical Speed Indicator

The vertical speed indicator shows the rate of climb.

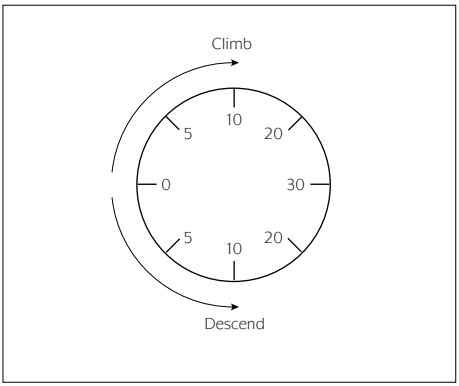


Diagram 5.3: *Direction of climb and descent*

Rate of Climb	
Scale	metres per minute / 10 (scale is non-linear)
Full scale deflection	+/-300 metres per minute

Artificial Horizon

The artificial horizon shows the helicopter pitch and roll attitude relative to the ground.

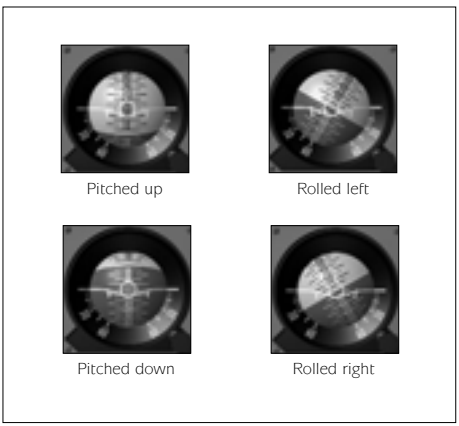


Diagram 5.4: *Pitch up/down rolled left/right*

Standby Compass

The standby compass shows the helicopter's heading.

90	East
'C'	North
18	South
27	West

Master Caution Light

The master caution light flashes, accompanied by an audible warning, to indicate that there is a problem. The problem will be indicated by the warning lights or EKRAN Display. To acknowledge the caution press M. This extinguishes the master caution light and silences the audible warning.

Fire Warning & Extinguisher Lights

The fire warning lights indicate if either engine or the auxiliary power unit (APU) is on fire. In case of a fire use the fire extinguisher. The fire extinguisher can only be used once per mission.

L ENG	Left engine fire
APU	APU fire
R ENG	Right engine fire

Ctrl + F Activate fire extinguisher

The fire extinguisher light indicates if the fire extinguishers have been used.

Warning Lights

TRQ	Engine over torque
RTR RPM	Low main rotor RPM
FUEL LOW	Low fuel level (<25% maximum fuel level)
HYD PRES	Low hydraulic pressure
OIL PRES	Low or high engine oil pressure
OIL TEMP	High engine oil temperature

Status Lights

RTR BRK	Rotor brake engaged
WHL BRK	Wheel brake engaged
NAV LTS	Navigation lights on
HOV HLD	Hover-hold active
ALT HLD	Altitude-hold active
AUT PLT	Auto-pilot active
RDR	Radar active
LSR	Laser active
RDR JAM	Radar jammer active
IR JAM	Infra-red jammer active
AUT C/M	Auto-countermeasures active
AUT TWD	TWD auto-paging active

Gear (Undercarriage) Lights

The GEAR UP/DOWN light is illuminated green when the gear is fully down and red when the gear is fully up. The light flashes when the gear is in a transitional state (raising or lowering). The GEAR DAMAGED light indicates a gear failure.

Ctrl + G Raise/lower gear

EKRAN Display

The EKRAN automatic check-up system monitors necessary systems and critical values and shows text warnings on this display and sends audible warnings to the pilot's headphones.

Multi-Function Displays (MFDs)

Each pilot has two multi-function displays (MFDs) available.

Each MFD can display one of ten selectable pages:-

Ground Radar
Air Radar
Electro-Optical System (EOS)
Tactical Situation Display (TSD)
Threat Warning Display (TWD)
Weapon
System
Engine
Flight
Mission

The pages can be cycled through on each MFD:-

[	Select next left MFD page
Shift + [	Select previous left MFD page
]	Select next right MFD page
Shift +]	Select previous right MFD page

The displays can be switched on and off:-

Ctrl + [	Switch left MFD on and off
Ctrl +]	Switch right MFD on and off

There are shortcut keys to select any page on either MFD.

Left MFD:-

Ctrl + 1	Ground Radar
Ctrl + 2	Air Radar
Ctrl + 3	Electro-Optical System (EOS)
Ctrl + 4	Tactical Situation Display (TSD)
Ctrl + 5	Threat Warning Display (TWD)
Ctrl + 6	Weapon
Ctrl + 7	System
Ctrl + 8	Engine
Ctrl + 9	Flight
Ctrl + 0	Mission

Right MFD:-

Alt + 1	Ground Radar
Alt + 2	Air Radar
Alt + 3	Electro-Optical System (EOS)
Alt + 4	Tactical Situation Display (TSD)
Alt + 5	Threat Warning Display (TWD)
Alt + 6	Weapon
Alt + 7	System
Alt + 8	Engine
Alt + 9	Flight
Alt + 0	Mission

Ground Radar MFD

See the 'Acquiring Targets' section.

Air Radar MFD

See the 'Acquiring Targets' section.

Electro-Optical System (EOS) MFD

See the 'Acquiring Targets' section.

Tactical Situation Display (TSD) MFD

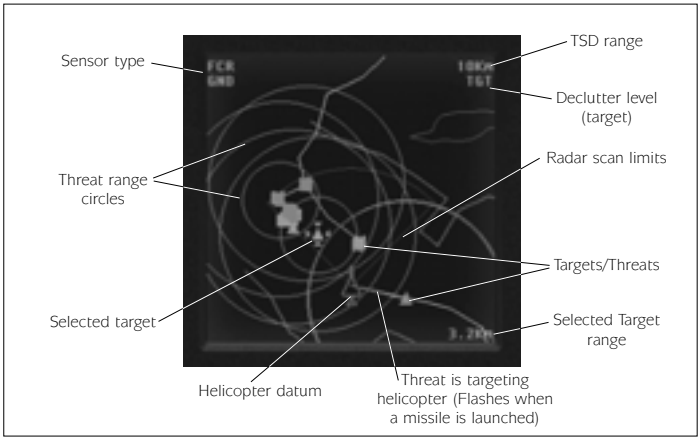


Diagram 5.5: *TSD MFD (target declutter)*

The Tactical Situation Display shows the moving map, navigation information, targets, anti-aircraft threats and air threats and is essential during combat situations.

Helicopter Datum

The TSD shows a plan view of the battlefield with the helicopter located at the bottom of the display.

Declutter Level

The TSD has 3 declutter levels:-

ALL	Display both target and navigation information
TGT	Display target information only
NAV	Display navigation information only
D	Next TSD declutter level
Shift + D	Previous TSD declutter level

TSD Range

The TSD range is selectable between 2, 5, 10 and 25Km. This also changes the range of the TWD display.

E	Next TSD range
Shift + E	Previous TSD range

Sensor Type

NO ACQ	No sensor is active
FCR/GND	Ground radar
FCR/AIR	Air radar
EOSS/FLIR	EOS forward-looking infra-red
EOS/LLLTV	EOS daylight TV
EOS/SCOPE	EOS periscope

Radar Scan Limits

The scan limits of the active ground or air radar.

Targets

Targets are displayed using the radar symbology (see the 'Acquiring Targets' section). Target symbols are displayed using two different colours for clarity. The selected target is marked by a cursor and it's range is shown in the lower right corner of the display.

Threats

Threat range circles are drawn around enemy anti-aircraft units. If the helicopter is inside the circle then you are in range of enemy fire. If a threat (anti-aircraft or airborne) is targeting the helicopter then a line is drawn between the threat and the helicopter datum. When this line flashes a missile has been launched.

Waypoint Route

The waypoint route shows the planned mission route. Information for the current waypoint is shown in the lower left corner of the display.

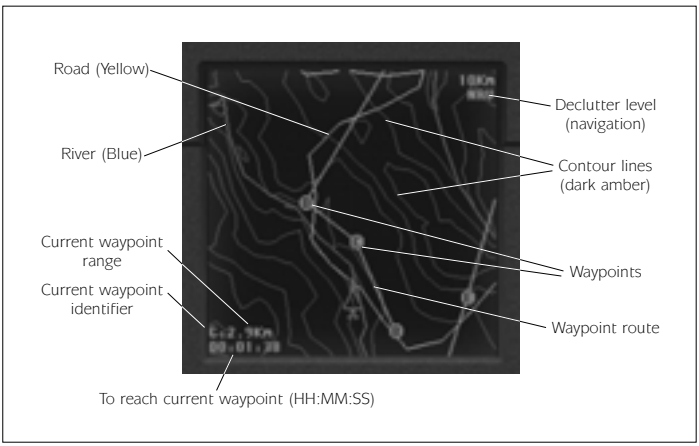


Diagram 5.6: *TSD MFD (navigation declutter)*

Threat Warning Display (TWD) MFD

The Threat Warning Display shows anti-aircraft, airborne and missile threats. It also shows if jamming is active and the number of chaff and flares remaining.

The TWD MFD 'auto-pages' when a threat engages the helicopter. The auto-paging can be disabled.

Ctrl + A Toggle TWD auto-page

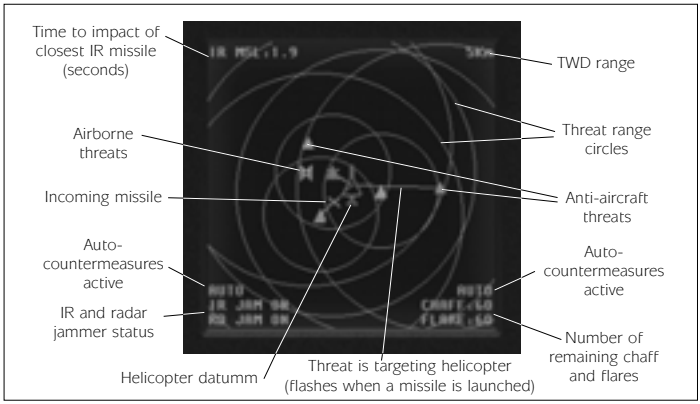


Diagram 5.7: *TWD MFD*

Helicopter Datum

The TWD shows a plan view of the battlefield with the helicopter located centrally.

TWD Range

The TWD range is selectable between 2, 5, 10 and 25Km. This also changes the range of the TSD display.

E Next TWD range

Shift + E Previous TWD range

Threats

Threat range circles are drawn around enemy anti-aircraft units. If the helicopter is inside the circle then you are in range of enemy fire. If a threat (anti-aircraft or airborne) is targeting the helicopter then a line is drawn between the threat and the helicopter datum. When this line flashes a missile has been launched. Threats are displayed using the radar symbology (see the 'Acquiring Targets' section). Target symbols are displayed using two different colours for clarity.

The TWD will not indicate threats from infantry tracking the helicopter with shoulder launched IR guided missiles. The launched missile, however, will be indicated.

Incoming Missiles

Incoming missiles are shown as 'X's. The time to impact for the closest incoming missile is shown (in seconds) in the upper left corner of the display. There are separate readouts for infra-red (IR), radar (RF) and laser (LS) guided missiles.

Jammers

The status of the infra-red and radar jammers is shown in the lower left corner of the display. 'AUTO' indicates that auto-countermeasures are active.

Chaff And Flares

The number of remaining chaff and flares is shown in the lower right corner of the display. 'AUTO' indicates that auto-countermeasures are active.

Weapon MFD

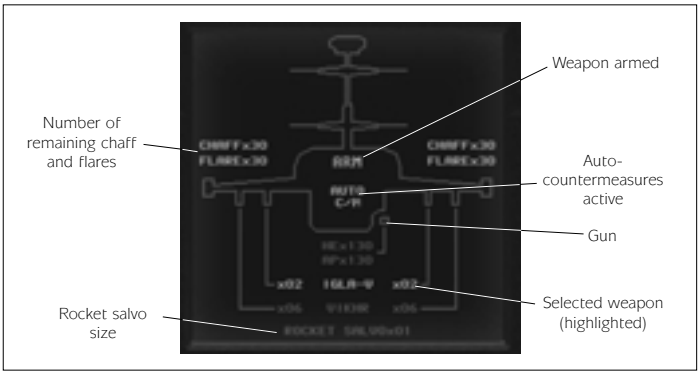


Diagram 5.8: *Weapon MFD*

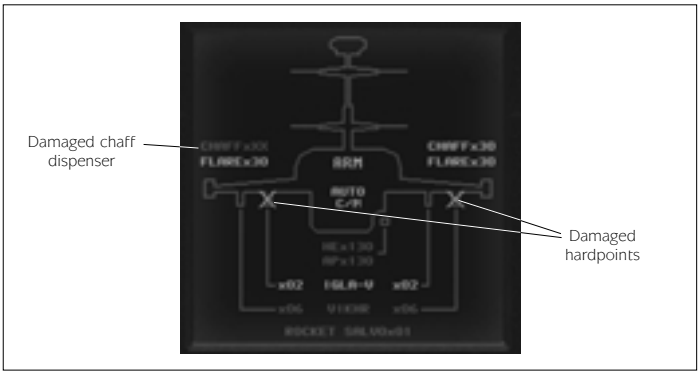


Diagram 5.9: *Weapon MFD showing damaged hardpoints*

The Weapon MFD displays a schematic diagram of the weapons configuration as viewed from behind the helicopter. The selected weapon is highlighted.

'HE'	30mm cannon (high-explosive rounds)
'AP'	30mm cannon (armour-piercing rounds)
'IGLA-V'	Igla-V IR guided air-to-air missiles
'VIKHR'	Vihkr laser guided anti-tank missiles
'S-8'	80 mm unguided rockets
'S-13'	130 mm unguided rockets
'CANNON'	GSh-23L 23 mm cannon pod

System MFD

Diagram 5.10: *System MFD*

The System MFD displays the status of important helicopter components.

Engine MFD

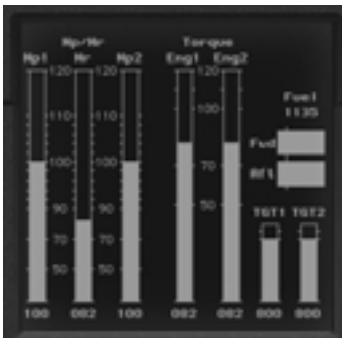


Diagram 5.11: *Engine MFD*

The Engine MFD page displays values for both engines and also monitors the fuel level.

'1'	Refers to the port (left) engine
'2'	Refers to the starboard (right) engine
'Np'	Engine RPM
'Nr'	Rotor shaft RPM
'TGT'	Temperature

The fuels weight is measured in kilogrammes.

Flight MFD

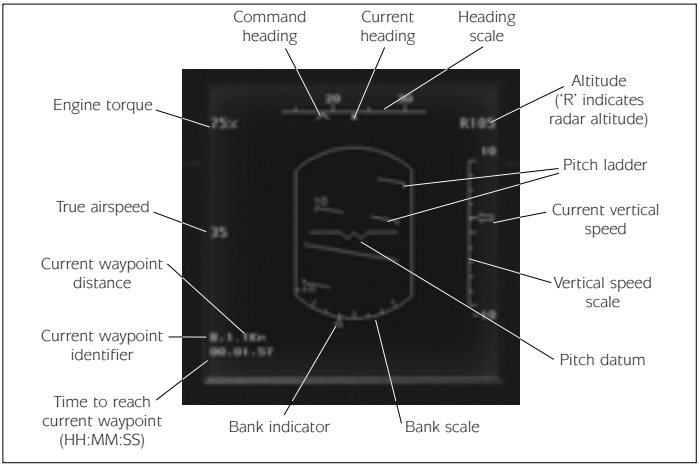


Diagram 5.12: *Flight MFD*

The Flight MFD duplicates the flight and navigation information from the HUD navigation display mode. Refer to the 'Head Up Display' section.

Mission MFD

The Mission MFD shows information about the flight group, mission and mission clock.

Flight Group

The company name is displayed followed by a list of the flight group members. The callsign for each member is displayed. The '>' symbol indicates the group leader. Player's rank and names are shown.

The current flight group formation is displayed. The group leader can change the formation via a radio message (refer to the In-flight 'Radio Messages' section).

Mission

TYPE: Mission type (refer to the In-flight 'Missions' section).
OBJECT: Mission objective
<x,y grid reference> range bearing
STATUS: Mission status
START: Mission start point
<x,y grid reference> range bearing
END: Mission end point
<x,y grid reference> range bearing
COUNT: Mission kills and losses

TIME: MT=HH:MM:SS elapsed mission time
MD=HH:MM:SS estimated mission duration

Mission Clock

Diagram 5.13: *Mission MFD*

The mission clock indicates the time of day.

Head Up Display (HUD)

The head up display (HUD) is used to display primary flight and navigation information. In combat modes the HUD is used in conjunction with the helmet-mounted sight (HMS) to display targeting information.

The helmet-mounted sight is activated when either a weapon or target acquisition system is selected. To return to the HUD navigation mode either make the weapons safe or switch off the target acquisition system.

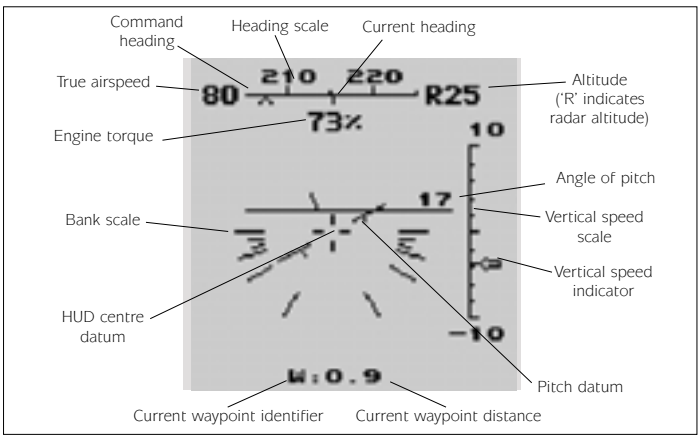


Diagram 5.14: *HUD in navigation mode*

The HUD display colour can be cycled to make it easier to read when the outside conditions change.

K	Select next HUD colour
Shift + K	Select previous HUD colour

Head Up Display In Navigation Mode

The Co-pilot/Gunner (CP/G) can assist you to identify targets. There are 3 levels of assistance; 'novice, 'realistic' and 'off'. This is selected in the 'Game Options' menu.

HUD Centre Datum

Indicates the centre of the display.

Heading Scale and Command Heading

The heading scale is calibrated every 30 degrees. The command heading indicates the direction to the next waypoint.

Angle of Pitch

The horizontal line indicates the direction of the horizon and the digital readout shows the pitch angle.

Helicopter pitched up	Horizontal line is below the HUD centre datum
Helicopter pitched down	Horizontal line is above the HUD centre datum

Aircraft Datum and Bank Scale

The aircraft datum shows the orientation of the helicopter relative to the horizon. The bank angle is indicated by the bank scale.

True Airspeed

True airspeed in km/h.

Altitude

Altitude in metres. Below 500m the readout is prefixed with an 'R' and shows radar altitude (height above ground) and above 500m the readout shows barometric altitude (height above sea level).

Vertical Speed Scale and Current Vertical Speed

The full scale deflection of the vertical speed scale is +/-10 metres. The current vertical speed is indicated by the arrow.

Current Waypoint Identifier

The identifier for the current waypoint as shown on the waypoint route on the map screen.

Current Waypoint Distance

The distance to the current waypoint in kilometres.

Head Up Display/Helmet-Mounted Sight In Combat Mode

See the 'Acquiring Targets' and 'Weapons' sections.

Bob-up Overlay

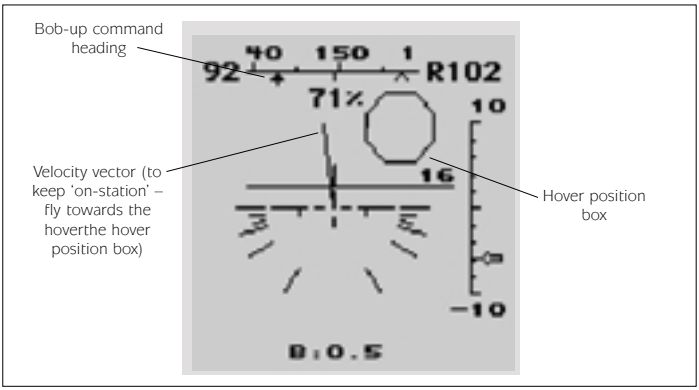


Diagram 5.15: *Bob-up overlay*

The bob-up overlay is useful for 'station-keeping' during bob-up or bob-sideways manoeuvres.

The symbology comprises an octagonal 'hover position' box, a bob-up command heading and a velocity vector.

The HIDSS display represents a 200m x 200m overhead view around the original bob-up position and the octagonal hover position box represents the helicopters rotor blades. As the helicopter drifts from the bob-up position so the hover position box will drift from the display centre. To keep 'on-station' fly towards the hover position box. The velocity vector will assist you to do this. The velocity vector is calibrated up to 20 km/h.

The bob-up command heading appears on the heading strip and records the heading when the bob-up overlay was engaged.

The bob-up overlay can be engaged with the display in either navigation or combat modes.

The bob-up overlay will disengage automatically if the helicopter drifts more than 500 metres from the original bob-up position.

Acquiring Targets

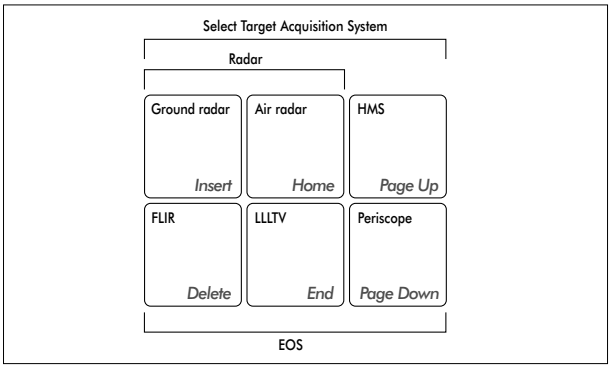


Diagram 5.16: *Select target acquisition system*

The Hokum has 3 target acquisition systems:-

1. a mast-mounted millimetric radar which can be used to scan for ground targets or airborne targets

2. an Electro-Optical System (EOS) with Forward-Looking Infra-Red (FLIR) and Low Light Level TV (LLLTV) channels plus a laser designator/range-finder. A ventrally mounted periscope provides direct view optics

3. a helmet-mounted sight (HMS).

All three systems are integrated and a target acquired with one system may be passed to another system as long as it falls within the targeting restraints of that system. Any target which has been acquired is kept on a target list and all of the target acquisition systems are able to cycle through this list.

Novice and Realistic Avionics

There is an option to select either 'Novice' or 'Realistic' avionics. This is selected in the Options Screen 'Realism' menu.

Novice

The Novice avionics option simplifies the target acquisition systems. With this option selected only the HMS system is available and this is automatically engaged whenever you arm a weapon.

The performance of the HMS is exaggerated in this mode and you will never get a HUD or HMS failure.

Realistic

The Realistic avionics option allows use of all the target acquisition systems as described below.

CP/G Assistance: Target ID

The Co-pilot/Gunner (CP/G) can assist you to identify targets. There are 3 levels of assistance; 'Novice', 'Realistic' and 'Off'. This is selected in the Options Screen 'Realism' menu.

Novice

The CP/G identifies the target immediately and reports them using simplistic names such as 'Enemy Tank' and 'Allied Aircraft'.

Realistic

The CP/G attempts to make a visual identification (using the EOS where possible). It may take the CP/G a few moments to make the identification depending on the target range and adverse weather conditions. During this time the message 'CP/G IDENTIFYING...' is displayed instead of the target name. If there is no line of sight to the target then no identification can be made. If you have selected an inappropriate EOS system (you cannot use FLIR in heavy rain or LLLTV/Periscope at night) the message 'LOW LIGHT' is displayed in place of the target name. In this case select a more suitable system. Once the identification is made the NATO reporting name is given for the target and you must decide if it is an allied or enemy target.

Off

The CP/G gives you no help whatsoever. Once a target has been selected then use the EOS systems to make the identification yourself. The 'Recognition Guide' will assist you in spotting key recognition features.

Mast-Mounted Radar

The mast-mounted radar scans for targets and a symbolic image of the returns is shown on the MFD display. The radar can only acquire targets to which it has line of sight (LOS). If an acquired target masks behind buildings or terrain features the radar will still display the target but the target category symbol will change. If the target was moving the radar will attempt to interpolate the target's new position. Target symbols are displayed using two different colours for clarity.

Target Categories	LOS	No LOS
Wheeled vehicle	●	○
Tracked vehicle	▟	▞
Air defence unit	▲	△
Aircraft	◆	◇
Helicopter	⧓	⧒
Ship	⧗	⧖
Structure	■	□

Using radar will alert enemy targets of your presence and may attract hostile fire. Ensure that you switch the radar off when you have finished using it!

Ground Radar

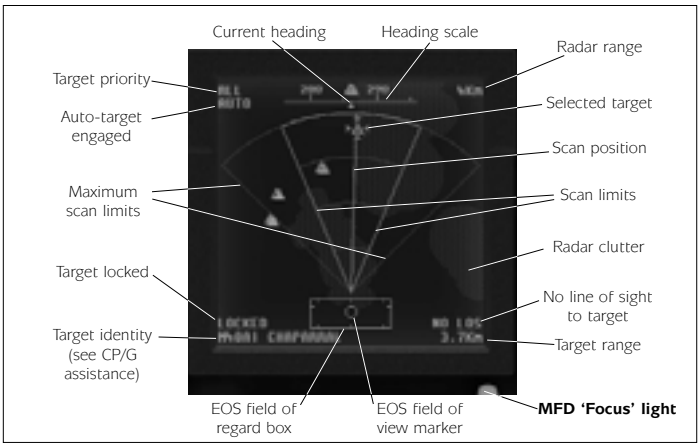


Diagram 5.17: *Ground radar display*

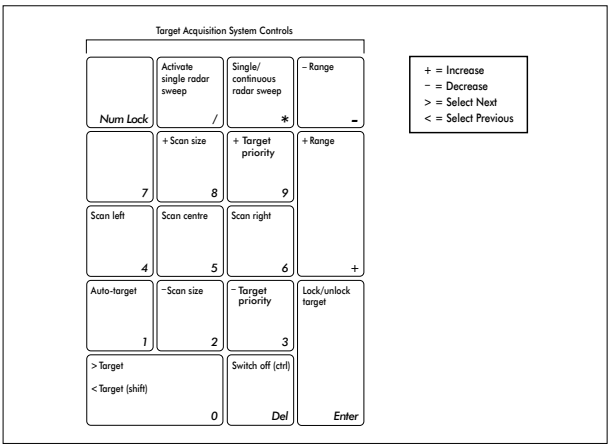


Diagram 5.18: *Ground radar controls*

The ground radar can acquire battlefield targets and low slow flying helicopters. It can categorise targets but cannot differentiate between allied and enemy. The ground radar sweep is limited to a 90 degree arc ahead of the helicopter.

The ground radar shows cities and other built up areas as 'radar clutter'. It is only possible to target certain strategic and tactical structures such as bridges and hardened aircraft shelters.

At the bottom of the ground radar display is the EOS field of view box and the field of regard marker. As you cycle through the targets you will see the CP/G moving the field of regard marker on to the target. In realistic CP/G Assistance mode the CP/G cannot identify the target until the marker is on the target. Therefore if you are flying erratically the CP/G will be unable to make an identification.

Range

Select ground radar range (1, 2, 4 or 6Km).

Scan size

Adjust the radar scan arc size. Minimising the arc size will reduce your visibility to enemy targets and will increase the scan rate.

Scan direction

Adjust the radar scan direction left or right of centre.

Scan centre

Centre the radar scan.

Single/continuous radar sweep

Toggle between single sweep and continuous sweep.

Activate single radar sweep

Activate radar sweep in single sweep mode. Use single sweep mode to reduce your visibility to enemy targets.

Target priority

Adjust the target priority (ALL, LOW, MEDIUM or HIGH) to declutter the radar. The ground radar priority for each target is given in the 'Recognition Guide'. Generally any target which can fire at the helicopter is high priority, other armour and battlefield targets are medium priority and soft targets are low priority.

Next/previous target

Cycle forwards or backwards through the targets.

Auto-target

Toggle auto-target mode. In auto-target mode the ground radar automatically assesses the highest threat target. This will only select targets of the selected priority.

Lock/unlock target

Lock the current target to prevent the auto-target system from selecting another target.

Switch off

Switch the ground radar off.

MFD 'focus' Light

The focus light indicates that this MFD page is being used by the selected target acquisition system.

Air Radar

The air radar can acquire airborne targets. It can categorise targets and identify between allied and enemy. The air radar can sweep through 360 degrees.

Air radar contacts will 'timeout' unless they are re-swept.

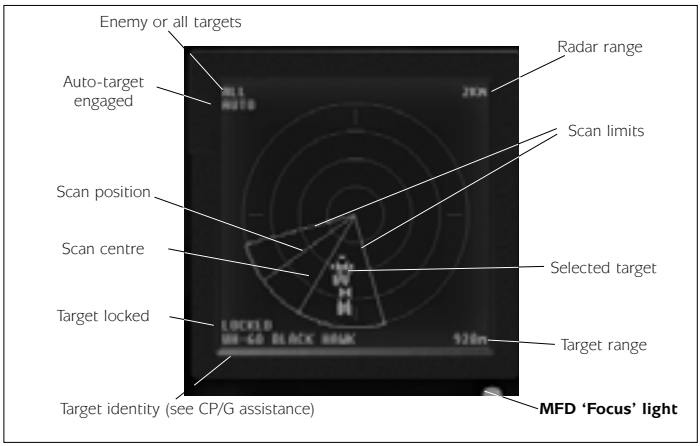


Diagram 5.19: *Air radar display*

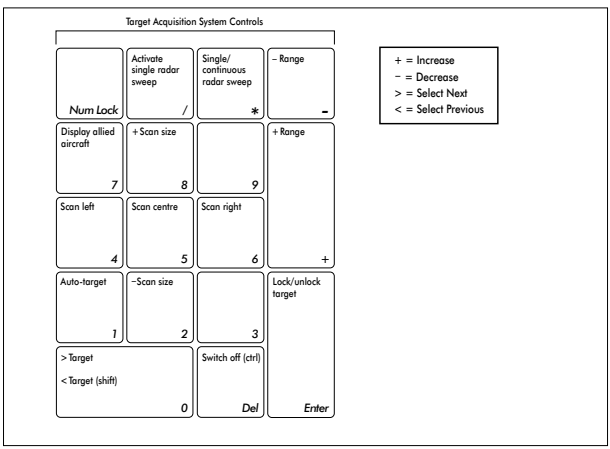


Diagram 5.20: *Air radar controls*

Range

Select ground radar range (1, 2, 4 or 6Km).

Scan size

Adjust the radar scan arc size. Minimising the arc size will reduce your visibility to enemy targets and will increase the scan rate.

Scan direction

Adjust the radar scan direction left or right of centre.

Scan centre

Centre the radar scan.

Single/continuous radar sweep

Toggle between single sweep and continuos sweep.

Activate single radar sweep

Activate radar sweep in single sweep mode. Use single sweep mode to reduce your visibility to enemy targets.

Display allied aircraft

Toggle display ALL aircraft targets or ENEMY targets only.

Next/previous target

Cycle forwards or backwards through the targets.

Auto-target

Toggle auto-target mode. In auto-target mode the air radar automatically assesses the highest threat target.

Lock/unlock target

Lock the current target to prevent the auto-target system from selecting another target.

Switch off

Switch the air radar off.

MFD 'focus' Light

The focus light indicates that this MFD page is being used by the selected target acquisition system.

Electro-Optical System (EOS)

The electro-optical system comprises 3 components; a roof mounted 'Samshit-F' (Boxwood) FLIR/TV/laser system, a ventrally mounted periscope for direct view optics and a chin mounted 'Shkval-V' (Gale) laser targeting and ranging system.

All 3 systems are slaved together and can move +/-110 degrees in azimuth (left or right) and from +10 to -30 degrees in elevation (up or down). The image from the EOS is displayed in an MFD.

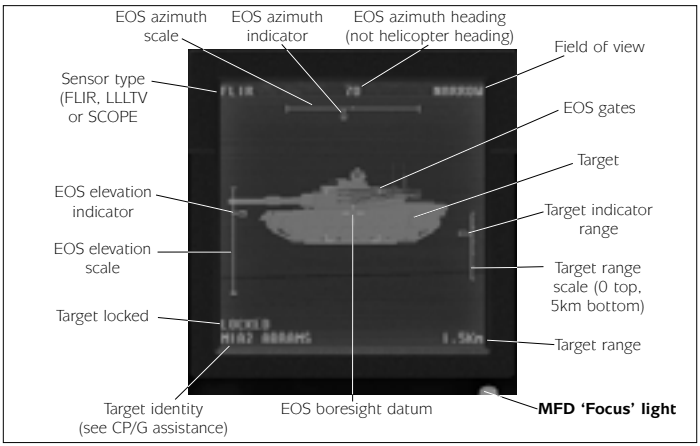


Diagram 5.21: *EOS display*

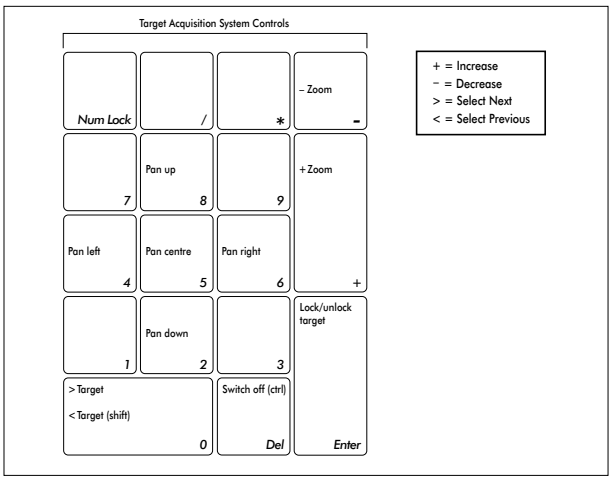


Diagram 5.22: *HMS controls*

The EOS is used to locate, identify and designate targets. If you have selected no CP/G assistance then you can use the EOS to identify targets before firing. Using the EOS is more stealthy than using the radar as enemy targets are less likely to know that they are being targeted.

To locate targets select the widest field of view available and slew the EOS in the direction of the area of interest. Targets are brighter than the surrounding terrain. When you have located a target, zoom in by reducing the field of view. When the EOS is aimed directly towards the target the EOS gates appear and you can lock the target to keep it centred in the display and make an identification. The EOS is especially useful for finding enemy armour lurking in the tree-lines.

It is very difficult to use the EOS system when the helicopter is moving. You are recommended to use this system when the helicopter is in a steady hover. Use the auto-hover facility [H].

If the light conditions are inappropriate for the selected sensor then a "LOW LIGHT" appears on the EOS display.

Forward-Looking Infra-Red (FLIR)

The FLIR has 3 fields of view; wide, medium and narrow. The FLIR is ineffective in adverse weather conditions.

Low Light Level TV (LLLTV)

The LLLTV only has a narrow field of view. The LLLTV is ineffective at night.

Periscope

The periscope has 2 fields of view; medium and narrow. The periscope is ineffective at night.

Zoom

Select EOS field of view (WIDE, MEDIUM or NARROW).

Pan

Pan the EOS left, right, up and down. On an external view of the Hokum you can see the EOS units move as you steer them.

Pan Centre

Centre the EOS pan.

Next/previous target

Cycle forwards or backwards through the targets.

Lock/unlock target

Lock the current target to prevent the auto-target system from selecting another target.

Switch off

Switch the EOS off.

MFD 'focus' Light

The focus light indicates that this MFD page is being used by the selected target acquisition system.

Helmet Mounted Sight (HMS)

The helmet-mounted sight enables the pilot to acquire targets simply by looking at them. Effectively the radar and EOS are slaved to the HMS. At night-time Night Vision Goggles (NVG) must be used. To activate night vision goggles press the [N] key.

The HMS display moves with your head and remains in the centre of the screen. You can pan your view using the virtual cockpit keys. The functionality of these keys is duplicated on to the numeric keypad arrow keys when HMS mode is selected.

To find targets with the HMS first select the HMS mode [Page Up] and make sure that you have a weapon selected [←]. The HMS will boresight targets near to the display datum. When a target is seen the target marker will appear.

You can 'padlock' the target by pressing either [Ctrl] + [Enter] or [1]. Press either [Ctrl] +[Enter] or [0] to unpadlock the target.

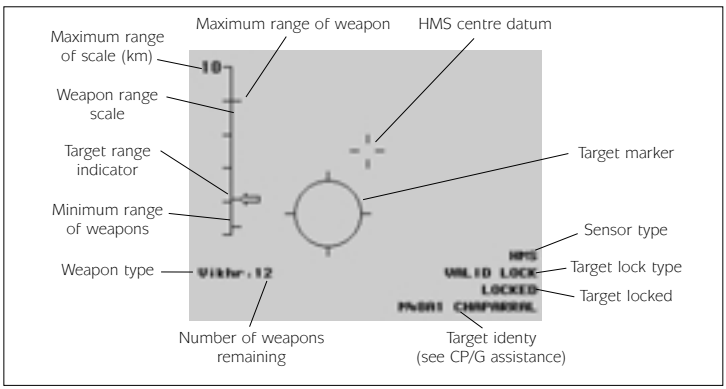


Diagram 5.23: *HMS display – weapons are covered in more detail in the Weapons section*

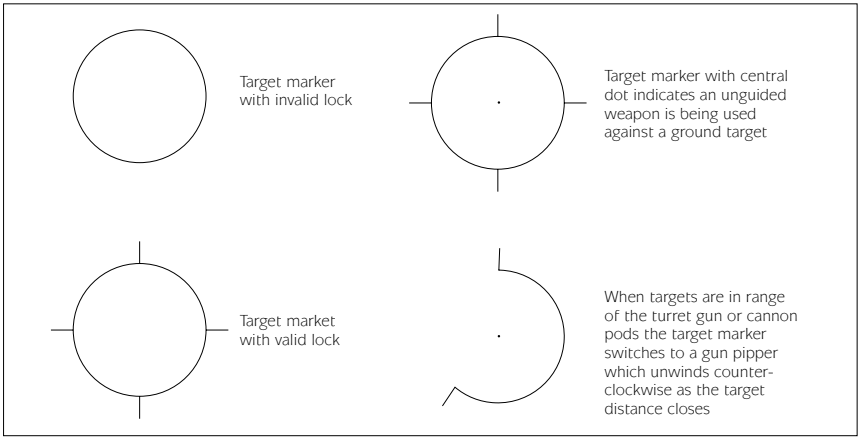


Diagram 5.24: *HMS display target marker*

The weapon range scale indicates the minimum and maximum ranges of the selected weapon and the range to the current target. The maximum range of the scale changes according to the selected weapon and the range is shown as a digital readout in kilometres.

The weapon type indicates the selected weapon:-

'Gun(HE)'	30mm cannon (high-explosive rounds)
'Gun(AP)'	30mm cannon (armour piercing rounds)
'Igla-V'	Igla-V IR guided air-to-air missiles
'Vikhr'	Vikhr laser guided anti-tank missiles
'S-8'	80 mm unguided rockets
'S-13'	130 mm unguided rockets
'GSh-23L'	GSh-23L 23mm cannon pods

The sensor type indicates the active target acquisition system:-

'GND RDR'	Ground radar
'AIR RDR'	Air radar
'FLIR'	Forward-Looking Infra-Red
'LLLTV'	Low Light Level TV
'SCOPE'	Periscope
'HMS'	Helmet-Mounted Sight

The target lock type indicates if the weapon has a valid lock else the reason for lock failure:-

'NO ACQUIRE'	No target acquisition system is active
'NO WEAPON'	No weapon is selected
'NO TARGET'	No target has been designated
'INVALID TARGET'	The target is unsuitable for the weapon
'SEEKER LIMIT'	The target exceeds the weapon seeker limit
'NO LOS'	No line of sight to the target
'MIN RANGE'	The target is too near
'MAX RANGE'	The target is too far
'VALID LOCK'	The lock is good

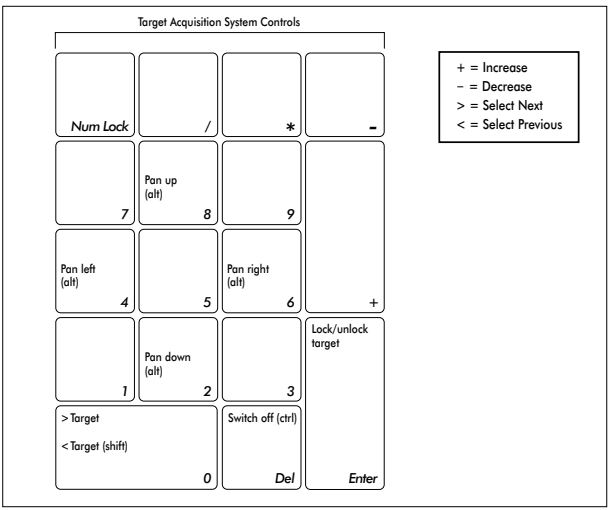


Diagram 5.25: *HMS controls*

Pan

Pan the HMS left, right up and down (use with Alt to pan the virtual cockpit view).

Next/previous target

Cycle forwards or backwards through the targets.

Lock/unlock target

Lock the current target to prevent the HMS from selecting another target.

Switch off

Switch the HMS target acquisition mode off.

Weapons

The Hokum is a heavily armed attack helicopter able to engage and destroy armoured and unarmoured battlefield targets and airborne targets.

The Hokum has four hardpoints two on each stub wing and can carry many weapons mixes depending on the mission requirements.

Selecting a weapon automatically switches the head-up display to combat mode and activates the hemlet-mounted sight display. Making the weapons safe returns the head-up display to navigation mode and switches the helmet-mounted sight off.

[←]	Select next weapon
[Shift] + [←]	Select previous weapon
[Ctrl] + [←]	Weapons safe

To fire a weapon press the [Spacebar]. If the weapon fails to launch check the lock failure status on the helmet mounted sight display.

30mm Cannon

The Hokum has a powerful 30mm 2A42 cannon mounted on the right (starboard) side of the fuselage. The cannon is fed selectively from two containers allowing a choice of either 230 high-explosive rounds or 240 armour-piercing rounds.

The cannon automatically tracks the selected target and can be rotated from –2.5 to 9.0 degrees in azimuth (left or right) and from +13 to -40 degrees in elevation (up or down).

The cannon can be used against ground or air targets. Armour-piercing rounds are effective against armoured battlefield targets and high-explosive rounds are effective against soft ground targets and aircraft.

Type	30 mm cannon
Rate of fire	300 rounds per minute
Maximum range	2,000 metres
Muzzle velocity	1,000 metres per second
Weight	1 Kg

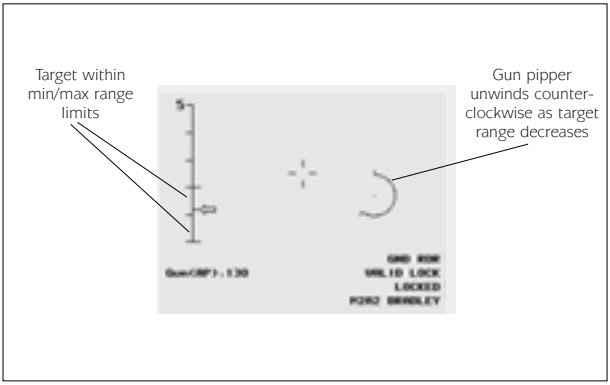


Diagram 5.26: *HMS display for turret gun showing valid ground target*

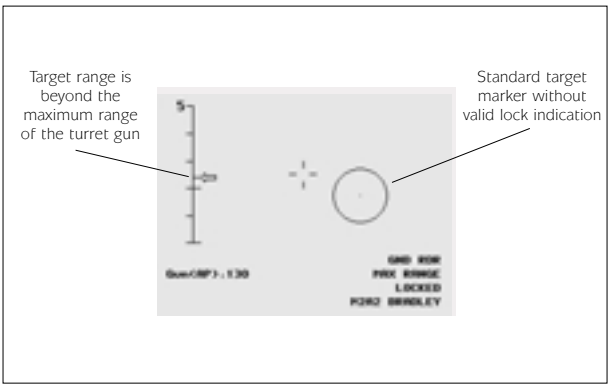


Diagram 5.27: *HMS display for turret gun showing out of range ground target*

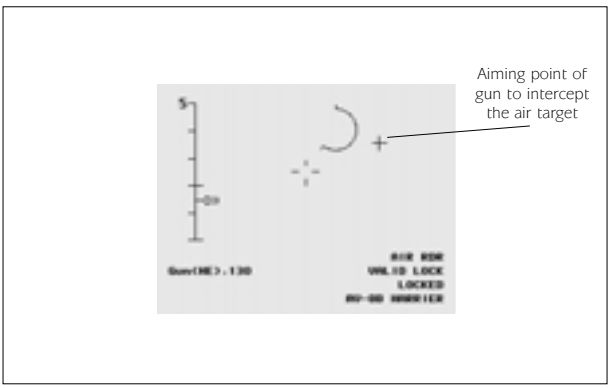


Diagram 5.28: *HMS display for turret gun showing valid air target*

Igla-V

The Hokum carries Igla-V short-range air-to-air guided missiles. They are mounted in pairs so a maximum of 8 missiles can be carried.

The Igla-V is a heat seeking missile and is effective against airborne targets. If a ground target is selected then 'INVALID TARGET' is displayed on the HMS display.

Enemy targets will use flares and IR jammers to distract this missile.

Type	Short-range air-to-air
Guidance	Infra-red homing (fire-and-forget)
Maximum range	5,200 metres
Cruise speed	Mach 2.5
Seeker field of view	60 degrees
Weight	18.2 Kg

Steering the HMS centre datum towards the computed intercept point will reduce the amount of manoeuvering that the missile will have to do in flight and increase the kill probability.

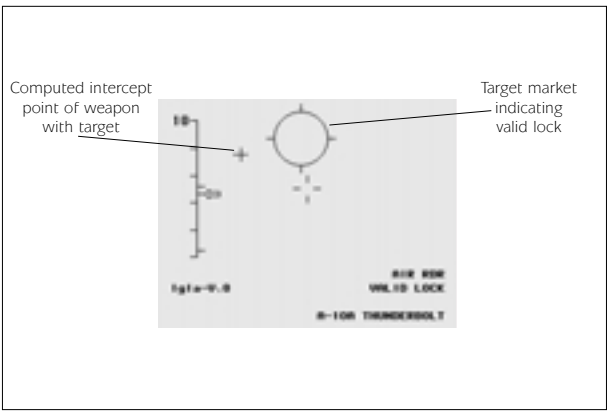


Diagram 5.29: *HMS display for Igla-V showing valid air target*

Vikhr

The Hokum carries Vikhr (Whirlwind) short-range anti-tank guided missiles. They are mounted in racks of 6 but can only be fitted to the outer hardpoints so a maximum of 12 missiles can carried.

The Vihkr uses laser beam riding guidance and the target must remain in line of sight of the helicopter throughout the missiles flight time. The missile flight time (in seconds) is displayed on the HMS. If multiple weapons are fired then the flight time of the most recently launched missile is displayed.

The Vikhr is effective against armoured battlefield targets but may also be used against slow moving airborne targets.

Type	Short-range anti-tank guided missile (ATGM)
Guidance	Laser beam riding
Maximum range	6,000 metres
Cruise speed	Mach 1.1
Seeker field of view	50 degrees
Weight	45.0 Kg

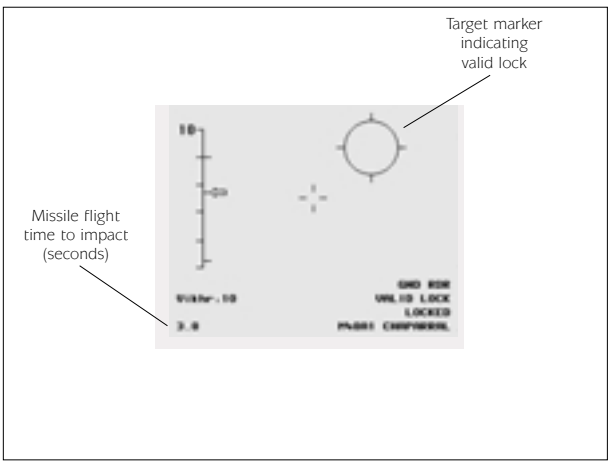


Diagram 5.30: *HMS display for Vikhr showing valid ground target*

Unguided Rockets

The Hokum carries 80 mm (S-8) and 130 mm (S-13) folding-fin aerial rockets (FFARs). These rockets are unguided so it is necessary to boresight the target by steering the helicopter towards it. Use the forward cockpit view [F1].

Rockets can be fired in salvos to increase the damage area footprint.

[S]	Increase salvo size
[Shift] + [S]	Decrease salvo size

S-8

The S-8 rockets are mounted in pods of 20 giving a maximum capacity of 80. They are effective against unarmoured battlefield targets, soft structures and slow moving aircraft.

[Please highlight 'Type ...' as on page 6.28 of the Apache Havoc manual]

Type	Folding-fin aerial rocket
Maximum range	4,000 metres
Weight	11.3 Kg

S-13

The S-13 rockets are mounted in pods of 5 giving a maximum capacity of 20. They are effective against unarmoured battlefield targets, hardened structures and slow moving aircraft.

Type	Folding-fin aerial rocket
Maximum range	6,000 metres
Weight	68.0 Kg

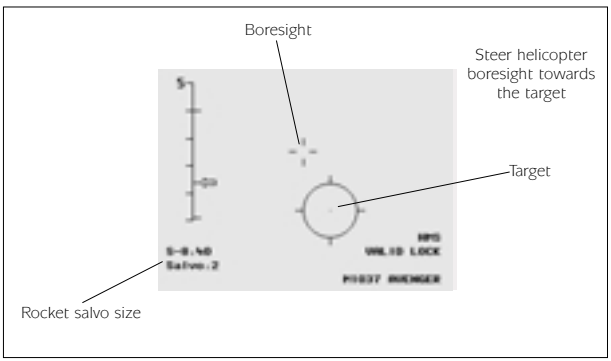


Diagram 5.31: *HMS display showing unguided rocket not lined up with ground target*

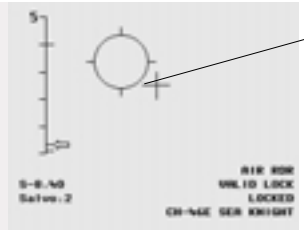


Diagram 5.32: *HMS display showing unguided rocket lined up with ground target*

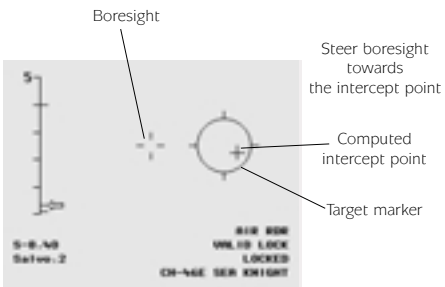


Diagram 5.33: *HMS display showing unguided rocket not lined up with air target*

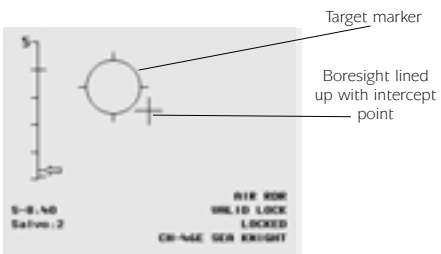


Diagram 5.34: *HMS display showing unguided rocket lined up with air target*

Cannon Pods

The Hokum carries cannon pods each containing twin-barrelled GSh-23L 23 mm cannons. Each pod contains 250 rounds of ammunition. The cannon pods are effective against soft ground targets and aircraft.

The cannon pods are aligned with the helicopter body-axis and so it is necessary to steer the helicopter towards the target. Use the forward cockpit view F1.

Type	Twin-barrelled 23 mm cannon
Rate of fire	1,000 rounds per minute
Maximum range	2,000 metres
Muzzle velocity	930 metres per second
Weight	0.2 Kg

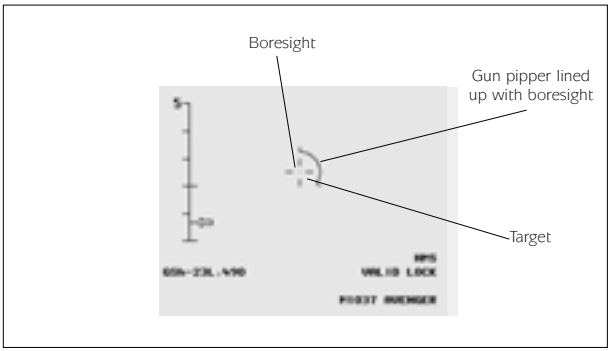


Diagram 5.35: *HMS display showing cannon pods lined up with ground target*

Countermeasures

When the TWD display indicates a radar or infra-red threat then the following countermeasures may be used to increase survivability.

Radar Jammer

The radar jammer is used to fool enemy radar of the helicopter's position by creating spurious targets.

J Radar jammer on/off

IR Jammer

The IR jammer pumps out intense IR radiation to confuse the seeker head of an incoming IR missile to break lock.

I IR jammer on/off

Chaff

Chaff comprises millions of strips of aluminised Mylar film which when released generate a cloud of radar signature to fool incoming radar guided missiles.

C Release chaff cartridge

Flares

Flares are hot pyrotechnic cartridges used to create false targets for incoming IR missiles.

F Release flare cartridge

The disadvantage of electronic countermeasures (ECM) such as the radar and IR jammers is that they unmask the helicopter and increase its visibility. They should be used as required.

The disadvantage of chaff and flares is that they run out! The Hokum carries 60 of each.

Automatic Countermeasures

The Co-pilot/Gunner can assist you with operating the countermeasures.

This option is selected in the Options Screen 'Realism' menu (Co-pilot ECM) and can also be changed in-flight.

Ctrl + C Automatic countermeasures on/off

Night Vision Goggles (NVG)

The Hokum pilot has night vision goggles to aid flying at night.

N NVG on/off

Windshield Wipers

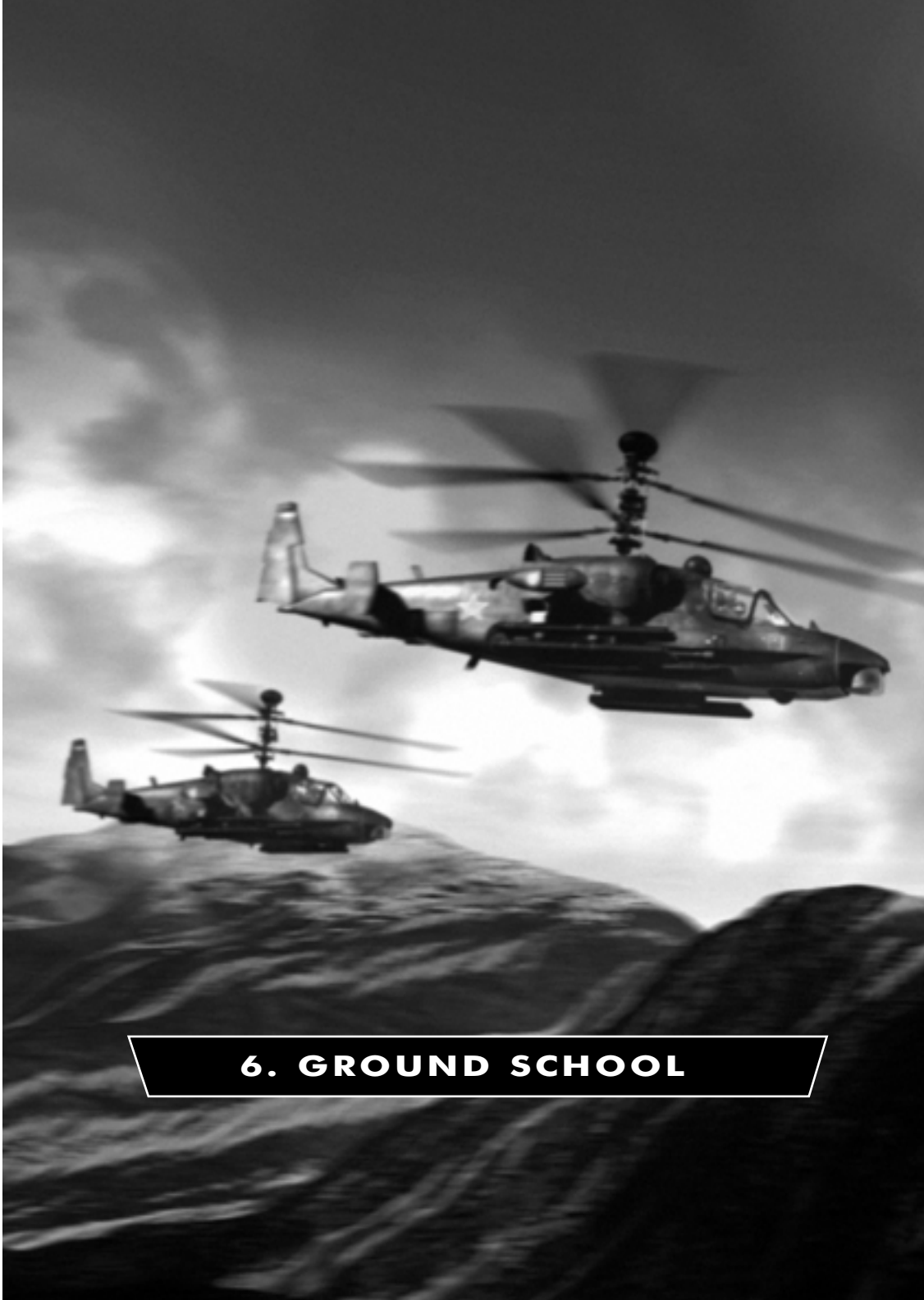
In wet weather conditions the windshield wipers should be used. There is an intermittent wipe option for lighter rain.

Y	Windshield wiper on/off
Alt + Y	Toggle intermittent wipe

Ejector Seats

The Hokum has the novel feature of being fitted with ejector seats. The eject sequence begins by blasting off the main rotors and canopy doors. Shortly afterwards the crew are ejected. The debris falling from the Hokum will damage, if not destroy, other aircraft so avoid ejecting if flying in close formation!

Alt + E Eject



6. GROUND SCHOOL

Helicopters - Basic Principles and Handling

This chapter is intended as a strictly practical guide for those who know little or nothing about how to fly a helicopter. It concentrates on what you need to know as a pilot and contains very little aerodynamic theory. Helicopters are untidy pragmatical machines which defy any attempt at elegant theoretical analysis, but the basic principles are simple enough. Once you understand what the controls do, and where the pitfalls are, flying a helicopter is (like any other job requiring more than one hand) mainly a matter of coordination and practice. In this writer's experience, it seems to be easier than learning to juggle - you have a lot more time to think about what happens next.

Conventional Helicopter Layout - Main and Tail Rotors

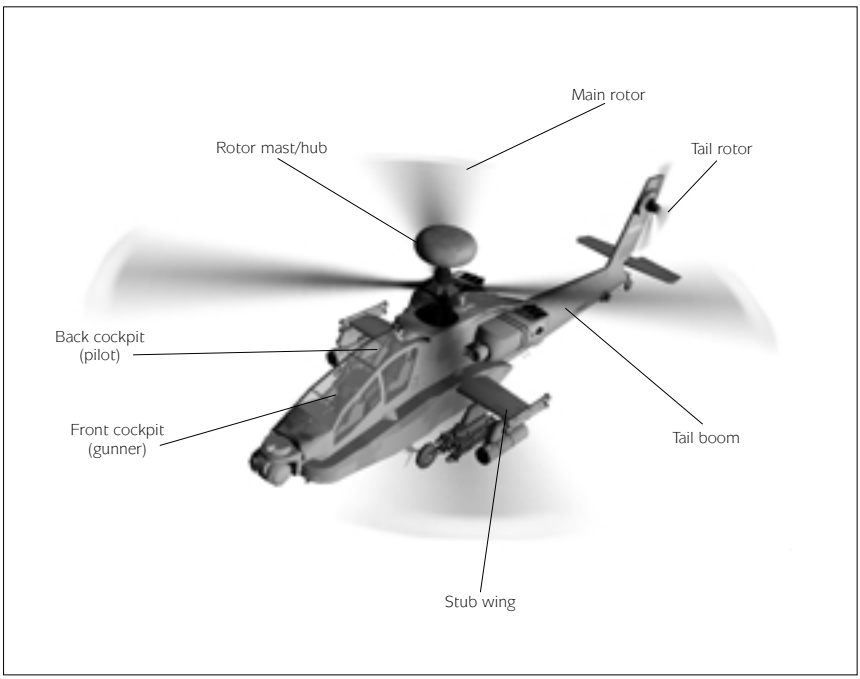


Diagram 6.1: *Conventional attack helicopter layout*

The general layout of a conventional helicopter has a large main rotor and a much smaller tail rotor, driven by powerful turboshaft engines. The main rotor, as you probably know, provides the thrust which lifts the helicopter and moves it forward (or backward, or sideways). The tail rotor's purpose is less obvious.

Imagine yourself sitting in a swivel chair, with your feet tucked up so the chair can spin freely. Your arms are above your head, supporting the middle of a long heavy plank. The plank is the helicopter's main rotor and you are the engine. The swivel chair is the rest of the helicopter, off the ground and free to pivot. Now start spinning the plank round and round like a rotor. As you do this, you'll find yourself spinning around in the opposite direction to the rotor. The harder you spin the rotor, the faster you spin yourself - and in this example, there's nothing you can do to stop yourself spinning except put your feet on the ground, which equates to landing the helicopter. This tendency for the engine to spin the whole helicopter in the opposite direction to the main rotor can be called Main Rotor Torque Effect.

The tail rotor solves this problem by creating a thrust in the opposite direction to the main rotor torque effect. Its small size is compensated by the fact that it's mounted at the end of a long lever (the tail-boom) which magnifies its effect. Also, by changing the amount of thrust the tail rotor produces you can pivot the whole helicopter on the spot, in either direction.

How Rotors Work

A rotor is simply a set of long thin wings attached to a central hub. The wings are more commonly called Rotor Blades, and when the rotor is spinning, the whole assembly is often referred to as the Rotor Disc. Just as in an ordinary aircraft, the wings generate a lift force when they are moved through the air. How much lift a wing generates is governed by three factors:

1: The Density of the Air

The atmosphere is densest (and provides most lift) at sea level. As you climb above sea level the density decreases and the wing produces less lift. Air temperature also affects density – hot air is less dense than cold air, and gives less lift. 'Hot and high' is the worst combination of conditions, and in practical terms this means you can lift less weight and have less 'performance' available.

2: The Wing's Speed Through the Air

The faster a wing moves through the air, the more lift it generates. In sophisticated modern helicopters the rotors spin up to a set flying speed before take-off and hardly change speed in flight, unless you demand more power than the engines can provide or something goes wrong with the engines or the transmission system. You don't control lift by changing the rotor speed, so at first sight this factor seems irrelevant – and it is indeed irrelevant in hovering or vertical flight. However, when the helicopter is moving forward at high speed this factor becomes critically important, and determines the maximum safe flying speed – and what happens when you exceed it [see page 6.19 – Retreating Blade Stall].

3: The Angle at Which the Wing Meets the Airflow

This is generally known as the Angle of Attack and up to a point which varies with the wing design, the greater the angle of attack the more lift the wing generates (and the more power is required to drive it through the air at a given speed). All of the helicopter's main flying controls work by changing the pitch angle of the main or tail rotor blades.

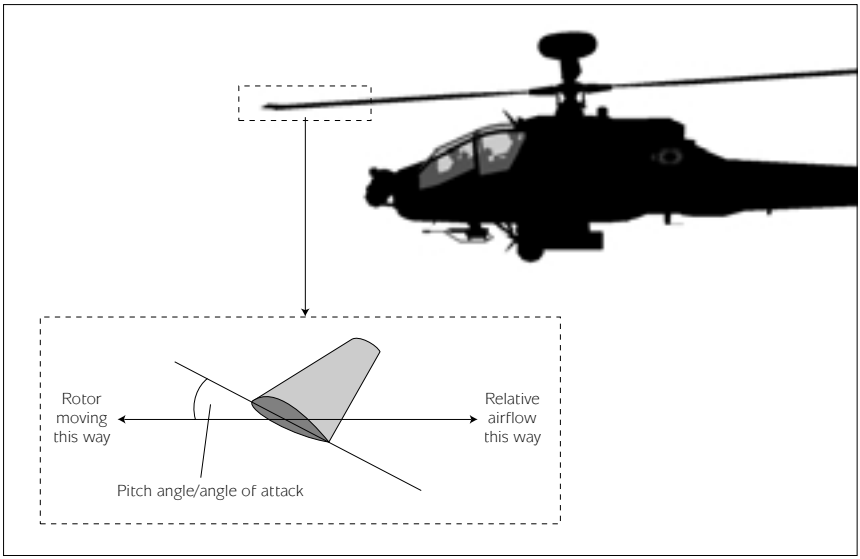


Diagram 6.2: *Rotor pitch angle/angle of attack in still air*

If the rotor were operating in still air, pitch angle and angle of attack would be identical, but this situation exists only in the first few seconds as the rotor spins up [diagram 6.2]. Once the rotor is spinning it sets up a constant air current (the rotor downwash) through the rotor disc. This means that the effective angle of attack is less than the blade pitch angle – though not much less because the rotor's speed is generally much higher than the speed of the air current down through the disc [diagram 6.3].

If there is an air current across the disc (as there is when you are hovering in a wind or moving over the ground at any significant speed) this also changes the effective angle of attack (and airspeed) of the rotor blades [diagram 6.4]. Blades advancing into the wind have a higher angle of attack (and higher airspeed), and generate more lift than the retreating blades. At the same time, the effect of the downwash air current is reduced because you are constantly moving into undisturbed air.

The net result is that the rotor generates more lift altogether ('Translational Lift'), and more lift on the advancing than on the retreating side of the disc, so there is a slight tendency to roll (a 'rolling moment') around the wind axis – an imaginary line through the centre of the helicopter drawn in the direction of the airflow [diagram 6.5].

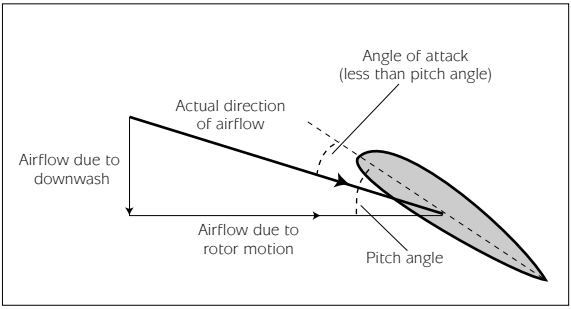


Diagram 6.3: *Pitch angle/angle of attack with rotor downwash*

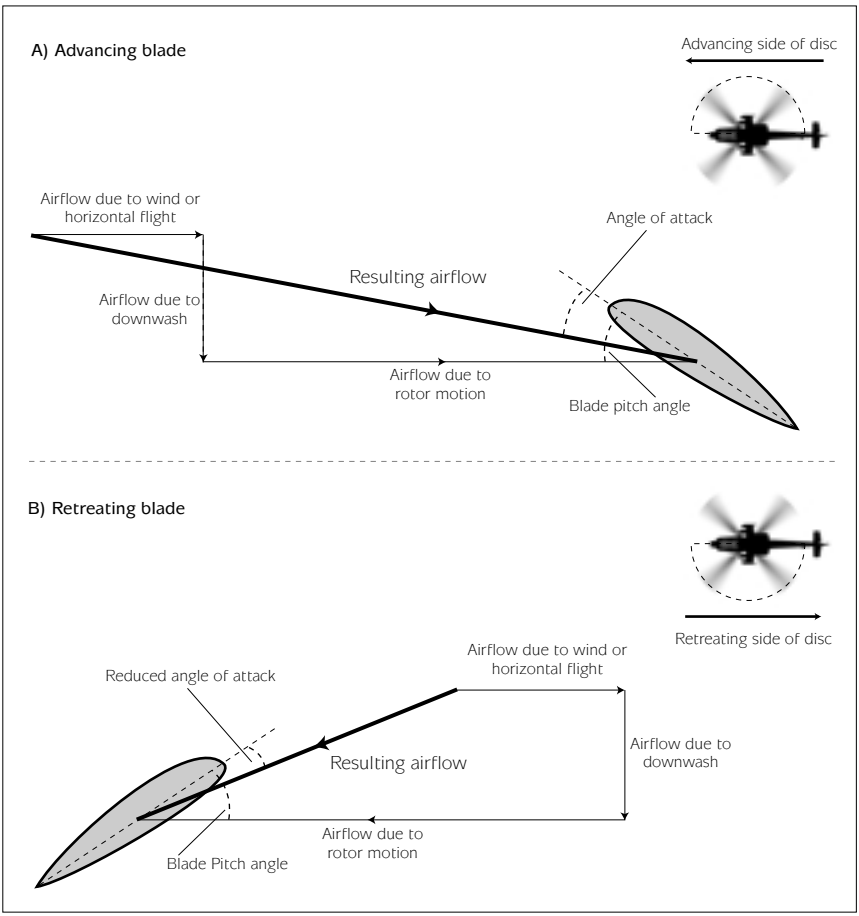


Diagram 6.4: *Pitch angle/angle of attack with airflow across rotor disc*

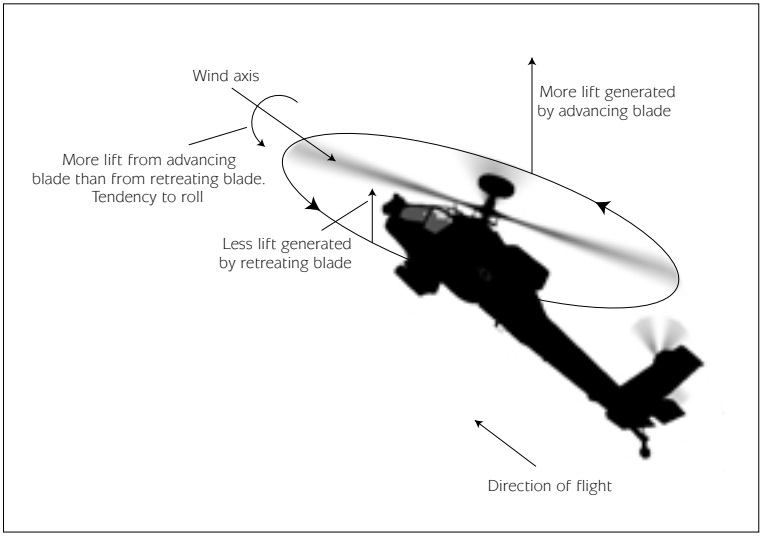


Diagram 6.5: *Rolling moment with airflow across rotor disc*

Flying Controls of a Helicopter

Three controls are used to fly a helicopter; the collective lever, the cyclic stick, and the yaw pedals [diagram 6.6]. Each has a Primary (main) and a Secondary (side) effect.

Collective Lever:

This is mounted on the left side of the seat, and pivots up and down about its back end, like the handbrake on most European cars. It is used with the left hand, and has a friction clamp so that when you take your hand off, it stays in the position where you left it. The three phrases commonly used to describe what you can do with it are 'raising the collective', 'lowering the collective', and 'bottoming the collective'. All three are simple, literal descriptions.

When you raise the collective, you are increasing the angle of attack of all the main rotor blades by the same amount, so that the rotor generates more thrust. Lowering the collective has the opposite effect. Bottoming the collective reduces main rotor thrust to effectively nothing. If you were hovering, raising the collective would cause the helicopter to climb straight up, lowering the collective would cause the helicopter to descend. This is the primary effect of the collective control.

The secondary effect of the collective is due to the fact that it takes more power to drive the rotor through the air at a high angle of attack than at a low one. In older (or simpler) helicopters, the pilot has to use a twist-grip on the collective lever to add or reduce power. More sophisticated modern helicopters do this automatically. In either case, because the engine must develop more or less power, the main rotor torque effect becomes larger or

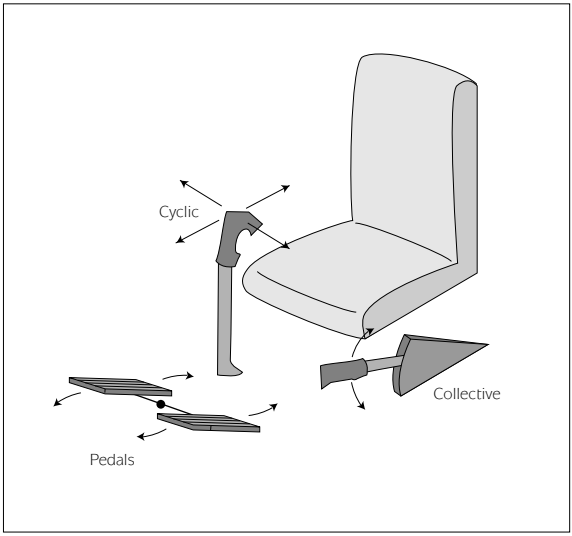


Diagram 6.6: *Main flying controls*

smaller and the whole helicopter tends to start rotating one way or the other. The yaw pedals [see page 6.7 – Yaw Pedals] are used to counter this tendency.

Cyclic Stick:

The cyclic stick (commonly called 'the cyclic') is mounted centrally in front of the pilot's seat, with a pivot at the base which allows it to be tilted forward, backward and to either side. It is normally held with the right hand, and spring-loaded to a more or less central, upright position.

When you tilt the cyclic away from the upright position, each main rotor blade changes its angle of attack as it moves around the hub. Over half the circle, the angle of attack is greater than the level set by the collective, producing more lift, while over the other half it is less, and less lift is generated. The maximum and minimum points are the same for all blades, so the main rotor's thrust is tilted in the same direction as the cyclic stick itself, the helicopter itself tilts the same way, and starts to move over the ground in that same direction.

Proper handling of the cyclic (especially at low speeds, or in the hover) demands a light touch and intelligent anticipation or the helicopter will slide and wallow about in an apparently endless series of overcorrections. A student pilot's first attempts to hover on the spot will usually have spectators gasping with laughter and alarm by turns – especially in variable winds.

Yaw Pedals:

The two yaw pedals (also called 'torque pedals' or just 'pedals') are mounted in the obvious place for pedals, one at each end of a bar which pivots in the middle. Push one pedal forward and the other moves back by the same amount. They operate on the tail rotor in much the same way that the collective operates on the main rotor, by changing the pitch (and hence the angle of attack) of all the blades at once, thus increasing and decreasing the tail rotor's thrust, or even reversing its direction. As described above, they are used to pivot the helicopter on the spot (a 'pedal turn'), and to keep the helicopter pointing in your chosen direction when the collective is raised or lowered by compensating for the changing strength of the main rotor torque effect.

Pushing on the left pedal turns the helicopter to the left, and vice versa for the right pedal. In this respect they work like the rudder pedals of an aircraft – and in exactly the opposite sense to a bike's handlebars. This can confuse beginners, but practice will quickly sort you out – and it seems to do no permanent harm to your ability to steer a bike.

Putting it all Together

Now that you've been told what each of the controls does by itself, it's time to show how they're used together when actually flying a helicopter. We'll look at the sequence of actions required to take off, transition to forward flight, climb and dive, make gentle turns, slow to a stop and land. Read through the exercise before trying it out for the first time. It is worth emphasising that all your control movements ('control inputs') should be as smooth and deliberate as possible. Sudden, violent control inputs are to be avoided. Make sure that you know where to find airspeed, altitude and vertical velocity readouts on the Head-Up Display (HUD).

1: Taking Off and Rising to the Hover

We'll start with the helicopter sitting on the ground, engines running and rotor spun up to flying speed, in calm conditions. In order to lift off we need to raise the collective slowly and carefully, until we have just enough lift to raise the helicopter off the ground and start climbing vertically. At the same time, we need to feed in some pedal. If we don't do this, then as soon as the weight comes off the wheels, we'll start slewing round on the spot because of the main rotor torque effect. This is one excellent reason for raising the collective gently – the harder you yank on the collective, the bigger the torque effect.

Ground Effect

If you were very slow and cautious in raising the collective, you may find that the helicopter slowly rises a short distance and comes to the hover a few feet off the ground without any change in the collective setting. If this happens, you can congratulate yourself on having demonstrated ground effect. The helicopter is, in effect, riding on an air cushion produced by the rotor downwash. Ground effect magnifies the lifting power available for a given collective setting, but the effect falls off quite rapidly with height, and disappears altogether at a height equal to the diameter of the rotor disc. Rough or sloping ground, violent manoeuvering or strong, gusty winds will all tend to spill the air cushion, push it off to one side, or prevent it forming in the first place, so a wise pilot is cautious about depending on ground effect for the lift needed to stay airborne.

In any case, for our first transition to forward flight we want to climb rather higher than this – say to a minimum of 100 feet/30 metres. As you approach the desired height, ease the collective down slightly and wait to see the effect. Remember that the helicopter has momentum – the faster you were climbing (or descending), the longer it will take for your vertical speed to change till it actually reflects the new collective setting. As you lower the collective, you'll also need to coordinate with pedal input. With practice, you can anticipate the effects of your control inputs, but be careful in the early stages – it's hard to avoid over-correcting.

2: Transition From the Hover to Forward Flight

Once you're above the minimum height and your climb rate is reduced to a low figure (a perfect hover is too much to expect, but DON'T start this exercise while descending!), check that there is a long clear run ahead, with no high obstacles. If necessary, use the pedals to turn onto a clear heading. Now, without changing the collective setting, ease the cyclic a little forward and hold it there, watching the HUD altitude readout. You'll see three effects from this control input:

1) The helicopter tilts forward.

2) The helicopter starts to accelerate forward.

3) The helicopter starts to lose height.

Effects 1 and 2 are easy enough to understand – we're tilting the rotor disc, which tilts the helicopter and directs some of the main rotor thrust forwards, accelerating us forward. The third effect is more indirect, but obviously important. We started in the hover (or very nearly so), with the main rotor producing just enough thrust (directed straight down) to support the helicopter's weight. Now we have tilted the rotor disc (and its thrust vector) in order to accelerate forwards. This leaves less thrust acting straight down to support the helicopter's weight, so it starts to descend. In order to maintain height, we must raise the collective slightly (not forgetting the pedal input), increasing the total main rotor thrust so that its downwards component is large enough to support the full weight of the helicopter. At the risk of stating the obvious, it should be pointed out that this effect applies whenever the cyclic is tilted away from the central position in ANY direction – the further away from the central position, the smaller the lift component.

Translational Lift

As the helicopter gathers speed, you'll find that you start gaining height again. This is due to a phenomenon called Translational Lift, which is hard to explain simply, but is basically due to the fact that the angle of the airflow passing through the main rotor has changed due to the tilting of the rotor disc and the helicopter's motion (translation) through the air. This increases the effective angle of attack of the main rotor blades, producing more thrust. Translational lift appears at quite low speeds, but disappears again with rising speed – and its effects are felt whether the helicopter moves forwards, sideways or backwards.

3: Climbing and Diving

To gain height in a helicopter flying forwards, you can a) pull back on the cyclic, b) raise the collective, or c) use both controls together or in sequence – this is what normally happens. If you just pull back on the cyclic, the helicopter's nose will rise and it will start to climb, but it will also start to lose forward speed – you're redirecting the main rotor thrust so that you have more lift force and less horizontal thrust. Provided that the cyclic is still forward of the central (hover) position, forward speed will stabilise at a lower figure than you started with.

If you simply raise the collective (with pedal input) in forward flight, you're increasing the main rotor thrust without changing its angle, so you have more lift AND more thrust available. The helicopter will climb and accelerate. If you want to climb without losing or gaining speed, you need to pull back on the cyclic AND simultaneously raise the collective.

In a similar (though not identical) way, you can lose height using cyclic input or collective input or both. If you push forward on the cyclic you will lose height and gain speed (more horizontal thrust, less lift). If you lower the collective you will lose both height and speed (less total thrust, so less horizontal thrust and less lift).

Once you appreciate the effects of the controls and have some experience in using them, you can choose the right combination of cyclic and collective inputs to make the helicopter do what you want, up to the limits of performance.

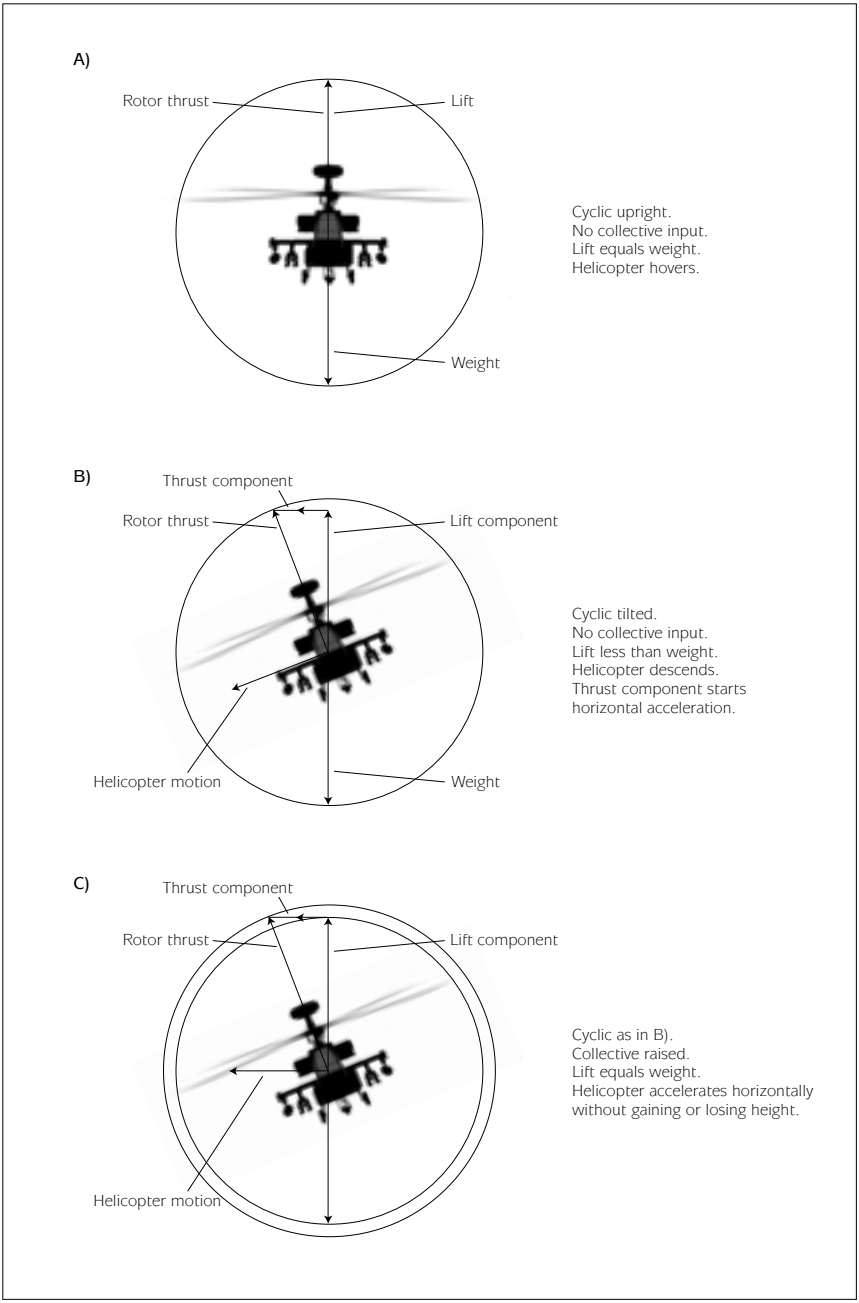


Diagram 6.7: *Lift and thrust components*

4: Turning in Forward Flight

When the helicopter is hovering or flying at low speed, if you want to turn you do it mainly or exclusively with the pedals. At higher forward speeds, turning is accomplished by tilting the cyclic left or right to bank the helicopter just like a fixed-wing aircraft, though there is no need to use pedal inputs to coordinate the turn. If you fly sustained or steeply-banked turns, however, you'll need to either raise the collective (with pedal input) or ease back on the cyclic, sacrificing some forward speed. If you do neither then you'll lose height because banking tilts the rotor disc (and thrust vector) further away from the vertical, trading off lift for the sideways thrust component which causes the turn [diagram 6.7].

5: Slowing to the Hover from Forward Flight

This technique is called Flaring, and is essentially similar for all wing-borne flying machines, though the helicopter variant is the most complex and demanding since it requires precisely coordinated use of all three controls. The object of the exercise is to slow to a stop in the minimum distance without losing or gaining height. Losing height can be unhealthy for obvious reasons, while gaining height (and exposing yourself unnecessarily) is in military terms 'tactically unsound' – a phrase normally used as a diplomatic substitute for 'lethally stupid'.

Throughout this manoeuvre you should constantly scan the HUD altimeter/vertical velocity indicator (to see and correct altitude changes) and the view forward (to crosscheck the altimeter and keep yourself heading in a straight line).

You start the manoeuvre by pulling back on the cyclic to tilt the helicopter backwards – use a moderate nose-up angle to start with, and experiment with steeper angles as you gain experience and confidence. This directs the rotor thrust backwards, which will tend to slow you down, but it also increases the rotor blades' effective angle of attack, and therefore the total thrust – which means that you'll climb unless you simultaneously lower the collective.

As the helicopter slows, main rotor thrust diminishes (slowly raise the collective to compensate), and as you approach the hover you'll need to ease the cyclic forward again to bring the helicopter level, simultaneously raising the collective to the hover setting. [Diagram 6.8] shows the relationship between cyclic and collective movements for the whole manoeuvre. Pedal is used as necessary to compensate for collective movement and to keep the helicopter straight.

6: Landing Problems and Techniques

Though we've just gone through the Flare manoeuvre, with the emphasis on slowing to the hover without gaining or losing height, this technique generally needs modifying to convert it into a sensible approach to a landing. The reason for this is that unless you're already flying very low indeed, the flare will leave you hovering higher than you want to be for a safe and sensible vertical descent to touchdown. The problem is mainly one of visibility, and is particularly acute in combat helicopters.

Visibility Factors

In a combat helicopter with a classical crew arrangement (gunner in front of pilot, both on

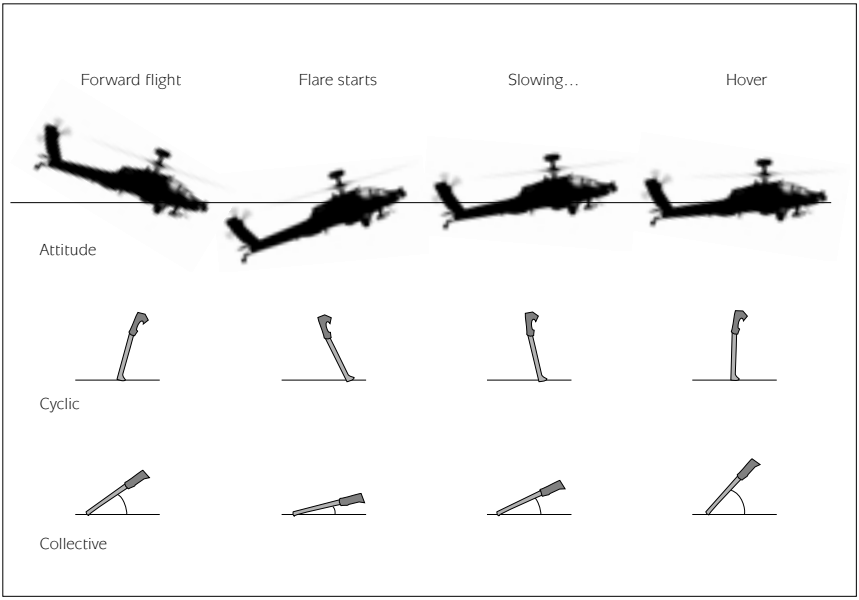


Diagram 6.8: *Coordinating cyclic and collective in the flare*

the centreline), you as pilot have an excellent field of view to either side. Your forward view is restricted by the gunner's cockpit and the length of the nose in front of you (more of a problem in the hover or the flare than in forward flight), and your view behind is obstructed to either side by engine pods, stub wings and armament and totally obscured directly behind by the solid bulk of the fuselage. You have no view at all straight down, so whenever you're descending vertically you are effectively exploring the unknown, tail-end first. It's a lot like trying to sit down in the dark in an area infested with scorpions.

You need to touch down at a chosen point on a reasonably smooth, level surface, preferably without striking anything with your main or tail rotors. A combat helicopter's main rotor system is amazingly robust – it's designed to support tons of helicopter through violent manoeuvres and shrug off cannon shells. If you're prepared to explain the damage to your maintenance crew and superior officers you can chop down small trees with it and still fly away. The tail rotor, however, is smaller and inevitably more delicate. It also projects further beyond the main rotor disc than any other part of the helicopter, and it's right in the middle of your blind spot behind.

Though you can largely compensate for the restricted view by doing pedal turns, and by picking visual reference points on either side, descending vertically from a high hover is usually far more trouble than it's worth [see also page 6.20 – Vortex Ring Effect]. The normal helicopter landing approach is very much like a fixed-wing aircraft's, until you reach the final stages.

Circuit Pattern

The obvious conclusion is that whenever you're landing in an unfamiliar area with potential hazards and obstructions you should always check it first. The standard technique for doing this is to fly a 'circuit' [diagrams 6.9 and 6.10].

The first piece of information you need is the wind direction and if possible its strength and gustiness. You may know this already, it may be provided for you by someone on the ground with a radio (or a set of marker panels), or if not then you can usually observe it for yourself by looking for drifting smoke, flags or other such clues.

The reason why wind direction is important is that you should try to land with your nose pointing into the wind. While this is a nearly inviolable rule for fixed-wing aircraft because it reduces speed over the ground and the length of the landing run, helicopter pilots have more choice in the matter [see page 6.18 – Sideways]. Nevertheless, your life will be easier if you can land facing into wind.

The wind direction (or the layout of the site) establishes the direction of your landing approach, and the orientation of the circuit pattern. Use the downwind and base legs of the circuit to inspect the landing area and reduce your height and speed. As you pass the touchdown point on the downwind leg, look for visual reference points on either side which you can use to locate yourself once the touchdown point has disappeared under your nose.

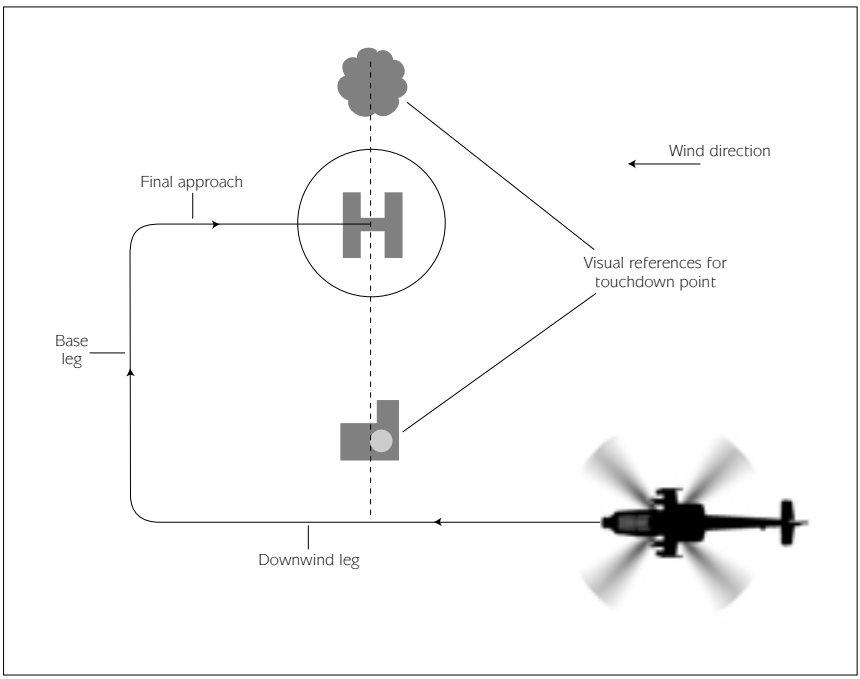


Diagram 6.9: *Circuit pattern for a clear landing area*

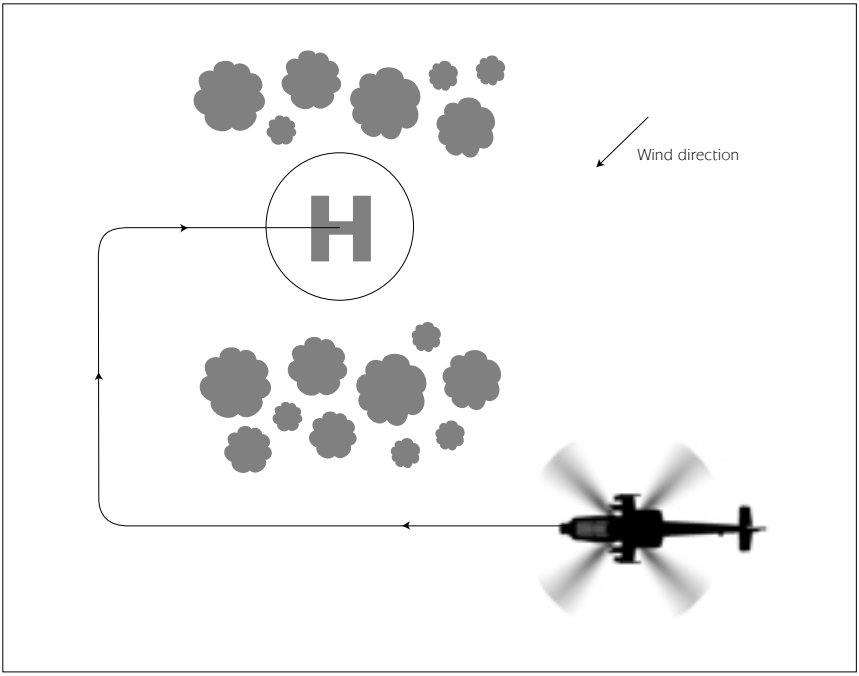


Diagram 6.10: *Circuit pattern for an obstructed landing area*

The size of the pattern, your entry height and speed should be determined by the size and nature of the landing area, and the likelihood of enemy action. If the landing site is large and unobstructed (and the enemy isn't watching or shooting) then you can afford a large circuit, entering high (say 500-1000 feet/150-300 metres) and at relatively high speed. If the landing area is cramped and obstructed, or you wish to avoid enemy attention, you should fly a much smaller, tighter circuit, entering at lower speed and altitude.

Final Approach

You should ideally make your final descent towards the touchdown point with the helicopter as nearly level as possible. Avoid pushing the collective forward to dive at the ground, and try to ensure that by the time you reach this stage you're travelling slowly enough that a very moderate flare – or ideally a constant slightly nose-up attitude – will be enough to bring you to the hover a few feet above your touchdown point. Now all you have to do is gently lower the collective and touch down.

If you find yourself too high and/or too fast on the final approach, you should abandon the landing and go around again [diagram 6.11]. If you attempt to kill off speed using a radical flare at low altitude then you risk striking your tail rotor on the ground. If you try to descend at too steep an angle from an excessively high approach then you'll suffer from all the

visibility problems we discussed earlier, plus running the risk of Vortex Ring Effect [diagram 2.14]. Just raise the collective to arrest your descent (or climb if there are obstacles to clear), fly on over and past the touchdown point, and turn into another circuit – smaller, lower and slower than the first. Keep it in mind that you'll find it much easier to establish the second circuit if you continue some way along the approach line past the touchdown point before you turn.

We Don't Need no Stinking Circuits!

Oh yes, you do. It's not just a piece of textbook ritual. The procedure described above may seem formal and longwinded but it really is useful. Not only does it give you the chance to scout the landing area, but the sequence of legs and turns lets you judge and adjust your speed and rate of descent relative to the touchdown point – and the turns can be used to kill off a great deal of speed. A straight-in approach looks much simpler and is perfectly practical for landing in the middle of a wide open airfield, but as soon as you have to deal with obstructions and previously unseen landing sites, the circuit pattern is much safer, usually faster, and saves a great deal of wear and tear on your nerves.

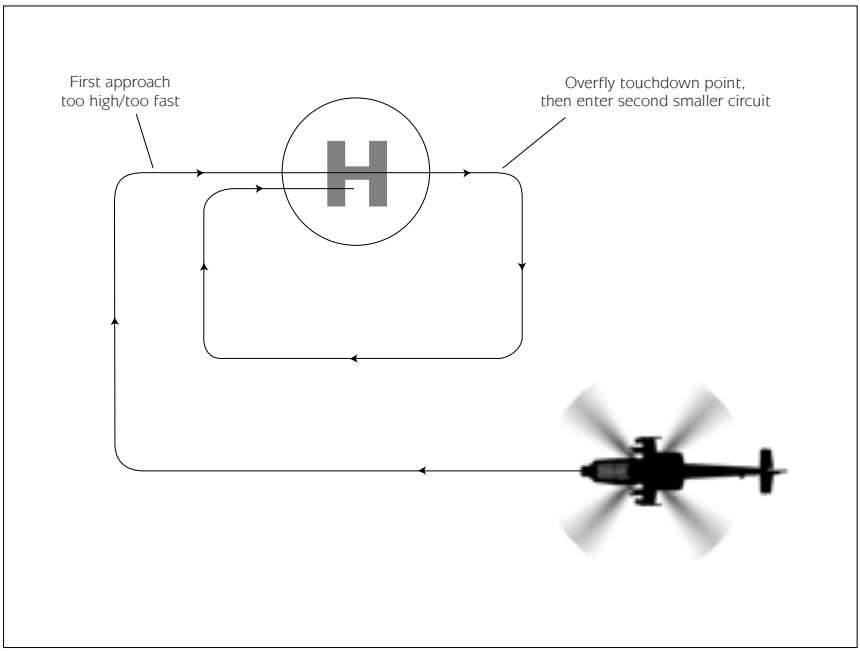


Diagram 6.11: *Going around again*

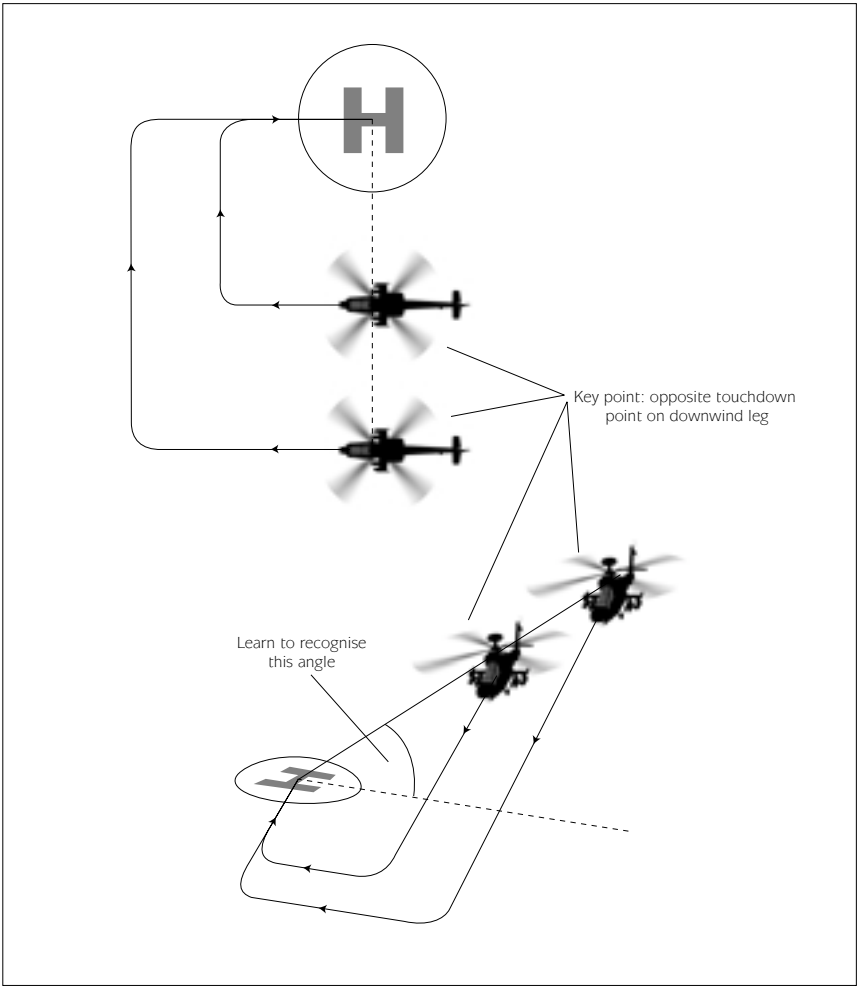


Diagram 6.12: *Judging offset and height in the circuit*

The key to a successful circuit of any size is to select the correct combination of height and lateral offset (between downwind and final legs). This can be done by learning to recognise the angle, or range of angles, you see when you look down on the touchdown point from the downwind leg. This skill, like any other, can only be acquired by means of practice.

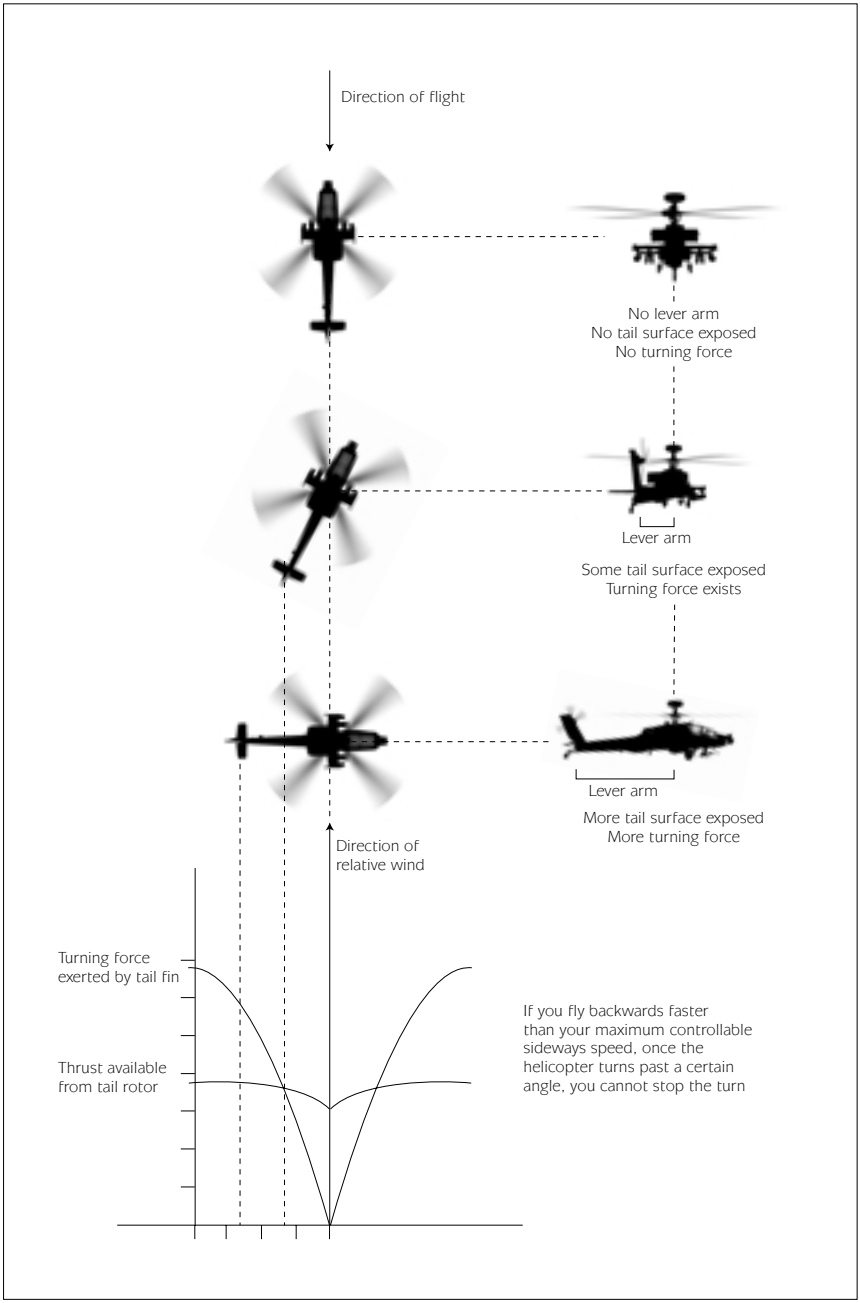


Diagram 6.13: *Turning forces in backwards flight*

Sideways, Backwards and Crosswinds

If you have absorbed and understood the basic principles of helicopter flight it should be obvious that you can fly the helicopter in any direction from the hover, without turning, by tilting the cyclic the way you want to go. You can also hover on the spot in a wind blowing from any direction by tilting the cyclic into the wind. There are, however, a few pitfalls which should be pointed out.

Weather-Cocking

The helicopter's tailboom is there for two main reasons. We've already mentioned that it provides a convenient mounting point for the tail rotor, outside the worst of the main rotor downwash, and at the end of a long lever arm. Those same factors also make it the best place to mount a vertical fin (or fins) very like what you find at the tail end of most fixed-wing aircraft, and serving exactly the same purpose; to provide automatic directional stability in fast forward flight, just like the fletching of a dart or an arrow.

The tail fin works against you when you try to fly sideways or hover in a cross-wind, generating a force which tends to turn the helicopter's nose into the relative wind. The whole helicopter acts like a weather-vane. To counter this effect you must use pedal inputs – and the faster you fly (or the stronger the crosswind) the larger the input needed to maintain heading. Eventually you'll reach a point where the tail rotor simply cannot provide any more thrust, and the nose will inexorably turn into the relative wind. This is one of the main reasons why a helicopter's maximum sideways speed is much lower than the maximum forward speed – and a wise pilot will always try to avoid flight regimes which can only be maintained by jamming any control hard against its stops.

Stability in Backwards Flight

Backwards flight is something that obviously needs to be done carefully – you can't see where you're going, and you're flying tail rotor first. There are less obvious problems which affect you even if you have unlimited space for manoeuvre, or if you're simply trying to hover in a strong tail-wind. The explanation involves some basic physics, but the diagram should help you grasp what's going on.

The strength of the turning force generated by the tail fin depends mainly on three factors:

1) The speed of the relative wind.

2) How large a surface the tail fin presents to the relative wind.

3) The effective length of the tail fin's lever-arm with respect to the relative wind and the helicopter's centre of mass, which we can assume will be more or less directly under the main rotor hub.

Taking these factors in order; 1) more airspeed means more force. In fact, because the force is proportional to the square of the airspeed, a little more speed means a lot more force. 2) When the tail is pointing straight into the wind, it is exposing the least possible area and generating the least possible force. As the tail swings out across the wind, it presents more and more surface area, generating more and more force. 3) When the tail is pointing

straight into the wind, it is in line with the centre-of-mass and there is no leverage. As the tail swings out across the wind, the length of the lever-arm increases and so does the turning force. Factors 2 and 3 both reach their maximum when the helicopter is broadside-on to the wind, as it is when you're flying sideways.

Because the tail fin exerts no turning effect when pointing straight into the relative wind (and the helicopter's fuselage is generating little or no more drag than it does when flying forwards) it is possible to accelerate to much higher speeds in backwards than in sideways flight.

The catch comes when the tail turns out of line. The moment any turning force is generated, it tends to turn the helicopter even further off the wind, generating even more turning force, and so on in a vicious circle. At high speeds this happens so quickly that you have very little time to correct the swing, and if you are moving faster than your maximum stable sideways speed, once the swing goes beyond a certain point you don't have enough tail-rotor thrust to stop it anyway.

At this point you've lost control of the turn, which is almost exactly like a handbrake turn or U-turn in a car. The helicopter swaps ends in an instant, the main rotor blades flap and thrash madly, and if you're lucky they don't smash the cockpit canopy or chop off the tail boom as the rotor disc tries to re-align itself with the suddenly and violently changing attitude of the rotor mast.

It is possible (and even potentially tactically useful) to perform milder variants of this manoeuvre under control, but work up to it cautiously. Approach it as you would approach the problem of performing a backflip while whirling a sharp sword around your head.

Hazards and Emergencies:

Landing on Slopes

When necessary, it is entirely possible to land safely on a smooth moderate slope, but the technique needs practice. Though at first sight it might seem natural to land facing up the slope, the preferred direction is sideways, facing into the wind. If you don't think the helicopter will be stable standing across the slope, then the slope is too steep, and you must find somewhere else.

Approach as normal, but slow your final descent so that you hover with your uphill wheel just touching the ground. Now very gently lower the collective, and as the helicopter leans, move the cyclic in the opposite direction so that the rotor disc remains horizontal. Once both wheels are on the ground, carefully lower the collective to transfer the weight to the wheels, keeping the rotor disc horizontal, to oppose the pull of gravity, rather than tilting it to match the cross-slope.

Take-off can be accomplished by simply reversing the landing drill. The important things are to keep the rotor disc horizontal and to use a very delicate touch on the collective when the wheels are on the ground.

Retreating Blade Stall

We have already talked about the difference in lift developed by the advancing and retreating blades of the main rotor in horizontal flight, which is due to the difference in their

effective airspeeds. Lift is directly and sensitively proportional to airspeed, but for any given wing at any angle of attack there will be a critical speed below which lift suddenly collapses – the wing stalls. For any reasonably powerful or streamlined helicopter, the maximum safe airspeed is determined by the speed at which the retreating rotor blade starts to stall.

In this situation, you suddenly start to lose lift on the retreating blade side, and the helicopter rolls towards it. Provided that you are not diving too steeply, you may be able to reduce speed by lowering the collective and pulling back on the cyclic before you lose control, but beware of violent panicky manoeuvres, which may stall more blade area or set the blades flapping violently.

Like all aerodynamic effects, retreating blade stall is affected by air density and by temperature. It will happen at lower speeds at higher altitudes and/or higher temperatures.

Vortex Ring Effect

The commonest visible example of a vortex ring (or ring vortex) is a smoke-ring. In fact they are quite a widespread phenomenon, but like all flow patterns they are usually impossible to see directly. All you need to start one is a stream with a more or less circular cross-section (like your rotor downwash) which satisfies certain other conditions.

In a helicopter, you can unintentionally create a vortex ring around your main rotor if you make a sustained high-speed descent vertically or at a steep angle. Once the ring has

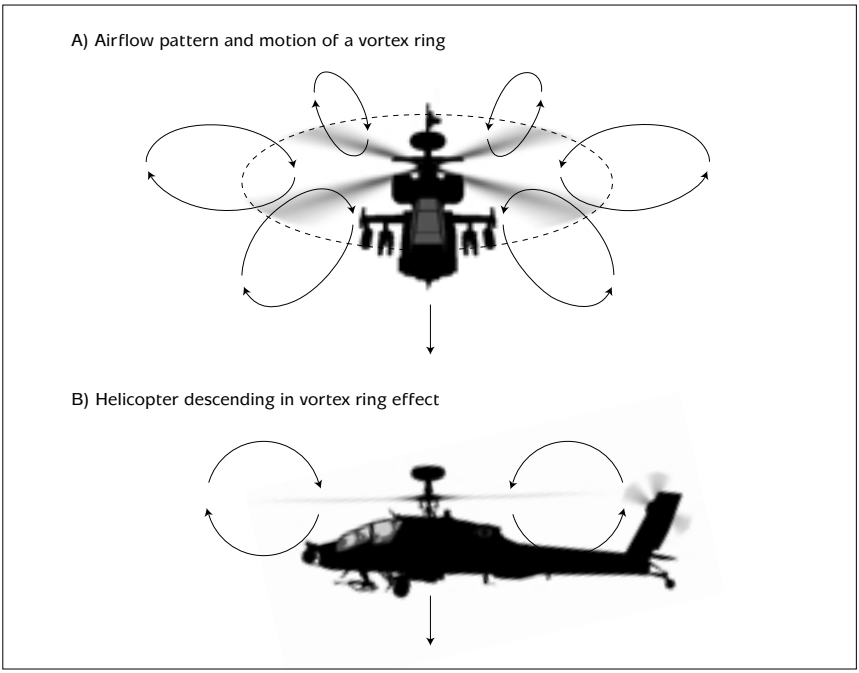


Diagram 6.14: *Vortex rings*

formed, it is surprisingly stable, and moves with you as you descend. The extra downwash of the circulating vortex ring destroys most of the main rotor's lift, and you cannot escape by raising the collective – you will only pump energy into the ring's circulation. You are already descending too fast to escape downwards and outrun it. The only way out is to use the cyclic to move laterally, because lateral movement disrupts the vortex, just as vertical movement maintains it.

Coping with Reduced Power

If you lose an engine in a powerful twin-engined helicopter like the Comanche or the Hokum you can still fly, land and take off, provided that you don't try to lift heavy weights in hot and high conditions or leap tall buildings at a single bound. The keys to achieving this are translational lift and ground effect. Every time you raise the collective for more lift you put more strain on the surviving engine, and the rotor speed may slow to dangerous levels.

Ground effect multiplies your main rotor lift and may let you hover with reduced power. It also provides a convenient low-friction environment in which to accelerate to a speed where translational lift can let you climb out of ground effect. When approaching for a landing, or descending and decelerating for any other reason, let yourself gently down at a shallow angle or a low speed, or both. The ground effect cushion is no deeper than your main rotor diameter.

If you cannot even hover in ground effect, you may still be able to achieve a running landing, if space is available. The approach is flown very like a low speed approach to a runway in a fixed-wing aircraft. Just as in an aircraft, you round out your descent by pulling smoothly back on the cyclic before you touch the ground so that you kiss it gently rather than crash into it at an angle. At the same time you must avoid plunging your tail-rotor into the ground.

If you're running out of horizontal speed but close to the ground you can probably afford to raise the cyclic to slow the last seconds of descent. If you run out of forward speed and rotor rpm at the same time, you'd better hope that you don't have too far to fall.

Running takeoffs are also possible if space, surface and wind direction permit. The idea here is to accelerate on the ground to a speed where translational lift will let you lift off and (you hope) climb. If you can't climb out of ground effect then you need a clear run to a lower altitude, or another rolling landing. Failing these, you're in trouble.

Autorotations

If a helicopter loses all engine power in flight, it can still be landed without serious damage or injury provided that the pilot does everything right, and there is a clear space in the right place for a landing. The technique and options vary according to your height when power is lost.

1) Loss of Power at Altitude

The standard Autorotation procedure assumes that the helicopter is flying at 500 feet / 150 metres or more. The key technique is to preserve the rotational energy stored in the main rotor system (treating it as a giant flywheel) until it can be used up in the last few seconds of flight to halt your descent and lower the helicopter more or less smoothly to the ground.

Two steps are essential to accomplish this. In the first place, as soon as the engine thrust disappears you must instantly bottom the collective, which reduces the main rotor pitch angle to its lowest value and minimises the drag on the rotor blades. At the same time, if you have the height and space to manoeuvre, you should try to preserve the helicopter's forward motion and minimise the rate of descent by using the cyclic to trim your speed to the minimum-rate-of-descent figure – about 70-80 knots/130-150 kmh. The resulting airflow will actually drive the main rotor around, just as it does in an autogyro (which has a powered propeller to give it forward speed, which drives its unpowered rotor). This is what the word Autorotation means. It is to a helicopter what gliding flight is to a fixed-wing aircraft.

Unfortunately, a heavy combat helicopter glides about as well as a fast jet does. Because of the low speeds involved, and the rotor's ability to deliver braking thrust straight down, it is still possible to land safely, but a very steep descent may be required to keep the main rotor turning. Your pull-out/round-out manoeuvre must be finely judged to avoid either hitting the ground in the dive or finding yourself running out of airspeed and rotor rpm with the ground still an uncomfortable distance below.

At the same time as the collective is bottomed and the cyclic trimmed, the pilot must also scan the area below and ahead (and preferably upwind) for the best place to put down and steer towards it. There is no time for hesitation or indecision in this sequence unless you have a great deal of height to spare. Action and decision must be nearly instantaneous, and once you've made your choice of landing area you are committed.

2) Loss of Power at Low Level

This is a more likely scenario for an attack helicopter than the classic autorotation described above. Your options are essentially limited to flaring more or less straight ahead, and/or raising the collective to convert rotational energy into braking thrust before you hit the ground. The helicopter will probably take severe damage, but its structure is designed to absorb energy and protect the crew in precisely this situation. Combat helicopter crews can expect to survive crashes which would be instantly fatal in most kinds of aircraft.

Tactical Flying

The most important, most fundamental piece of advice for a brand-new attack helicopter pilot who knows more about fast jets than ground combat is to stop thinking like a fighter pilot and start thinking like an infantryman or a tank commander. Cover, vantage points, fields of fire, and lines of retreat are everything. Fly high and fast in the neighbourhood of the enemy and you simply expose yourself.

Unless you are planning a slashing surprise attack on a known enemy position, every time you come to a skyline which may expose you to an enemy on the other side you should either avoid it or creep up to it and peer cautiously over the top. A pair, or a larger unit of attack helicopters advancing to contact with the enemy should ideally leapfrog forward in the classic pattern of advancing infantry; one group holds position at a point which combines cover with good fields of view and fire, while the other group scuttles forward to the next vantage point, to cover the next advance.

Withdrawal or retreat is also usually handled the same way, with one group providing covering fire, or at least attracting the enemy's attention while the other group concentrates on falling back to the next available cover while minimising their own exposure.

Security: Cover, Speed and Manoeuvre

Using Cover

Crests, valleys, forests, rivers with steep or wooded banks, sunken roads and buildings can all provide cover. At the personal level and on a small scale, everyone who has ever played hide-and-seek understands the concept well. The difference between this and the military concept of cover is mainly one of scale. Hiding yourself is rarely difficult in any normal environment. Hiding troops, vehicles or helicopters requires the use of much larger obstacles and, especially, landscape. For a helicopter there is no better form of cover available than high ground between you and the enemy.

When you know roughly where the enemy is, it is not too difficult to identify the 'dead ground' which he cannot see or sweep with fire. These are the areas you can use to approach, to launch an attack, to hide, or to retreat safely. If the terrain favours you,

and you exploit it properly, you may be able to approach, attack and withdraw without exposing yourself for longer than it takes to fire.

On the other hand, there may not be continuous cover between your current position and the place where you want to go next. If the target is stationary you need to get closer, you must now risk exposed dashes between dead zones. If the target is moving, however, its dead ground changes rapidly, and if you can predict how it will change, you can often use broken cover as effectively as the continuous kind.

Valleys and depressions are the best places to find dead ground, since they can shield you from view all around, or at least over wide angles, but the same is obvious to any competent enemy, and roads often run down valleys. Cover is valuable to everyone, and the enemy may have got there first.

Obstacles like hills, woods or groups of buildings provide a different sort of cover. If the enemy is moving, you must move around your cover to stay behind it. Clearings in woods, or open spaces surrounded by buildings, can be considered as shallow depressions or valleys.

Moving from cover to cover may be the safest way to advance, but it doesn't guarantee complete safety. Whenever you expose yourself, consider what you can do if the enemy appears over the horizon at the worst possible moment.

Using Speed and Manoeuvre

If you don't have cover, then the next best things are speed and agility. A helicopter stationary in the open is an easy high-value target. A helicopter flying slowly, or in a straight line, is not much harder to hit. If you must expose yourself to enemy fire, try to build up speed before you break cover, and fly a tight three-dimensional zigzag. Don't just put your head down and run; change your path every few seconds. The gain in safety under fire is well worth the minor loss of speed. If you must fly straight, to line up for an attack with unguided rockets, for example, then try to zigzag vertically. The vertical zigzag is your best tactic against radar-directed gunfire from any direction except close ahead and behind.

Offensive Tactics

Just as there are two basic forms of defence; cover on the one hand, manoeuvre on the other, there are two corresponding modes of attack available to a combat helicopter; Sniping and Slashing. Each has its advantages and disadvantages. Be prepared to use both, and to switch rapidly from one mode to the other.

Sniping Attack

This method is usually the safer of the two, especially against a numerous enemy. As the description suggests, you set yourself up in cover and expose yourself only as much as is necessary to pick your targets and fire, though if you're using the older-model laser-guided Hellfire in the Comanche, or the laser-guided Vikhr missile in the Hokum, you will have to stay exposed long enough to keep your sights on the target until the missile reaches it.

If you don't have a fire-and-forget missile available, this means that in some ways you're safer sniping from close range. The missile flight time is shorter, and so you are exposed for less time while you guide it.

The best way to use this technique at the individual level is to fire a single missile, or a short salvo, duck back into cover, and move to a new position before popping up (or sideways) to shoot again. If two or more helicopters cooperate, taking turns to attack from widely separated positions, the technique is even more effective.

At a slightly higher tactical level, the sniping attack is also a relatively low-risk way to grab the enemy's attention and focus it in one direction, while a second force approaches to strike from a fresh direction, preferably the enemy's flank (side) or rear.

Slashing Attack

Used properly, this technique resembles a cavalry charge, or a firing pass by a ground-attack aircraft. As noted above, as the range closes your weapons' flight time grows shorter, and your unguided weapons also become more accurate. If you can surprise the enemy and make your run from an unexpected direction, you will have a vital few seconds - how long depends on the enemy's state of readiness - before sensors and weapons can be re-oriented against you. You must make the most of this grace period to take out the enemy's

most dangerous air defence systems.

Another vitally important question to consider is what happens at the end of your run. If you do not succeed in suppressing the enemy's air defence systems, then you will need to find cover quickly. Don't even think about turning round and retreating to your starting position - you must keep your speed up and open the range as fast as possible, dodging as hard as you can.

As ever, intelligent cooperation can vastly increase the effectiveness of the tactic, and reduce the risks. If several helicopters attack from different directions simultaneously, the enemy must divide the available defensive fire between them. Another tactical variation worth considering is to attack in a series of waves. As the first wave passes the enemy's position and the defences swing to follow them, a second attack wave may enjoy a few seconds of immunity while the defences re-orient against them - and this also takes the pressure off the first wave as it retreats.

A well-executed slashing attack can be devastating, but used wrongly, this tactic will devastate your own forces. The classic example of the wrong way to take the offensive comes from the mass infantry attacks of the first world war. If the enemy knows where you're coming from; if his weapons are already pointed in your direction; if his forces are behind cover while you must cross open ground, then you are inviting disaster.

Another situation where the basic principles of the slashing attack are important is the unexpected engagement. If you must cover ground quickly, and a cautious leapfrog advance is not possible, then every time you cross a ridgeline or come around a bend in a valley you may find the enemy in your path. Unless he saw you coming he'll be just as surprised as you. If you have the weight of fire to do him serious damage, or there is cover available beyond, a hasty slashing attack may be the best form of defence - your fastest way out of a dangerous situation.

Defensive Tactics

In those cases where attack is not a practicable form of defence - when faced with superior forces in open ground, for example - the first essentials are cover and a line of retreat. Ducking into cover without a line of retreat amounts to trapping yourself. Mobility is the helicopter's prime asset, and its only defence against area weapons like large blast warheads or submunitions clusters. Remember that when the enemy knows where you're hiding he can attack you with mortars or artillery, even if you are out of sight, or outflank your position by advancing around it, either with ground forces or other helicopters.

The only guaranteed counter to a properly executed flanking manoeuvre is to retreat. If you don't have the space and the cover to do this, then outside intervention may be your only hope. The moral of the story is simple - keep your line of retreat open, especially in a sniping engagement. If it is threatened by enemy movement, use it straight away while you still can. If you know in advance that you're going to have to make a fighting withdrawal, pick out in advance the places where you can turn and fire back at your pursuers, and be aware of places where you can find friendly fire support. Lead the enemy to them if possible.

Air-to-Air Tactics

If you have to fight another combat helicopter, or an aircraft, remember the mantra "this is not a jet fighter". To a fighter pilot, altitude is a resource, a source of potential energy to be converted into speed. To you, as a combat helicopter pilot, altitude means exposure to enemy ground fire. Speed, too, works differently for a helicopter pilot. If an enemy aircraft makes a high-speed slashing attack on you while your own speed is low, the advantage swings to you as soon as the enemy is past. He is the prisoner of his own momentum, you can pedal-turn and launch your own weapons from his blind spot.

Use cover and ambush tactics when the enemy is chasing you. When you're chasing him, beware of the same tactics. Some classic air-to-air doctrines still apply to helicopter combat; If you're part of a formation attacked by enemy helicopters, the formation should split up. At the least, the enemy must divide his forces to pursue the different elements. If the enemy leaves any of your elements unengaged, these should then turn around and come in on the enemy's own tail.

Another classic air-combat tactic that may work for you is turning towards your opponent's approach. This brings your own weapons to bear and shortens his firing time.

Using Ground-attack Weapons in Air Combat

Even if you're not carrying specialised air-to-air missiles, you should be aware of the anti-aircraft potential of your ground-attack weapons. Cannon, rockets and anti-tank missiles may all be usable, if less than ideal. If you have to use these weapons against aircraft, try to do it at short range, and set up a low-deflection shot from ahead or behind. Remember that your guided weapons may fly a pursuit path to the target, rather than an intercept path, which reduces their effective range. Anti-tank missiles also generally have lower acceleration and top speeds, higher drag, and much less agility than anti-aircraft missiles - launching a Hellfire at a passing or retreating fast jet is most likely to achieve nothing more than the waste of an expensive missile.

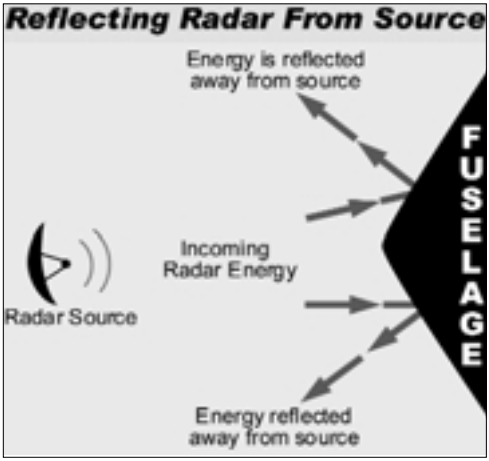
7. COMANCHE VERSUS HOKUM

RAH-66 Comanche

Carrying on the design tradition of American attack helicopters with the tandem cockpit and turreted nose cannon, the RAH-66 Comanche also brings a suite of new technologies shaped to fit the US Army's 21st century vision. It is a vision often described using terms such as efficiency, economy, flexibility and rapid-deployment. With the reduction of military strength after the cold war and the increasing involvement of the US Army in "Operations Other Than War", it has become evident that future forces need to be of a higher quality. They need to deploy anywhere in the world rapidly and win in combat with the minimum number of casualties.

Combining systems initially developed for the Apache and Light Helicopter Experimental (LHX) program with new high-technology systems, the Boeing Sikorsky RAH-66 Comanche represents the state-of-the-art in attack helicopters.

Visually, the most striking feature is the exterior body shape. Using what is known as low observable (LO) properties, the fuselage is designed to reflect radar energy away from any transmission source. Boeing claims the radar signature is around 1/300th of current aircraft. To maintain a low radar profile, stores can be hidden in IRAMS (Integrated Retractable Munitions System), this is an internal weapons bay capable of holding 6 Hellfire missiles.



Mounting stores internally in such a way prevents any radar energy being deflected back off the weapon and thus increasing the helicopter's radar cross section (RCS). Should the mission profile call for firepower over stealth then additional weapons may be fitted under removable wings. A total of 14 Hellfire missiles can be fitted in this configuration.

The Comanche has an advanced bearingless composite rotor with swept blade tips that reduces its acoustic signature, particularly at the reduced RPM levels of the so-called "quiet" flight mode. The low-noise rotor system, reduced infrared exhaust and small radar cross-section make the Comanche the stealthiest helicopter in the world. While not invisible to radar it is much harder to detect at longer ranges.

Sensors are mounted on the nose and top of the rotor mast in a similar configuration to the AH-64D Longbow Apache. Indeed the RAH-66 boasts the next generation Longbow radar system that is half the size of the previous model fitted to the Apache D model. Mounted on the nose is a second generation FLIR (forward looking infrared), this has double the resolution of the FLIR pod fitted to the Apache. This second generation FLIR permits more reliable target recognition at 40% greater range. With 100% greater resolution and 35% greater field of view, it is much safer for night flying which should give some comfort to the crew.

In populated regions the greatest threat to a helicopter operating at night comes from suspended or overhead cables. Whenever conventional helicopters are lost or damaged it is usually through a cable strike. The improved FLIR can resolve cables that have small currents running through them; electrical currents heat up wire to a point where they begin to "glow" by a small amount in the infrared spectrum. To further reduce the risk of wire strikes, the Comanche is fitted with a wire detector that provides an audible warning should it stray too close to a current carrying cable.

Flying the AH-64 Apache using the PNVS (pilots night vision system – presented via a helmet mounted monocle) has been described as, "trying to fly a helicopter by looking through a drinking straw". The RAH-66 comes with a 53° wide field of vision holographic helmet mounted display system and is biocular. Called HIDSS, the Helmet Integrated Display and Sight System delivers FLIR sensor, flight and targeting symbology to both eyes. As in the Apache, weapon targeting can be slaved to the pilots' helmet movements. Wherever the pilots look, the helicopter sensors will follow. In addition to this, the chin mounted 20mm GIAT Vulcan-II cannon can also be slaved to follow the pilots' head movements. When not in use, the cannon is normally stowed in a LO cowling positioned under the chin.

Front and rear cockpit configurations are near identical. The fly-by-wire flight control system is triply redundant, the cyclic side-stick includes a twist action which controls aircraft yaw. When used with flight assist modes the Comanche can be flown with just one hand. This makes the Comanche a remarkably easy aircraft to control.

The cockpit is over-pressurized to prevent any possible crew contamination from NBC - nuclear, biological or chemical agents. Should the cockpit suffer a minor breach after an attack the positive cabin pressure will prevent any contaminant invading the crew area.

On-board computing power is equivalent to four super computers, however only 10% of this power is needed to fly the aircraft; the rest is utilized in a highly advanced mission equipment package. For target acquisition, there is automatic visual and radar target recognition. Depending on the orientation of the target to the sensor, the computer can distinguish not only between wheeled and tracked vehicles, but also determine vehicle type. It has the remarkable ability of recognizing the difference between an M1 Abrams and a T-80.

EO sensors can be set to visually scan a crew-designated sector and automatically classify and track high-priority targets detected within that sector. Target removal is via man-in-the-loop battle damage assessment, if a target has been hit and destroyed, the operator is required to confirm destruction before it is removed from the tactical picture.

Sensor information can be shared with other elements of the combined arms team via a "tactical internet". Command & Control (C2), ground forces, JSTARS, AWACS, indeed any compatible system can exchange correlate and share tactical information with the Comanche systems. Supported protocol stacks include; AFTDS, AFAPD, TACFIRE, VMF, and MTS. Other tactical information distribution systems can be easily incorporated.

For communications, an existing system known as Air Force Integrated Communications Navigation Identification Avionics, is used for interoperability. In addition there are two VHF-FM single channel ground and airborne radio systems, a VHF-AM radio set and a HF (high frequency) radio for non-line of sight communications. An IDM or Improved Data Modem is used for communicating with the tactical internet.

Mission planning and rehearsal can be done completely in-cockpit using the advanced "Tactical Mode". Digital terrain maps provide elevation and feature data, which are optionally overlaid with a tactical situation display then rendered in plan or a real-time 3D perspective view. The map can be overlaid with threat forces, friendly positions, waypoint information and calculate intervisibilities. It can be used for threat avoidance or enroute mission planning. Positional information comes from a composite GPS/Doppler/Inertial navigation system that is constantly cross-checking and updating itself.

Each processor is an easily replaceable module common to the Air Force and Navy. If a module should fail, the systems reconfigure themselves allowing the Comanche to remain in battle and continue its mission despite malfunctions or battle damage.

Analysis of conducted exercises have shown that maneuverability, rate of climb, tandem (instead of side-by-side) cockpit configuration and a turreted gun are winning combinations in head to head helicopter engagements.

Development History

Back in 1981, a plan was drawn up for a single basic utility helicopter called LHX (Light Helicopter Experimental). The intention was to replace the aging UH-1, OH-58 and AH-1 fleets with a production run of 5,000 LHXs. To fulfil the diverse mission roles currently undertaken by the existing fleet, different LHX models were to be equipped with a large variety of new technologies and mission equipment packages. While it was considered to be an expensive program, military spending was generous under the current administration. Six years later in 1987 these mission roles were substantially reduced to scout and attack only. The projected LHX requirement then fell to around 2,000.

The upgrade/replacement program needed a rethink and quite possibly a different helicopter better suited to the narrower mission profile. In 1988 the Department Of Defense issued a "Request for Proposals", the request received a rapid response from Boeing Helicopters in collaboration with Sikorsky Aircraft.

In 1990, the projected number of new helicopters required was further reduced to 1,292 with an option of a further order of some 400. A year later, the Boeing Sikorsky partnership was awarded a contract to build 4 prototypes, designated the RAH-66 (RAH being an acronym of Reconnaissance Attack Helicopter).

Modernisation programs for the Apache and Kiowa were started with a view to enhance real-time intelligence gathering and distribution capabilities. These programs helped shape Army XXI's view of the electronic battlefield and have in-turn influenced Comanche systems specification.

A combination of cost reviews and specification changes initially resulted in patchy development. At present, the Boeing Sikorsky team manages some 1,100 major subcontractors and suppliers across the United States, quite a feat of co-ordination. Recent successes with two flying prototype Comanches have been good news for the program. The U.S Defense Department has approved an early operational capability program, which will provide six additional aircraft to the U.S Army so they can begin operational testing. These new aircraft will be manufactured in 2001.

Meanwhile, digitization programs of OH-58 Kiowa and AH-64D Apache continue, results suggest both platforms can be integrated more closely with ground forces than previously thought. They will integrate well with the Comanche when it becomes operational and eventually the older OH-58 will be finally phased out.

Initial operating capability (IOC) for the U.S Army's Comanche is set for 2006. While the Comanche has its critics in the Senate and Pentagon, in the Army there is no doubt that the RAH-66 will be an indispensable asset in the early 21st century battlefield.

Specifications - RAH-66 Comanche

Country Of Origin	USA
Type	Reconnaissance Attack Helicopter
Manufacturer	Boeing Sikorsky

Dimensions

Main Rotor Diameter	12m (39ft 0.48 in)
Overall Length	14.2m (46ft 9.36 in)
Height	3.5m (11ft 7 in)
Fuselage Width	2.8m (9ft 3 in)

Weight

Normal take-off	3,522 kg (7,765lbs.)
Maximum take-off	5,845 kg (12,880 lbs.)
Primary Mission	5,276 kg (11,632 lbs.)

Power Plant

Turboshafts	2 x T800-LHTEC-801 Turboshaft
Take-off Power	2 x 1562 shp (shaft horse power)
Fuel (internal)	302 U.S gallons
Fuel (external)	900 U.S gallons

Performance

Never Exceed Speed	200 kts (370 km/h)
Cruise Speed	165 kts (305 km/h)
Maximum Rate of Climb at sea level	260 m/min (850 ft/min)
Hover Turn Rate	80° per/sec
Maximum Sideways Speed	60 kts (112 km/h)
Range (internal fuel)	485 km
Range (ferry tanks)	2,335 km

Armament

- 20mm Three-barrel Gatling Gun
- Longbow Hellfire
- AIM-92 Stinger Missile
- Hydra 70 rocket

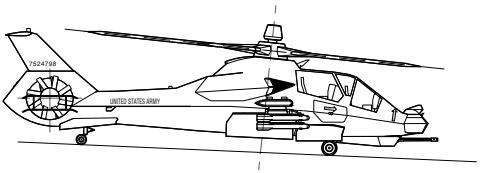
(NATO export options*)

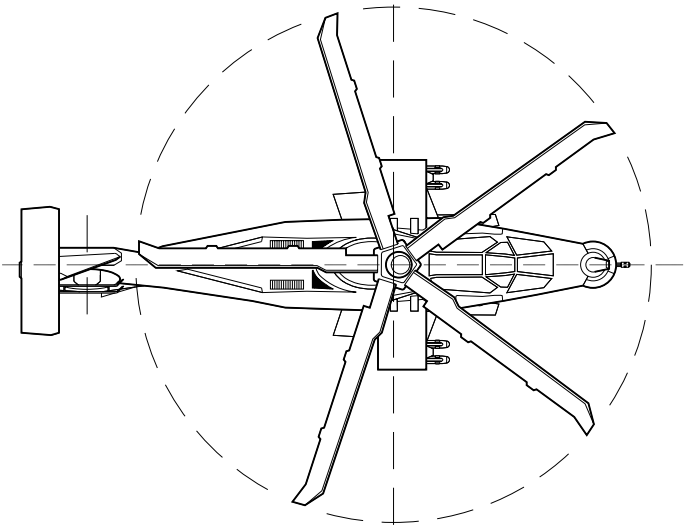
- Army Counter Air Weapon System
- TOW II Missile
- Starstreak
- Matra Mistral
- Euromissile HOT II
- Sura D-81mm Rocket
- Oerlikon Snora 81-mm Rocket

* Not featured in the simulation.

Features

- Five-bladed bearingless main rotor
- Fantail anti-torque system
- Triply redundant fly-by-wire control system
- Low-workload crew cockpit
- 4 x large flat panel colour multifunction displays
- Wide field-of-view biocular helmet mounted display
- Low observable properties throughout
- Self-healing electronics
- Onboard electronic technical manual
- Simple plug-and-remove modular maintenance
- Internal missile bay
- Stowable three-barrel 20-mm Gattling gun





Ka-52 Hokum B "Alligator"

Created by the Kamov Design Bureau, the unusual co-axial rotor configuration has in some small way become one of the company's trademarks. Anti-armour helicopter design usually copies the Bell AH-1 Cobra configuration, tandem cockpit, single main rotor and anti-torque tail rotor.

Kamov's design approach is tempered by the view that the typical tail-rotor configuration imposes an unnecessarily high-degree of vulnerability to ground fire. Also the long transmission shaft and associated gearbox places high-loads on the tail boom, a structure vulnerable to ground strikes and contact damage when hovering in confined spaces.

Eliminating the anti-torque rotor and associated gearbox transmission is achieved by adopting a twin rotor configuration. One rotor is mounted above the other and spin in opposite directions thus cancelling the effect of torque. This system makes ground maintenance easier and more importantly to a pilot - increases helicopter performance, nearly all the power provided by the two turboshaft engines is delivered straight to the main rotor. There is no need to use power driving a tail rotor that doesn't provide any lift. Increased power allows for heavier armament more armour protection and greater speed – all of these are fundamental constraints when designing a battlefield helicopter.

The co-axial rotor configuration of the Ka-52 has other benefits; the helicopter is capable of performing flat-turns throughout the entire flight speed range. This affords an ability to rapidly turn the nose onto a target even at dash speeds or rapid sideways transitioning to

evade fire while attacking. Mechanics are battle-hardened, systems have been proved against rounds up to 23mm, the power-plant can run for 30 minutes without oil, this gives the pilot an opportunity to land in a safe location in the event the oil system is damaged.

The Alligator is a high-performance all-weather, day and night attack helicopter. The primary mission role being similar to the Comanche - battlefield reconnaissance and strike co-ordination. To achieve this, there is an impressive avionic and sensor fit.

First is the FH-01 Arbalat (Crossbow) centimetric and millimetric wavelength radar made by Phazotron. The centimetric antenna of the Crossbow has a 360-degree search capability and mounted in a small 2-foot diameter dome on top of the rotor mast. This provides the Ka-52's air search and track capability. The larger millimetric wave antenna mounted in the nose of the helicopter is used to detect ground objects (such as vehicles) and provide information for 3D terrain mapping avionics. Little is known about the search parameters of the Crossbow, estimates place it's ground search and track capability in excess of 11km.

The helicopters electro-optical package consists of a number of systems. Like the American AH-64 and RAH-66 combat helicopters, there are two discreet night vision sensors, one for the pilot and another for weapon sighting. A sensor ball positioned on the roof between the cockpit and the rotor mast houses the Samshit (Boxwood) STS gyro-stabilized reconnaissance & sighting unit. The Samshit incorporates a FLIR imager (PNVS), which feeds the pilots' helmet-mounted display. Located under the fuselage is a small hemispherical fairing which houses the weapon operators' periscope: its rotation and elevation is aligned with the Samshit pod. Laser designation and LLLTV (Low Light Level Television) weapon guidance is achieved using a standard Shkval-V turret; this flat windowed chin mounted housing is used for employing most of the Ka-52's beam riding weapons such as the supersonic Vikhr (Whirlwind). The accuracy of the target guidance system is so great, it is said you can choose which "wheel" to hit on targets as far as 8 to 10km away. Because of this accuracy the Vikhr can be used against air-to-ground or air-to-air targets, the missile adjusts its profile accordingly.

The "Glass Cockpit" is a new feature in Kamov helicopters, four French made multi-function colour displays provide most of the instrumentation and systems management required for flight operations. An advanced EWS (Electronic Warfare Suite) provides early warning and countermeasures; basic components are the RWR (Radar Warning Receiver), Missile Warning System (MWS), Laser Warning Receiver (LWR) and chaff / flare launchers. The EWS displays threat information on a moving map display allowing the crew to relate threat bearing and distance to their immediate surroundings. Together with information from the radar and electro-optical sensors, this target data is automatically exchanged via a digital communications system to other force elements.

Navigation utilizes a combination of Inertial Guidance (laser gyroscopes and accelerometers) and GPS signals from both GLOSNASS and NAVSTAR satellites. This positional information is fed to an electronic moving map display that can be called up on one of the MFDs and also transmitted digitally to a ground command centre. Radio outfitting is made up of three VHF transceivers; one for monitoring the "guard" channel, one for secure communications and another for communicating with other mission specific force elements.

Gun installation consists of a 30mm 2A32 cannon mounted on a hydraulic drive that allows a limited amount of deflection: -2° to +9° azimuth (side to side) and +3° to -37° elevation (up and down). Cannon ammunition is supplied from two cartridge boxes, the fore box contains 240 rounds of armor piercing tracers, and the rear box contains 230 high-explosive incendiary rounds. The pilot selects which kind of ammunition to feed the gun and chooses between two rates of fire: high (550-600 rounds per minute) or low (350 rounds per minute). Burst lengths are automatically adjusted to either 10 or 20 rounds according to the rate of fire.

Kamov has gone to considerable lengths for crew protection. Just as with the Comanche, the crew cockpit is slightly pressurized to prevent NBC contamination. Protecting the crew from ground fire is approximately 300kg (661 lbs.) of steel hybrid armor in two layers. The steel armor is proved against direct hits by 20mm rounds. Lighter ceramic armor was rejected due to its tendency to shatter after successive impacts. In an emergency landing, the fuselage and landing gear struts can crumple to absorb large impact forces. Cockpit components and other structural elements are designed to preclude crew compartment volume compression by no more than 10-15%.

Another unusual feature of this helicopter is the "Pilot Rescue" capability by way of the K-37-800 ejection seat which was first fitted to the Ka-50 (the first helicopter in the world to be fitted with an ejector seat). Once the ejection handle has been pulled, a very carefully timed series of events take place. First, explosive charges in the rotor blade roots are detonated resulting in the separation of all 6 blades (this is potentially dangerous for any nearby onlookers). Both cockpit canopies are ejected sideways then the towing rocket on both ejection seats fire in low-thrust mode. When the towing-line is pulled taught the rocket increases thrust pulling the seat up on its mounting rails and out of the helicopter. After the rocket burn, the seat falls away and a cute is deployed. This ejection can be performed throughout the entire flight envelope including inverted flight (given a minimum altitude of 90 meters). Should a pilot eject over water, the seat is also fitted with survival pack and life raft. A survival beacon is activated automatically on ejection.

The Ka-52 is simple to control, highly maneuverable and has a lethal day/night weapons capability. A valuable asset for any modern army.

Development History

Since the mid-1970's, the mainstay of the soviet attack helicopter fleet was the Mi-24 Hind. This rather large and heavy helicopter, originally built as a flying Infantry Fighting Vehicle (IFV), has a capacity for ferrying up to 8 fully equipped soldiers. Over the years, it was realised that this troop carrying capability was underused; smaller lightweight (and more manoeuvrable) helicopters proved more suited to the anti-armour role. The USSR government took the decision to initiate the development of the next generation of army helicopters in December 1976. The task was handed to the Kamov Design Bureau and the Mil Helicopter Plant of Moscow.

In the early 1980's, Kamov demonstrated its light attack helicopter concept, it was designated V-80 (for "Helicopter of the 80s", V = "vertolyot" meaning helicopter). This helicopter was later re-designated the Ka-50 Hokum. In June 1982, the first Ka-50 prototype designated "White 010" made its maiden flight.

By 1990, soviet Army Aviation (Armeiskaya Aviatsiya) published its requirement for an anti-tank helicopter with night fighting capability. The Mil Helicopter Plant of Moscow submitted its two-seat Mi-28 Havoc and Kamov demonstrated their single-seat Ka-50 Hokum. Both officially won tender in 1994 and a year later, President Yeltsin signed a decree commissioning the Ka-50 for military service.

The first airframe left its Siberian factory in 1992. However lack of money forced production to stop after only 12 airframes had been built, and most of those did not meet the night flying requirement. As a result, Mil continued development of the Havoc, giving the company a chance to develop better night flying technologies and offer a more attractive helicopter.

With the difficulty in manufacturing heat vision equipment at that time, emphasis was placed on radar development. The Mi-28 and Ka-50 used the prototype Almaz and Arbalat (Crossbow) radar systems respectively. Advances in radar and FLIR design resulted in a much more complex avionic suite in both helicopters. This proved to be a great disadvantage in the single-seat Ka-50 where the pilot workload was considerably greater. Given the high weight of Soviet avionics, fitting a comprehensive suite of avionic systems to a two-seat helicopter was deemed impractical.

As it happens, a two-seat version of the Ka-50 had been constructed, used for pilot training it featured a side-by-side cockpit configuration. By adding more powerful engines and reducing protective armour, a practical two-seat attack helicopter was demonstrated. Further to this, Kamov contracted western companies to supply lighter and user-friendlier avionic components.

The first Ka-52 prototype designated "White 061" was premiered at the "Bangalore Aero India" show in 1996. It was based on the 11th production Ka-50 with a rebuilt front-fuselage section. It is estimated the Ka-52 is around 80-85 percent identical to the basic Ka-50 helicopter airframe and main system components. The principal dimensions of both helicopters remain more or less the same. White 061 was flown for the first time on the 25th June 1997 at Kamov's flight test base in Lyubertsty.

Experience with the Mi-24 Hind in Afghanistan had convinced Kamov that better crew co-ordination could be achieved by crew members sitting next to each other. Although interestingly Mil was not so convinced, and neither was Turkey when it evaluated the Hokum in 1998. Consequently this marked the start of an unlikely east/west relationship; Kamov in collaboration with Israeli Aircraft Industries (IAI) began work on the Ka-50-2. This is an export variant of the Ka-50/52 but has options for a traditional tandem cockpit and a turreted 20mm cannon mounted under the belly. The IAI sensor fit includes a night targeting and laser range-finder/designator package compatible with a subset of western missile systems.

Kamov are currently offering Armeiskaya Aviatsiya a mixed package of Ka-52s with existing Ka-50s upgraded to an all weather/night attack capability. Together they will adopt roles of battlefield reconnaissance, target identification/distribution and hand-off in a similar fashion to the AH-64D Apache and AH-64D fitted with the Longbow radar/fire control system.

Specifications – Ka-52 Hokum B

Country Of Origin	Russia
Type	Reconnaissance Attack Helicopter
Manufacturer	Kamov Design Bureau

Dimensions

Main Rotor Diameter	14.5m (47ft 5 in)
Overall Length	13.5m (44ft 3 in)
Height	4.9m (16ft 2 in)
Fuselage Width	2.6m (8ft 7 in)

Weight

Normal take-off	10,400 kg (22,928 lbs.)
Maximum take-off	11,300 kg (24,910 lbs.)
Primary Mission	1,811 kg (4000 lbs.)

Power Plant

Turboshafts	2 x TV3-117VMA-SB3s Turboshaft
Take-off Power	2 x 2,500 shp (shaft horse power)
Fuel (internal)	3,271 lbs.
Fuel (external)	3,792 lbs.

Performance

Never Exceed Speed	350 km/h (189 kts)
Cruise Speed	310 km/h (167 kts)
Hover Ceiling (out of ground effect)	5,500m (18,050 ft)
Maximum Rate of Climb at sea level	480 m/min (1,575 fpm)
Hover Turn Rate	80° per/sec
Range (internal fuel)	460 km
Range (ferry tanks)	1,200 km

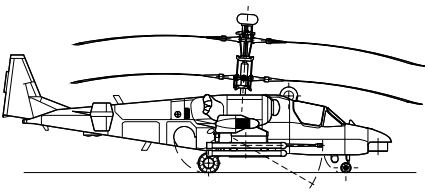
Armament

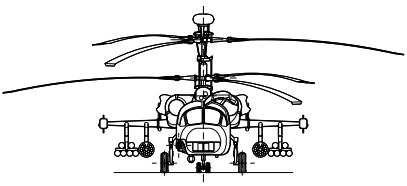
- 2A42 30mm cannon*
- S-8 80mm Rocket*
- S-13 122mm Rocket*
- Vikhr-M (AT-9) Laser Guided air-to-surface *
- Igla-V air-to-air missile*
- Kh-25ML (AS-12 Kegler) Laser Guided air-to-surface
- Kh-25MP anti-radar missile
- R-73 (AA-11 Archer) air-to-air missile
- KMGU-2 submunitions dispenser
- UPK-23 Gun Pod Twin 23mm*
- 500-kg aerial bomb
- 250-kg aerial bomb

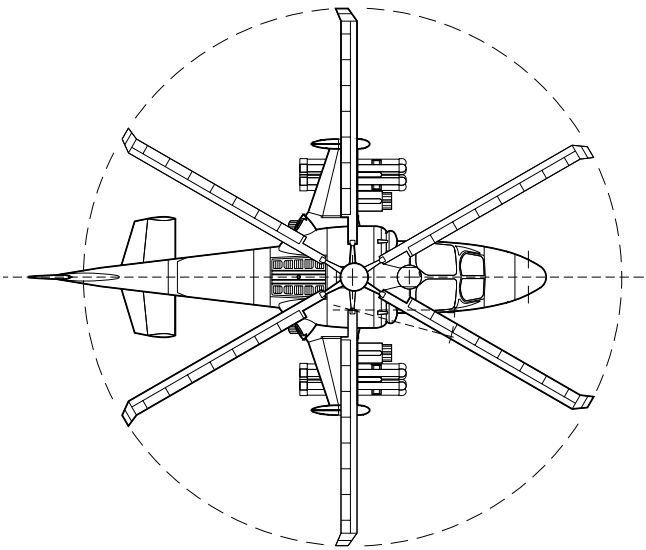
* Featured in the simulation.

Features

- Co-axial rotor configuration
- Zvezda K-37-800 pilot ejection system
- Phazotron FH-01 Arbalat (Crossbow) CMW/MMW radar
- Shkval-V gyro-stabilized recon unit with TV, FLIR and Laser
- Under hull turret-mounted periscope
- Target data exchange over digital communications
- Automatic flight-control system
- Glass cockpit with Multi-Function Colour Displays
- Hands On Collective And Stick (HOCAS)
- Helmet Mounted Display
- High power-to-weight ratio
- Reduced Pilot Workload





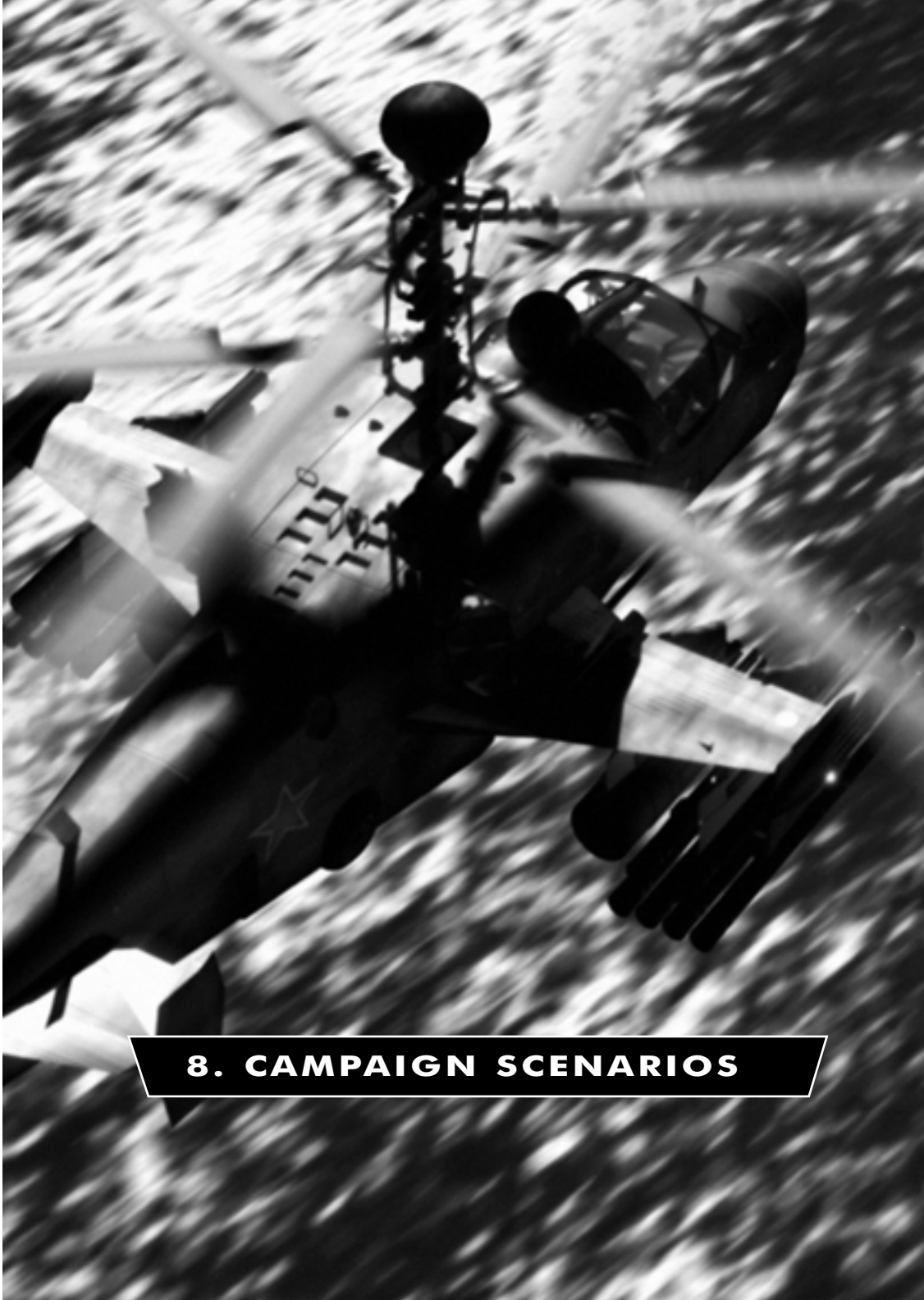


Performance Comparison Table

	RAH-66 Comanche	Ka-52 Hokum B
Never Exceed Speed	200 kts.	188 kts.
Max Forward Speed	172 kts (318 km/h)	161 kts (298 km/h)
Max Sideways Speed	60 kts	43 kts
Rate Of Climb (at sea level)	260 m/min (850 ft/min)	1,574 ft/min
Range (internal)	485 lm	450 km
Range (ferry)	2,335 km	1,200 km
Engine Output	2 x 1,563 shp	2 x 2,500 shp
Weight Max	5,845 kg	10,800 kg

Used Acronyms

AFAPD	Air-Force Applications Program Development
AFTDS	Advanced Field Artillery Tactical Data System
CMW	Centimetric Wave
EO	Electro Optics
EWS	Electronic Warfare Suite
FLIR	Forward Looking Infra Red
HF	High Frequency
HIDSS	Helmet Integrated Display & Sight System
HOCAS	Hands On Collective and Stick
IDM	Improved Data Modem
IOC	Initial Operating Capability
I-RAMS	Integrated Retractable Munitions System
LLLTV	Low Light Level Television
LO	Low Observable
MMW	Millimeter Wave
MTS	Marine Tactical Systems
NBC	Nuclear Biological Chemical
PNVS	Pilot Night Vision System
RCS	Radar Cross Section
TACFIRE	TACtical FIRE direction system
VMF	Variable Message Format



8. CAMPAIGN SCENARIOS

Sword In The Sand

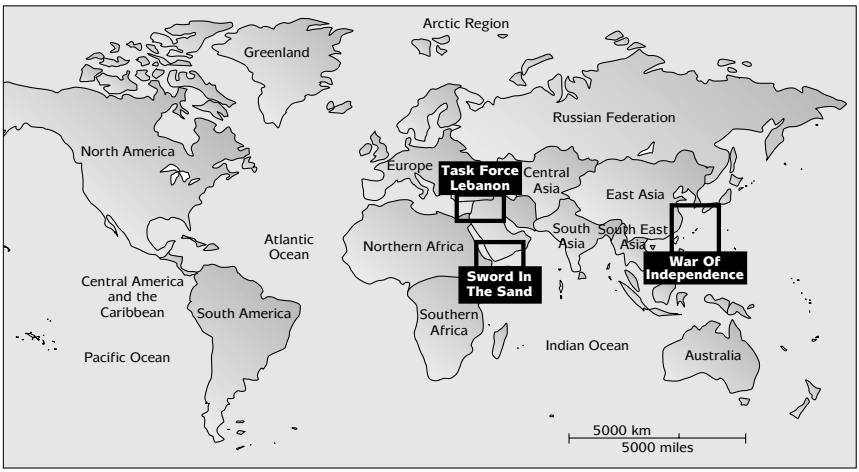
For ten years both Saudi Arabia and Yemen have been squabbling over the exact course of their mutual border, resulting in frequent armed clashes. As both sides re-arm with state of the art equipment from their respective super power patrons the discovery of rich oil deposits in the disputed region escalates the tension. Finally, another confrontation on the border triggers one or both sides to lose patience and the desert reverberates to the sound of helicopter engines as battle is joined over a 'line in the sand'.

War Of Independence

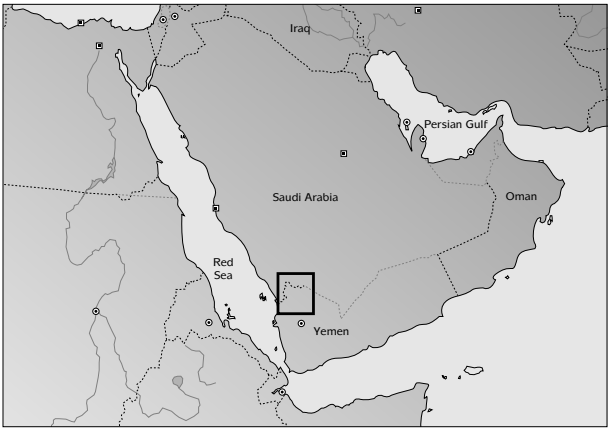
Beijing has always considered Taiwan to be part of China and talks between the two to resolve this have continually broken down. For the Chinese the final straw was the surprising victory of the Taiwan Independence Party (TIP) in the 2001 elections. The PLA, having spent the last decade re-equipping with state of the art Russian equipment, sees a window of opportunity to settle the issue by force of arms and under cover of large scale naval manoeuvres launch a sudden invasion and rapidly seize the northern side of the island. With the UN Security Council prevented from taking action by the Russian veto the Americans rush a task force to the area determined to prevent the Chinese from consolidating their bridgehead.

Task Force Lebanon

The discovery of a plot by terrorists to detonate a nuclear warhead in Baltimore has made the US determined to renew the war against terrorism. The perpetrators are discovered to be sheltering in Lebanon and elements of the US 6th Fleet are dispatched to the area. The Lebanese militias, backed up with Russian hardware supplied through Syria, are determined to defend their homeland from American incursions and a 'swift surgical strike' soon degenerates into a much wider conflict.



Sword In The Sand



BLUE FORCE

From the Middle East Gazette

Blue Force Briefing (Saudi Arabia)

It appears that the Yemeni claims to the oil rich Marib border area have finally pushed the Saudis too far. For years the Yemeni government has been provoking the Saudis over this sensitive issue, the final straw being their granting of drilling rights in the disputed region to various foreign oil companies (including several Russian concerns). This Russian connection must not be overlooked. For several years the Russians, chafing under American global dominance, have been re-establishing links with their old client states wherever possible. They have been supplying an ever increasing amount of support to Yemen, possibly to offset their loss of influence in the northern part of the Persian Gulf. It is rumoured, that should the Yemeni government prevail in its claims along the Saudi border they will grant the Russians naval basing rights at Aden (finally giving them what they have long craved - a warm water port).

We must also not forget the Yemeni support given to Saddam Hussein during the invasion of Kuwait. That this made them the outcasts of the Arab world seems to have made them only more determined to pursue their claims on Saudi Arabian territory. They have recklessly increased expenditure on their armed forces, despite the fact that they have long been unable to meet the repayment schedules and some say there is almost an air of desperation about this military adventure.

Despite this, the start of the conflict seems to have been carefully orchestrated by the Yemeni government. First there was their open support of fundamentalists hostile to the Saudi regime. This was swiftly followed by the show trials in Aden where hundreds of dissidents were rounded up and made to testify to being part of some far fetched Saudi plot. Then there was the government statement that Yemeni actions would be seen as 'the

signal of a pan Arab awakening embodying the dreams of the Arab masses in a borderless great Arab homeland, a unified nation' (a statement chillingly similar to the one issued by Hussein during his attempt to annex Kuwait) and finally there was the granting of the drilling rights in the disputed border region.

The conflict appears to have erupted around several almost insignificant border villages - including Ifrine and Al - Baqah, the clashes occurring during Saudi military manoeuvres. All Saudi attempts at reconciliation have been rebuffed and now the conflict can only be settled on the battlefield. Saudi units are already moving up to the border to put an end to these provocations once and for all.

RED FORCE *Partial transcript of a government broadcast to the Yemeni people*

Red Force Briefing (Yemen)

Fellow Yemenis! Since 1969 Saudi Arabia has clung to the territory she illegally took from us despite all our attempts to settle the matter peacefully. We are a new nation, born out of the destruction of a dreadful civil war, anxious to be granted the hand of friendship. Instead we have discovered only selfish enmity. Surely you would think that a poor country such as ours would be allowed to share the mineral riches of the Marib in order that we could rebuild our shattered cities and give some measure of comfort to our people. But no! Our rich Saudi neighbours would not concede in this matter, despite the justness of our cause. Not content with merely attempting to drive us into poverty they have continually meddled in our affairs. They have sheltered the traitors who plunged us first into civil war. They insulted our noble leader, calling him an 'ignoramus' and 'parasitical and ignorant'.

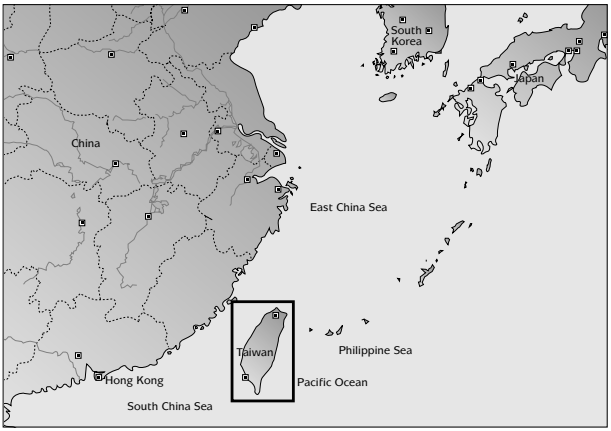
But they do not only use words to attack us. They have steadily built up the size of their army, despite the strain this so evidently places in their economy. When asked why they claimed that it was for protection against Iraq. But if this is so, why was it necessary to hold TEN days of live fire exercises along our border. Their plan became obvious when a plot was discovered to place bombs throughout our country. Thankfully the ringleaders were arrested before they could act and during their trial the truth emerged - that this vile conspiracy was organised by our neighbour.

No doubt smarting at their failure the Saudi units on this so called exercise have crossed the border and occupied the villages at Ifrine and Al - Baqah. It is now obvious that they resolutely oppose any peaceful solution to the border question, and with a heavy heart we have ordered our military units to defend our sovereign territory.

Our forces may be small, but it was they that unified our nation and they are still fiercely proud of this great endeavour. Even now our soldiers are preparing to valiantly defend Yemeni citizens so ruthlessly attacked by our implacable neighbours. Rest assured that they will strike, and strike hard at our foes to avenge all the slights and humiliations heaped upon us.

The struggle may be hard, the sacrifices many but we have come too far to be defeated now. Our cause is just and our victory will be absolute!

War Of Independence



BLUE FORCE

From a briefing given to a US aviation unit

Blue Force Briefing (Taiwan/USA)

Gentlemen. You are going to war. You are going to war in fulfilment of a promise. The promise that we gave to Taiwan that the 'United States make available to Taiwan such defence articles and defence services in such quantity as may be necessary to enable Taiwan to maintain a sufficient self defence capability'.

Sadly, the articles provided have failed to deter Chinese aggression, now it is up to you to ensure that we do not let the Taiwanese down. The first invasion echelon of the Chinese Army (PLA) has already formed a bridgehead on the northern part of the island under the cover of a considerable air umbrella. The second wave can be expected to land shortly and exploit the initial gains. Taiwanese forces, although putting up a brave resistance are being overwhelmed, both by numbers and technology. The situation is now critical. Be aware, there is nothing subtle about the Chinese operation. They have massed their best units in the area, and ensured that these are equipped with the most modern weapons they can lay their hands on. It will come as no surprise to you to learn that most of this has been provided by our old friends the Russians.

Our task force will shortly be entering the combat area and active operations will commence immediately. Your initial objective is to attack the Chinese bridgehead. It is imperative that not only is this contained and prevented from consolidating but that the follow on and support forces are also interdicted and attrited before they reach the main theatre. It is essential that the enemy build-up is hampered to allow time for our reinforcements to reach the area. Until then gentlemen you will be on your own. With the situation stabilised we can carefully prepare our own riposte and so restore all of the island to its rightful owners.

Brief your men, prepare your aircraft and … give em hell!

RED FORCE

From a Chinese briefing to their armed forces

Red Force Briefing (China)

The situation with Taiwan has become intolerable. This after all is Chinese sovereign territory yet its leaders have antagonised and insulted us. This perhaps could be borne with stoicism, for we always said that eventually there would be a peaceful rapprochement between us. However, now the situation threatens to spiral out of control and our patience is exhausted. Unlike the restoration of Hong Kong and Macao a peaceful solution now seems impossible to come by.

The new government of Taiwan, the so called 'Taiwanese Independence Party' has stated quite unequivocally that they well be claiming independence from China. Such an adventurist action removes any claim to legitimacy that this so called government might have and we have resolved to undertake an action to remove them from power, finally ending these splittest tendencies.

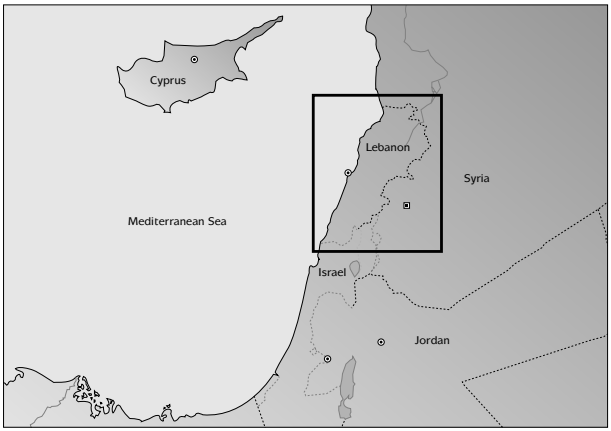
Rest assured that you will be embarking on this action with the full support of the Chinese people behind you as this misguided island is restored to the protection of Beijing.

Do not undertake your duties lightly. Whilst there will be some resistance from the reactionaries in Taiwan, we feel the challenge you must meet and overcome will come from further afield. America has made no secret of its support for Taiwan and the opposition from this quarter will have to be overcome before final victory is assured.

You are well equipped for the task at hand. We have left no stone unturned to obtain for you some of the most modern weapons in the world. These have not only been produced in our new advanced factories and shipyards but have been bought from far and wide. Many have been provided by our friends the Russians. With ships, aircraft and missiles of the most advanced types our comrades in the navy and airforce have pledged to deliver you safely on Taiwan. It is then that your work will commence.

Equipment however can only do so much. It is upon your endeavours that the final decision will rest. You must look to the example of your leaders and cadre as you march to obtain the ultimate victory all our citizens so desperately crave.

Task Force Lebanon



BLUE FORCE

From a satellite news channel report

Blue Force Briefing (USA)

Who would have thought that a routine raid on a warehouse in Baltimore a few weeks ago would culminate in an American Task Force standing off the coast of Lebanon? Although it was a surprise to everyone when the FBI uncovered what turned out to be the equipment for the manufacture of a nuclear weapon all parts of the American intelligence establishment rapidly swung into action. The CIA traced the origin of the warheads plutonium to the Russian Tomsk-7 site whose security has been worrying experts for years. It appears that this material was smuggled out of Russia by the Mafia and into Turkey and from here down into Lebanon. This was where it fell into the hands of the terrorist splinter group 'The Sword of Freedom' which is reported to be based in the country. As soon as this was verified, large elements of the 6th Fleet set sail for the eastern Mediterranean whilst a retaliatory action was planned.

Unfortunately the situation today seems somewhat confused and the chance of a swift, surgical strike is rapidly diminishing. The Lebanese Militias have declared that American forces have no business in their waters and have been rapidly mobilising their forces. It has now become apparent that Syrian support for these militias has been far more extensive than was first thought. The Militias have revealed themselves to be in possession of top of the range military hardware, most of which the Russians originally supplied to the Syrian army. The crisis has caused the various factions to unify in the face of what they see as little more than an American invasion and have pledged to resist any and all US incursions into their territory. They have made no secret of the fact that they believe they have the weapons to halt any US action dead in its track. Tensions have been raised to such a pitch that we now find ourselves in a 'hair trigger' situation and full scale military operations could commence at any minute.

A spokesman for the Task Force Admiral told me that 'whilst we have no wish to become embroiled in a shooting match with the Militias we are worried by the very real possibility that there may well be more of these weapons of mass destruction - or the material for their construction somewhere in the Lebanon. It is imperative that our forces are allowed to investigate this matter and punish those responsible. Whilst we seek the support of the Lebanese people in this affair, we cannot, and will not, allow ourselves to be deterred by their hostility'.

RED FORCE

From a Syrian government press release to assembled journalists

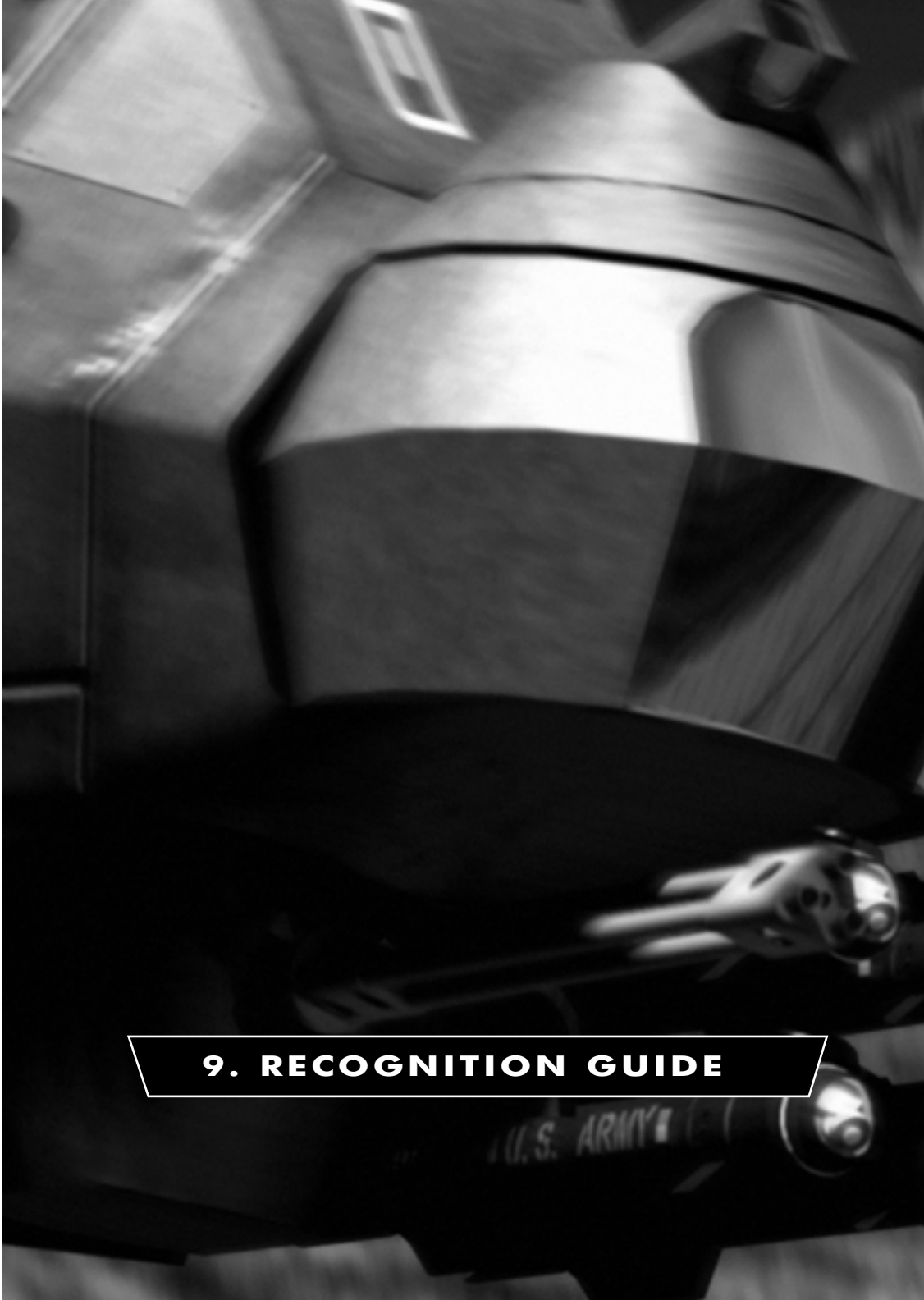
Red Force Briefing (Lebanese Militias/Syria)

In the first place we want to make it absolutely clear that Syria does not support or sponsor terrorist activities in any way. We do not do this now and will not do so in the future. We vehemently deny the irresponsible accusations concerning Syrian involvement with this so called 'Sword of Freedom' group. Indeed, we go further. We are not at all convinced that such a group exists, or if it does, that it is based in Lebanon. As you all know we have taken an active role in the rebuilding of that unhappy country and under our guidance and with our support it is now returning to a normal way of life. Should all of this be jeopardised on the say so of the American CIA? Has not this much vaunted organisation been wrong in the past?

As we have said, we have no interest in terrorism and offer no succour to its perpetrators. However, in the face of what can only be seen as an irresponsible and reckless American adventure we absolutely maintain the right of the Lebanese people to actively defend themselves with every means at their disposal. Over the years too many foreigners have meddled in Lebanese affairs with no call to do so and this threatened American action is no different. Finally with our support, and the assistance of our friends in Russia our colleagues in Beirut have the weapons to protect themselves and we very much hope that this will deter the Americans from their reckless and dangerous endeavour.

Should this deterrence fail be aware that Syria does not, and will not abandon its friends and allies. We are fully prepared to furnish every assistance to the Lebanese in the face of this gross American provocation.

Once more, we say again that every nation has the right to self defence and to resist outside meddling in their internal affairs. America should be aware that Syria will ensure that the Lebanese have, and will continue to have, the means with which to uphold this right.



9. RECOGNITION GUIDE

USA COMBAT HELICOPTERS

Type: Attack

AH-64A Apache

Recognition features:

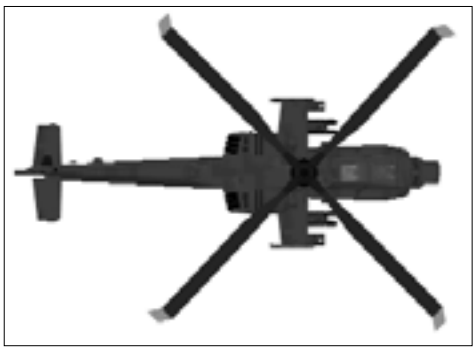
- 4-bladed main rotor - no radome - and 4-bladed X-shaped tail rotor
- tandem cockpit arrangement under single flat-glazed canopy
- stub wings with wingtip missile mounts
- engine nacelles on each side of fuselage with 'fish tail' exhaust cooling vanes to rear
- slender symmetrical sponsons on each side of cockpit blending under fuselage nose section
- nose-mounted TADS / PNVS turrets
- chain gun turret-mounted under forward fuselage
- all moving tail plane
- fixed main undercarriage and tail wheel

Armament:

- M230 30mm Chain Gun
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114K Hellfire II laser guided anti-tank missiles
- Hydra 70 M255 unguided rockets (HE)
- Hydra 70 M261 unguided rockets (MPSM)

Decoys:

- chaff
- flares



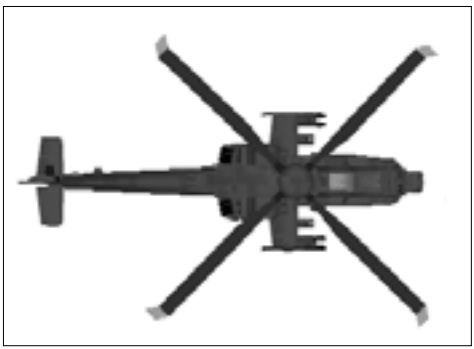
Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

USA COMBAT HELICOPTERS

Type: Attack

AH-64D Apache Longbow



Recognition features:

- 4-bladed rotor with 'Swiss cheese' style radome, 4-bladed 'X' shaped tail rotor
- tandem cockpits with single canopy
- stub wings with wing-tip missile mounts
- engine nacelles on each side of fuselage with 'fish-tail' exhaust cooling vanes to rear
- enlarged flat-sided sponsons (avionics bays)
- nose-mounted TADS/PNVS turrets
- chain gun turret mounted under forward fuselage
- all-moving tail-plane
- fixed undercarriage and tail wheel

Armament:

- M230 30mm Chain Gun
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114L Longbow Hellfire radar guided anti-tank missiles
- AGM-114K Hellfire II laser guided anti-tank missiles
- Hydra 70 M255 unguided rockets (HE)
- Hydra 70 M261 unguided rockets (MPSM)

Decoys:

- chaff
- flares

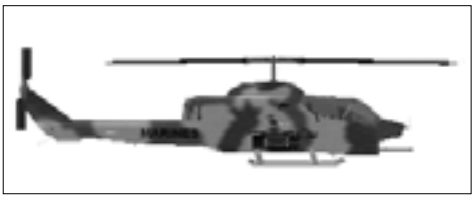
Game notes:

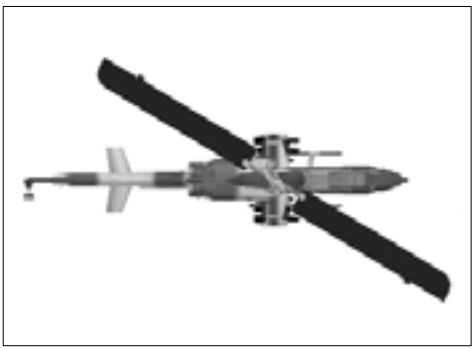
- radar symbol: ⋈
- ground radar priority: **medium**

USA COMBAT HELICOPTERS

Type: Attack

AH-1W SuperCobra





Recognition features:

- broad twin rotor blades
- tall narrow fuselage, short ridged tail boom with centrally mounted tail plane, sharply backward slanting tail fin
- narrow tandem cockpit arrangement under single rounded canopy, shallow sponsons each side of forward fuselage section
- rounded air intakes and engine nacelles each side of fuselage separated by raised ridge at rear, distinctive twin elongated oval exhaust outlets
- sharply pointed nose with conical TADS turret under
- short stub wings with wing tip weapons pylons and edge-on ECM pods on upper wing surface
- chin-mounted triple-barrelled nose gun turret
- squat landing skids under central section

Armament:

- 20mm cannon
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114K Hellfire II laser guided anti-tank missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

USA COMBAT HELICOPTERS

Type: Marine attack

AH-1T SeaCobra

Recognition features:

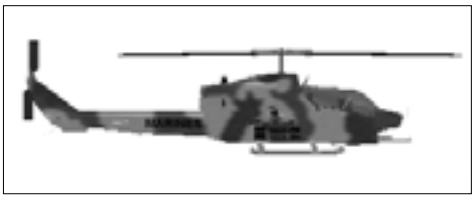
- broad twin rotor blades
- tall narrow fuselage, short ridged tail boom with centrally mounted tail plane, sharply backward slanting tail fin
- narrow tandem cockpit arrangement under single rounded canopy
- elongated air intakes to rounded engine nacelles each side of fuselage joining in flat ended projection at rear with twin circular exhaust outlets
- sharply pointed nose with conical TADS turret under
- short stub wings with wing tip weapons pylons and edge-on ECM pods on upper wing surface
- chin-mounted gun turret with long triple-barrelled cannon
- squat landing skids under central section

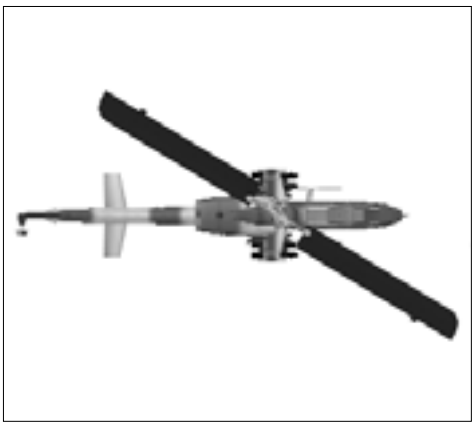
Armament:

- 20mm cannon
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114K Hellfire II laser guided anti-tank missiles

Decoys:

- chaff
- flares





Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

USA COMBAT HELICOPTERS

Type: Reconnaissance/attack

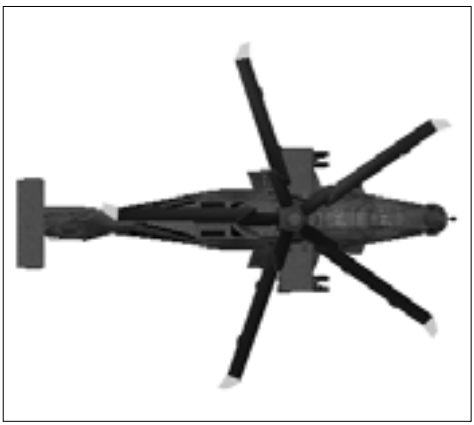
RAH-66 Comanche

Recognition features:

- 5-bladed 'low profile' main rotor with enclosed hub and mast-mounted conical radome, integral fenestron tail rotor
- distinctive angular stealth composite fuselage design with asymmetrical canted tail section and canted T-shaped tail configuration
- tandem cockpit arrangement under single high visibility flush sided canopy
- shallow angular engine nacelles with distinctive triangular inlets
- conical nose-mounted TADS/PNVS turret
- retractable weapons bay doors with integral pylons, optional detachable stub wings to provide additional weapons hardpoints
- chin-mounted stowable cannon turret
- retractable main undercarriage and tail wheel

Armament:

- 20mm Gatling gun
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114L Longbow Hellfire radar guided anti-tank missiles
- AGM-114K Hellfire II laser guided anti-tank missiles
- Hydra 70 M255 unguided rockets (HE)
- Hydra 70 M261 unguided rockets (MPSM)



Decoys:

- chaff
- flares

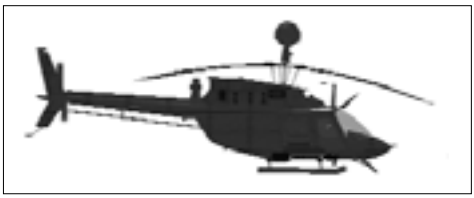
Game notes:

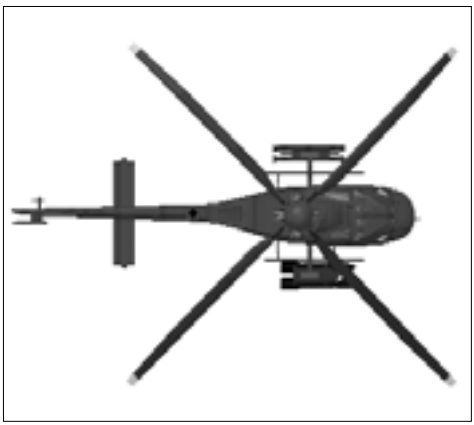
- radar symbol: ⋈
- ground radar priority: **medium**
- stealth features reduce radar signature

USA COMBAT HELICOPTERS

Type: Scout

OH-58D Kiowa Warrior





Recognition features:

- 4-bladed main rotor with large mast-mounted spherical sight, twin-bladed tail rotor
- tall and narrow curved fuselage, flat sided engine compartment atop with large ECM mount to rear
- small sharply rounded nose section with bubble glazed cockpit giving distinctive 'bug-eyed' appearance
- slender round-section tail boom with centrally located tailplane and twin fins to rear,
- squat landing skids under central section
- upward cranked tubular external stores supports for weapons payloads

Armament:

- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114K Hellfire II laser guided anti-tank missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

USA COMBAT HELICOPTERS

Type: Attack/assault

UH-60 Black Hawk

Recognition features:

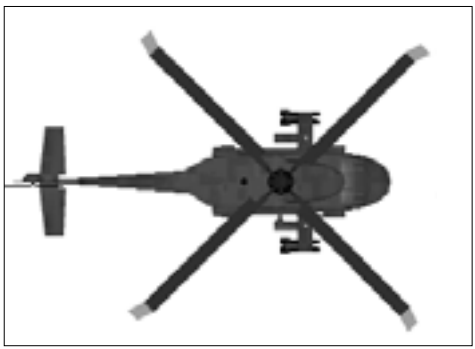
- 4-bladed main rotor and 4-bladed tail rotor
- twin seat side-by-side cockpit
- low and wide appearance to main fuselage section with flat underside and elongated nose
- sliding doors on either side of main cabin
- IR suppressors fitted to engine exhaust outlets
- external stores supports for weapon pylons
- all-moving tail-plane
- fixed undercarriage and tail wheel

Armament:

- AGM-114C Hellfire radar guided anti-tank missiles
- Hydra 70 M255 unguided rockets (MPSM)

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

USA COMBAT HELICOPTERS

Type: Marine assault

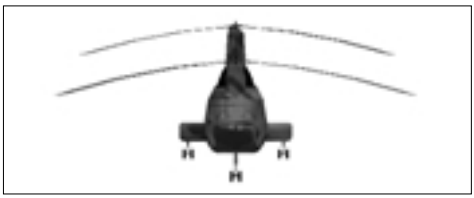
CH-46E Sea Knight

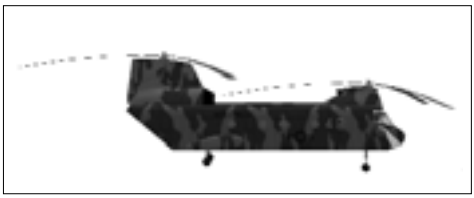
Recognition features:

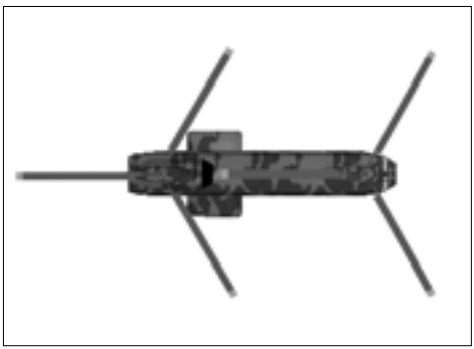
- twin 3-bladed tandem main rotors
- twin seat side-by-side cockpit inside glazed nose
- long rectangular fuselage with elevated engine housings and rearward stub wings
- rear hinged loading ramp to cargo hold
- fixed tricycle undercarriage with main rear wheels supported by stub wings

Decoys:

- chaff
- flares







Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA TRANSPORT HELICOPTERS

Type: Medium-lift

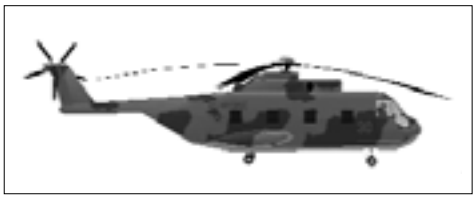
CH-3 (Jolly Green Giant)

Recognition features:

- 5-bladed main rotor and 5-bladed tail rotor
- twin seat side-by-side cockpit behind shallow nose
- long main fuselage with sloping rear section and short tail boom
- rear hinged loading ramp to cargo hold
- semi-retractable tricycle undercarriage with main rear wheel housings in stub wings

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

USA TRANSPORT HELICOPTERS

Type: Heavy-lift

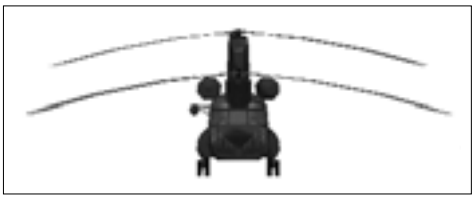
CH-47D Chinook

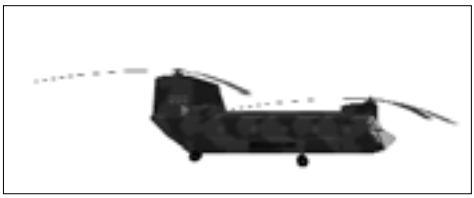
Recognition features:

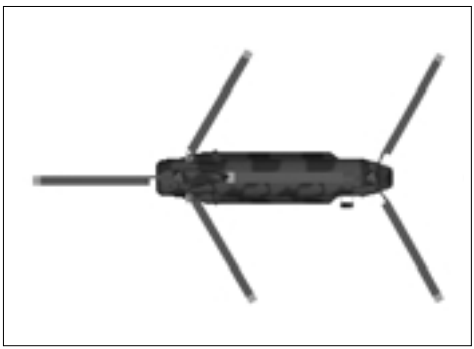
- twin 3-bladed tandem main rotors
- twin seat side-by-side cockpit inside glazed nose
- long rectangular fuselage (bulging along lower sides), elevated front and rear engine housings
- external engine nacelles on rear sides of fuselage
- rear hinged loading ramp to cargo hold
- fixed 4-wheeled undercarriage

Decoys:

- chaff
- flares







Game notes:

- radar symbol: ⋈
- ground radar priority: medium

USA TRANSPORT HELICOPTERS

Type: Medium-lift tilt-rotor

MV-22 Osprey

Recognition features:

- distinctive twin 3-bladed tilt-rotors and rounded hub spinners
- high-wing configuration with short wing sections supporting large tilt rotor engine nacelles at tips
- rounded square-section flat bottomed fuselage, with large bulging underwing sponsons
- short rounded nose section, side-by-side cockpit arrangement under single rounded canopy, nose-mounted mini radome and forward projecting refuelling probe
- rear sloping fuselage section rising to distinctive flattened and curved rear tail boom supporting twin finned tail plane with hinged loading ramp to cargo hold under
- squat retractable tricycle undercarriage

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

USA TRANSPORT HELICOPTERS

Type: Heavy-lift

CH-53E Super Stallion

Recognition features:

- large 7-bladed main rotor with flattened circular hub cap, canted 4-bladed tail rotor
- broad and long rounded square sectioned fuselage sloping up to short tail boom with flattened underside, sharply canted tail fin with distinctive cranked side-mounted tail plane
- rounded engine housing tapering along upper fuselage, large outboard tubular air intakes with conical intake filters, large angled circular exhaust tubes to rear
- large curved sponsons at centre section with projecting outer supports for large droptanks
- distinctive rounded flat nose section incorporating cockpit nose glazing and forward projecting refuelling probe
- rear hinged loading ramp to cargo hold
- squat semi-retracting tricycle undercarriage

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

USA COMBAT AIRCRAFT

Type: Close air support

A-10A Thunderbolt

Recognition features:

- low-wing, square leading and trailing edge with upward canted outer sections and down-turned wing-tips, projecting fairings over main landing gear
- short nose with 'up-front' cockpit arrangement
- twin fin assembly
- large pair of circular engine nacelles mounted on upper rear fuselage
- many under-wing weapon hard points and large nose mounted cannon
- semi-retractable tricycle undercarriage

Armament:

- 30mm cannon
- AIM-9M Sidewinder IR guided air-to-air missiles
- LAU-69/A unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

USA COMBAT AIRCRAFT

Type: Multi-role fighter

F-16 Fighting Falcon

Recognition features:

- mid-wing, swept leading edge, square trailing edge, wings blended to fuselage
- long bubble-shaped canopy and short sharp nose
- single large curved air intake under nose
- single large tail fin, downward canted all-moving tail plane
- wing-tip missile mounts, under-wing hard-points
- retractable tricycle undercarriage

Armament:

- 20mm cannon
- AIM-9M Sidewinder IR guided air-to-air missiles
- AIM-120 AMRAAM radar guided air-to-air missiles
- AGM-65D Maverick IR guided air-to-surface missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: medium

USA COMBAT AIRCRAFT

Type: Carrier-borne attack

AV-8B Harrier

Recognition features:

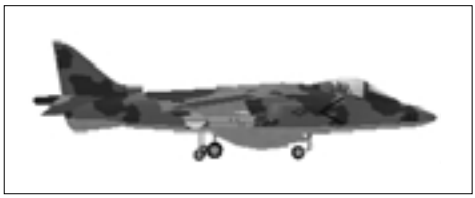
- high-wing, swept leading and trailing edges, sharp downward cant
- swept tail fin, downward canted all-moving tail plane
- compact bulbous fuselage with rounded main air intakes immediately aft of either side of cockpit
- short nose with 'up-front' cockpit arrangement
- thrust vectoring nozzles under wings on either side of fuselage
- under-wing hard-points, under-fuselage bulging cannon housing
- retractable main landing gear with under-wing retractable stabilisers

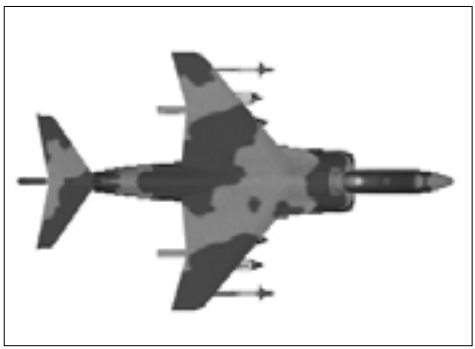
Armament:

- 25mm cannon
- AIM-9M Sidewinder IR guided air-to-air missiles
- LAU-69/A unguided rockets

Decoys:

- chaff
- flares





Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

USA COMBAT AIRCRAFT

Type: Carrier-borne interceptor

F/A-18 Hornet

Recognition features:

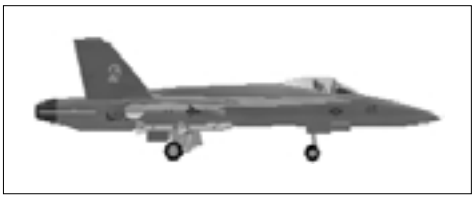
- mid-wing, swept leading edge extended into 'hood' along forward fuselage, square trailing edge
- long slender nose section and canopy, with wings centred well aft of fuselage centre line
- swept all-moving tail plane well aft of tall sharply canted twin tail fins
- engine intakes either side of fuselage under wing leading edge, closely-spaced rear nozzles
- under-wing and fuselage hard-points with wing-tip missile mounts
- retractable tricycle undercarriage

Armament:

- 20mm cannon
- AIM-9M Sidewinder IR guided air-to-air missiles
- AIM-120 AMRAAM radar guided air-to-air missiles
- AGM-65F Maverick IR guided air-to-surface missiles

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

USA TRANSPORT AIRCRAFT

Type: Medium-lift

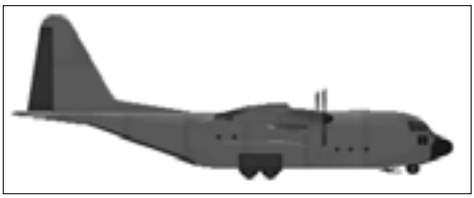
C-130J Hercules II

Recognition features:

- 4 propfan engines on under-wing engine nacelles, distinctive sabre-like 6-bladed propellers
- broad high-wing configuration with square leading edge blending to fuselage
- distinctive broad tail plane and tall round-topped tail fin arrangement
- large circular-sectioned fuselage rising to broadly flattened and tapered tail boom at rear, rounded bulging sponsons to lower underwing section
- short rounded up-turned nose below broad rounded cockpit section with distinctive wrap-around glazing
- large hinged cargo doors to rear under sloping tail underside
- retractable undercarriage with 4 fixed main wheels and twin steerable nose wheels
- no under-wing fuel tanks as per earlier Hercules variants

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

USA TRANSPORT AIRCRAFT

Type: Heavy-lift

C-17 Globemaster III

Recognition features:

- 4 stout turbo-fan engines mounted on large forward-projecting under-wing pylons with large circular metallic air intakes and conical exhaust outlets to rear
- distinctive swept high-wing configuration, large downward sloping tapered wings ending in up-turned swept winglets, large underwing deflection flaps and rearward projecting supporting fins
- huge circular-section main fuselage, bulging over wing junction, rear raised bulging tail section tapering to rounded point at rear, flattened underside at hinged cargo door area
- large underwing sponsons, smoothly blended to mid fuselage and angling outwards at base, rounding back into fuselage underbelly
- large distinctive swept T-tail configuration
- smoothly rounded tapering nose section with wrap-around glazed cockpit
- retractable undercarriage with 12 fixed main wheels arranged in 4 triplets at rear and twin steerable nose wheels

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

USA ARMOURED VEHICLES

Type: Main battle tank

M1A2 Abrams

Recognition features:

- tracked - 7 road wheels plus drive sprocket and idler on either side
- long low flat-sided hull, flat raised rear section behind turret, flattened rear end with engine louvres and circular lamp housings
- large angular low profile turret topped by small thermal sighting turret and large hatch-mounted MG with stowage racks to rear
- long high calibre main gun barrel overhangs hull front

Armament:

- 120mm gun
- 12.7mm machine gun

Decoys:

- smoke grenades

Game notes:

- radar symbol: ▙
- ground radar priority: **medium**
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment

Type: Infantry fighting vehicle

M2A2 Bradley

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- angular high-sided hull, sloping front and port-side inset driver's hatch, flattened rear end with troop compartment loading ramp and large projecting stowage bins on either side
- small angular turret with secondary armour panels to rear, short low calibre main gun barrel and side mounted flip-up TOW launcher

Armament:

- 25mm cannon
- M220 TOW2B tube-launched optically-tracked wire-guided missiles

Decoys:

- smoke grenades

Game notes:

- radar symbol: ▙
- ground radar priority: **high**
- surface-to-air ceiling 2,000m
- surface-to-air range 4,000m
- armoured
- night vision equipment

USA ARMOURED VEHICLES

Type: Armoured personnel carrier

M113A2

Recognition features:

- tracked - 5 road wheels plus drive sprocket and idler on either side
- high-sided box-shaped hull, backward sloping front and flattened rear end with loading ramp to troop compartment
- hatch mounted MG on hull topside (no turret)

Armament:

- 12.7mm machine gun

Game notes:

- radar symbol: ▬
- ground radar priority: high
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment

Type: Scout car

M1025 HMMWV (HumVee)

Recognition features:

- high 4-wheeled chassis
- distinctive flat-sided wide and low-profiled body, square front, slightly sloping bonnet, vertical windshield, downward slope at rear end of cab roof
- roof-mounted MG

Game notes:

- radar symbol: ●
- ground radar priority: low

USA SELF-PROPELLED ARTILLERY

Type: Artillery (howitzer)

M109A2 (155mm)

Recognition features:

- tracked - 7 road wheels plus drive sprocket and idler on either side, no side-skirts over tracks
- wide angular hull with bevelled nose section and downward sloping top at front, flattened rear with hull access door and stowed entrenching 'spades'
- large flat-topped turret centred aft with sloping curved front and flat sides, thermal sighting turret and hatch-mounted MG atop, flattened rear end with projecting stowage box and racks
- very long high calibre main gun extending well forward of hull front with large open-sided muzzle

Armament:

- 155mm howitzer
- 12.7mm machine gun

Game notes:

- radar symbol:
- ground radar priority: medium
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment

Type: Multiple rocket systems

M270 MLRS (227mm)

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side, no side-skirts over tracks
- box-shaped cab section at front with backward sloping front-face and protective louvres over windows, rear flatbed platform for launcher
- large box-shaped turret-mounted multiple rocket launcher stowed horizontally at rear, turned and pitched to firing position

Armament:

- 227mm rockets

Game notes:

- radar symbol:
- ground radar priority: low

USA AIR DEFENCE VEHICLES

Type: AAA

M163 Vulcan

Recognition features:

- tracked - 5 road wheels plus drive sprocket and idler on either side
- high-sided box-shaped hull, backward sloping front with bulged section, box-shaped bulges along upper sides, flattened rear end
- small circular turret with sloping sides and flat open top, small side-mounted radar dish, distinctive multi-barrelled cannon on pivoting 'skeleton' mount

Armament:

- 20mm cannon

Game notes:

- radar symbol: ▲
- ground radar priority: **high**
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment
- range-only radar

Type: SAM

M1037 Avenger

Recognition features:

- high 4-wheeled chassis
- distinctive flat-sided wide and low-profiled body, square front, slightly sloping bonnet, vertical windshield to cut-short cab, flatbed launcher platform to rear
- platform-mounted box-shaped sloping-top turret with pivoting side-mounted rectangular rocket launchers

Armament:

- FIM-92A Stinger IR guided surface-to-air missiles

Game notes:

- radar symbol: ▲
- ground radar priority: **high**
- surface-to-air ceiling 3,000m
- surface-to-air range 5,000m
- night vision equipment

USA SELF-PROPELLED ARTILLERY

Type: SAM

M48A1 Chaparral

Recognition features:

- tracked - 5 road wheels plus drive sprocket and idler on either side
- box-section hull with sloping front, raised rectangular forward cab section and flatbed launcher platform to rear
- platform-mounted flat-sided curved roof turret on circular base with Chaparral missile pairs mounted on either side

Armament:

- Chaparral IR guided surface-to-air missiles

Game notes:

- radar symbol: ▲
- ground radar priority: **high**
- surface-to-air ceiling 3,000m
- surface-to-air range 5,000m
- night vision equipment
- FLIR

USA TRANSPORT VEHICLES

Type: Light 4x4 vehicle

M998 HMMWV (HumVee)

Recognition features:

- high 4-wheeled chassis
- distinctive flat-sided wide and low-profiled body, square front, slightly sloping bonnet, vertical windshield to cut-short cab, flatbed cargo area to rear

Game notes:

- radar symbol: ●
- ground radar priority: **low**

USA TRANSPORT VEHICLES

Type: Utility vehicle (truck)

M923A1 "Big Foot"

Recognition features:

- high 6-wheeled truck chassis - 2 wheels in front, 4 at rear
- large flat radiator grille with integral headlights, flat tapering bonnet, box-shaped cab with vertical windshield, angled mud guards over front wheels
- high sided canvas covered cargo area to rear

Game notes:

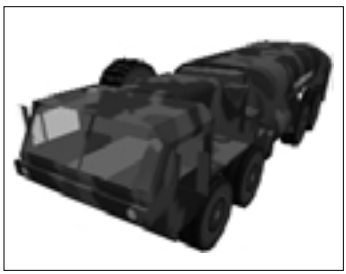
- radar symbol: ●
- ground radar priority: low

Type: Fuel tanker

M978 (HEMTT)

Recognition features:

- high 8-wheeled chassis - 2 pairs of 4 wheels
- distinctive forward-projecting cab with steeply angled large flat windshield and underside, narrow rectangular section behind cab with side-mounted spare wheel
- large curved-sided flat-topped fuel tank to rear and adjoining downward angled curved rear end section



Game notes:

- radar symbol: ●
- ground radar priority: low

USA WARSHIPS

Type: Amphibious assault ship

Tarawa Class

Recognition features:

- wide and high-sided box-section hull, long bow, square stern section
- continuous flight deck
- port side outboard aircraft lift, stern inboard aircraft lift, large stern water-line loading door
- long narrow rectangular starboard side superstructure, large forward-mounted lattice mast and aft-mounted structures atop
- two storey bridge
- large deck-side crane

Armament:

- 25mm cannons
- Sea Sparrow radar guided surface-to-air missiles

Game notes:

- radar symbol: ▼
- ground radar priority: **high**
- surface-to-air ceiling 5,000m
- surface-to-air range 1,0000m
- air search radar

Type: Frigate

Oliver Hazard Perry Class

Recognition features:

- slender low-profile hull with sharp high-sided bow, square inward sloping shallow stern
- long high-sided box-section superstructure forward raised bridge section, small spherical radome atop
- tall central lattice mast with large outboard aerials, shorter forward mast with large rectangular radar dish atop
- small forward deck gun position on circular base
- aft deck-level helicopter landing pad

Armament:

- 76mm guns
- SM-1MR Standard radar guided surface-to-air missiles

Game notes:

- radar symbol: ▼
- ground radar priority: **high**
- surface-to-air ceiling 5,000m
- surface-to-air range 10,000m
- air search radar

USA WARSHIPS

Type: Landing craft

Tarawa Landing Craft

Recognition features:

- flat rectangular hull with squarely angled-in bow and stern, raised gusseted sides to cargo deck
- hinged bow loading ramp, twin crane booms astern
- narrow box-shaped superstructure on starboard side cargo deck, single pole-mounted radar antenna

Game notes:

- radar symbol: ▼
- ground radar priority: low

Type: Hovercraft

LCAC

Recognition features:

- rectangular flat-bed hull, widely projecting all-round inflatable skirt with square corners
- long and narrow deck-side superstructures with top-mounted engine intakes/exhausts
- hinging bow and stern loading ramps
- prop-shafts to aft-mounted twin 5-bladed propellers in circular enclosures with rudder planes attached

Game notes:

- radar symbol: ▼
- ground radar priority: low

RUSSIAN COMBAT HELICOPTERS

Type: Attack

Mi-28N Havoc-B

Recognition features:

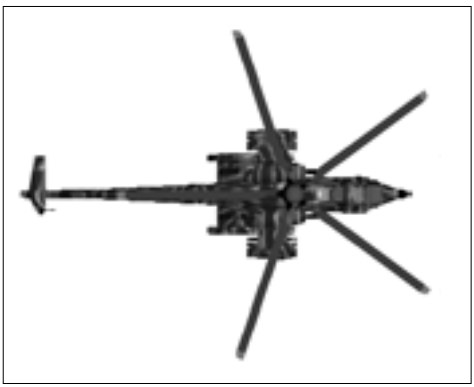
- 5-bladed main rotor with spherical radome, 4-bladed 'X' shaped tail rotor
- tandem 'stepped' separate cockpit arrangement
- nose-mounted radome with FLIR turret underneath
- rounded engine nacelles with downward pointing rearward exhaust outlets
- stub-wings (downward sloping) with pylons and wing-tip ECM pods
- chin-mounted cannon turret with ammo panniers
- asymmetrical tail plane arrangement
- fixed undercarriage and tail wheel

Armament:

- 30mm cannon (both armour piercing and high explosive rounds)
- Igla-V IR guided air-to-air missiles
- Ataka radio command guided anti-tank missiles
- 80mm unguided rockets
- 130mm unguided rockets
- GSh-23L 23mm cannon pods

Decoys:

- Chaff
- Flares



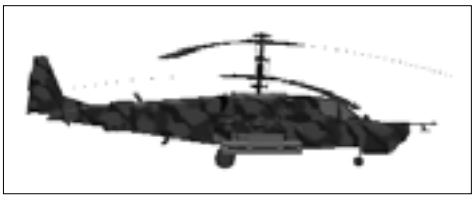
Game notes:

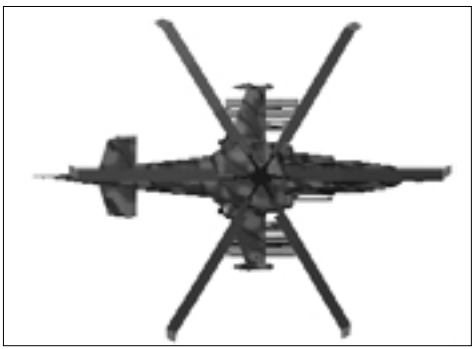
- radar symbol: ⋈
- ground radar priority: **medium**

RUSSIAN COMBAT HELICOPTERS

Type: Attack

Ka-50 Hokum





Recognition features:

- twin 3-bladed co-axial main rotors (no tail rotor), mast-mounted 'mini' radome
- single seat cockpit with angular flat armour glass canopy
- narrow angular cockpit section blending to smoothly sharpened nose section with chin-mounted fixed sight on flattened underside, rounded square-section tail boom with even taper to point at rear
- rounded engine nacelles each side of upper fuselage immediately aft of cockpit, domed dust filters to air intakes
- distinctive tail configuration - angular tail fin and tail plane with endplate fins
- enlarged stub wings with weapons pylons and wing tip ECM pods
- side-mounted 30mm cannon
- retractable tricycle undercarriage

Armament:

- 30mm cannon (both armour piercing and high explosive rounds)
- Igla-V IR guided air-to-air missiles
- Vikhr laser guided anti-tank missiles
- 80mm unguided rockets
- 130mm unguided rockets
- GSh-23L 23mm cannon pods

Decoys:

- chaff
- flares

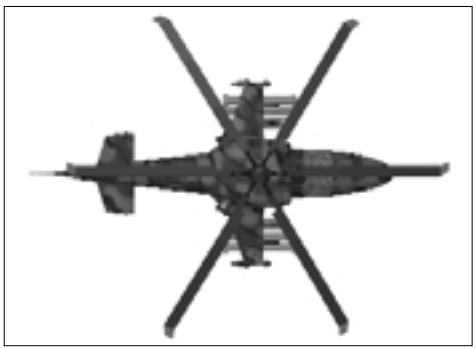
Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

RUSSIAN COMBAT HELICOPTERS

Type: Reconnaissance/attack

Ka-52 Hokum-B



Recognition features:

- twin 3-bladed co-axial main rotors (no tail rotor), mast-mounted 'mini' radome
- twin seat side-by side cockpit with flat armour windshield and curved 'gull-wing' style upward opening canopy doors
- smoothly sculpted forward fuselage section with rounded nose, rounded square-section tail boom with even taper to point at rear
- rounded engine nacelles each side of upper fuselage immediately aft of cockpit, domed dust filters to air intakes
- distinctive tail configuration - angular tail fin and tail plane with endplate fins
- nose-mounted cylindrical FLIR turret, spherical SAMSHIT turret above cockpit rear
- enlarged stub wings with weapons pylons and wing tip ECM pods
- side-mounted 30mm cannon
- retractable tricycle undercarriage

Armament:

- 30mm cannon (both armour piercing and high explosive rounds)
- Igla-V IR guided air-to-air missiles
- Vikhr laser guided anti-tank missiles
- 80mm unguided rockets
- 130mm unguided rockets
- GSh-23L 23mm cannon pods

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

RUSSIAN COMBAT HELICOPTERS

Type: Attack/assault

Mi-24D Hind

Recognition features:

- 5-bladed main rotor, 3-bladed tail rotor
- tandem stepped cockpits with domed canopies
- tall and narrow appearance to main fuselage
- hinged loading doors on either side of main cabin
- IR suppressors fitted to engine exhaust outlets
- sharply downward angled stub wings with weapons pylons and down turned wing-tips
- chin-mounted gun-turret and sight/radar mounts
- retractable tricycle undercarriage

Armament:

- 12.7mm Gatling gun
- AT-6 Spiral radio command guided anti-tank missiles
- 57mm unguided rockets
- 80mm unguided rockets

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

RUSSIAN COMBAT HELICOPTERS

Type: Marine assault

Ka-29 Helix-B

Recognition features:

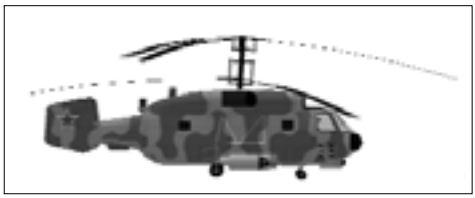
- twin 3-bladed co-axial main rotors (no tail rotor)
- twin seat side-by-side cockpit
- short rectangular section fuselage with distinctive flat nose and tail plane with endplate fins
- hinged loading doors on either side of main cabin
- weapon pylons supported on outboard racks
- fixed 4-wheeled undercarriage with main gear outboard of fuselage sides

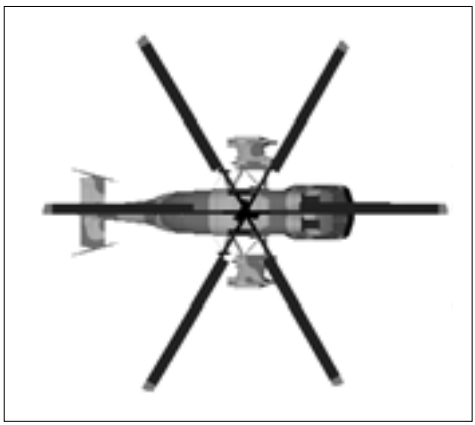
Armament:

- 57mm unguided rockets
- 80mm unguided rockets

Decoys:

- chaff
- flares





Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

RUSSIAN TRANSPORT HELICOPTERS

Type: Medium-lift

Mi-17 Hip

Recognition features:

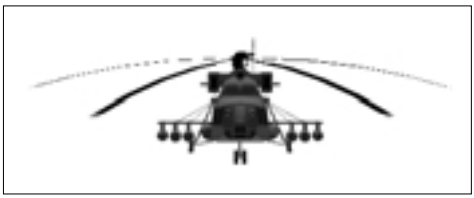
- 5-bladed main rotor and 3-bladed tail rotor
- twin seat side-by-side cockpit inside glazed nose
- long rounded main fuselage and slender tail boom
- rear fuselage has 'clam shell' cargo hold doors
- IR suppressor fitted to engine exhaust outlets
- weapon pylons supported on outboard racks
- fixed tricycle undercarriage with outboard struts supporting main wheels

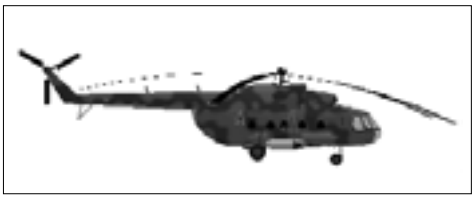
Armament:

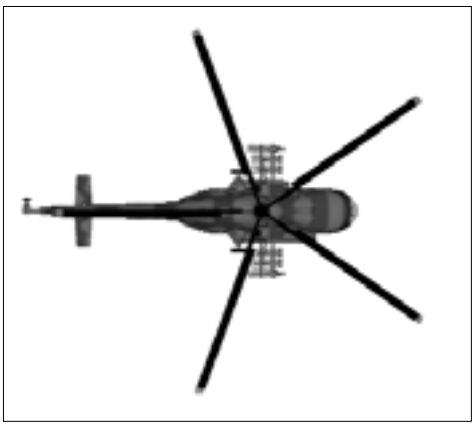
- 57mm unguided rockets
- 80mm unguided rockets

Decoys:

- chaff
- flares







Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

RUSSIAN TRANSPORT HELICOPTERS

Type: Heavy-lift

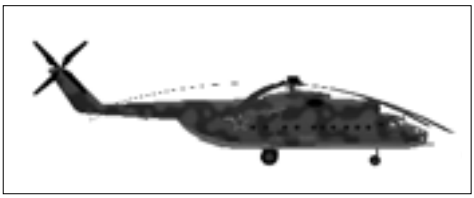
Mi-6 Hook

Recognition features:

- 5-bladed main rotor and 4-bladed tail rotor
- twin seat side-by-side cockpit aft of glazed observers station in nose
- extremely long rounded main fuselage section with shorter tail boom
- large wings, tail plane and external fuel tanks
- rear fuselage has 'clam shell' cargo hold doors
- fixed tricycle undercarriage with outboard struts supporting main wheels

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

RUSSIAN COMBAT AIRCRAFT

Type: Close air support

Su-25 Frogfoot

Recognition features:

- high-wing, swept leading edge, square trailing edge, wing-tip pods
- single tall tail fin with smaller aft upward canted tail plane on aft projecting boom
- short sloping nose and canopy, flattened fuselage sides and bottom, rounded engine nacelles with aft projecting circular outlets
- many under-wing weapon hard points and large nose mounted cannon
- fully retractable tricycle undercarriage

Armament:

- 30mm cannon
- AA-8A Aphid IR guided air-to-air missiles
- 80mm unguided rockets

Decoys:

- chaff
- flares

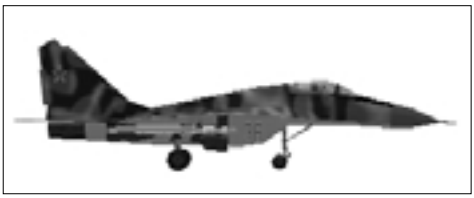
Game notes:

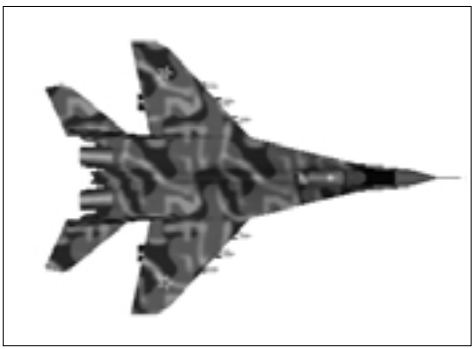
- radar symbol: ◆
- ground radar priority: **medium**

RUSSIAN COMBAT AIRCRAFT

Type: Multi-role fighter

Mig-29 Fulcrum





Recognition features:

- low-wing, swept leading and trailing edges, wings blended to fuselage
- all-moving swept tail plane and canted twin tail fins
- downward-pointing nose, 'humped-back' fuselage aft of cockpit tapering to flattened projecting 'fish-tail' section at rear, flattened fuselage underside
- separated under-fuselage engine nacelles with canted and angled rectangular air intakes and widely spaced rear nozzles
- under-wing hard points and side-mounted cannon
- retractable tricycle undercarriage

Armament:

- 30mm cannon
- AA-10A Alamo radar guided air-to-air missiles
- AA-10B Alamo IR guided air-to-air missiles
- AA-11 Archer IR guided air-to-air missiles
- AS-10 Karen IR guided air-to-surface missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

RUSSIAN COMBAT AIRCRAFT

Type: Carrier-borne attack

Yak-41 Freestyle

Recognition features:

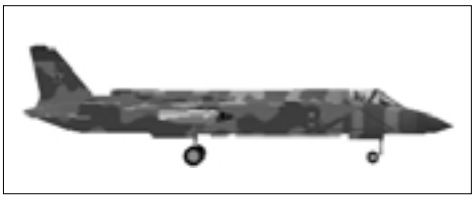
- high-wing, swept leading edge, square trailing edge with slight sweep along outer section, wing-tip pods
- compact square-sided fuselage with angled side air intakes and short nose with 'up-front' cockpit
- distinctive twin tail booms and canted fins, cutaway for extendable thrust vectoring engine nozzle
- under-wing hard-points
- retractable tricycle undercarriage

Armament:

- 30mm cannon
- AA-8A Aphid IR guided air-to-air missiles
- 80mm unguided rockets

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ◆
- ground radar priority: medium

RUSSIAN COMBAT AIRCRAFT

Type: Carrier-borne interceptor

Su-33 Flanker

Recognition features:

- low-wing, swept leading and trailing edge, blended to fuselage, swept canard foreplanes
- downward angled forward fuselage with enlarged bulbous nose section, 'humped-back' central fuselage tapering to flattened projecting 'tail-sting' at rear
- swept tail plane and twin vertical tail fins
- separated under-fuselage engine nacelles with canted and angled rectangular air intakes and large widely spaced rear nozzles
- under-wing and fuselage hard-points with wing-tip missile mounts
- retractable tricycle undercarriage

Armament:

- 30mm cannon
- AA-8A Aphid IR guided air-to-air missiles
- AA-8B Aphid radar guided air-to-air missiles
- AA-10A Alamo radar guided air-to-air missiles
- AA-10B Alamo IR guided air-to-air missiles
- AS-14 Kedge laser guided air-to-surface missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

RUSSIAN TRANSPORT AIRCRAFT

Type: Medium-lift

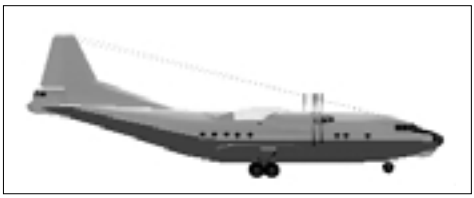
An-12B Cub

Recognition features:

- 4 turboprop engines with 4-bladed propellers on under-wing nacelles
- high-wing configuration with swept leading edge and downward canted wing tip sections
- large angled tail fin incorporating tail gun turret, tail plane set well aft
- large circular-sectioned fuselage tapering to broadly flattened tail boom at rear, rounded sponsons to lower fuselage centre section
- smoothly rounded nose section tapering to glazed observation turret below wrap-around cockpit glazing, chin-mounted radome feature
- large inward hinging cargo doors to rear under sloping tail underside
- retractable undercarriage with 4 fixed main wheels arranged 2 pairs at rear and twin steerable nose wheels

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

RUSSIAN TRANSPORT AIRCRAFT

Type: Heavy-lift

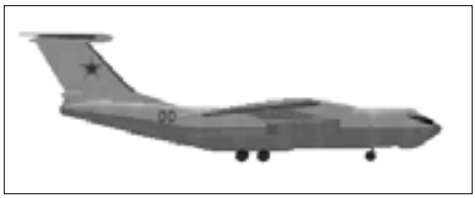
IL-76MD Candid

Recognition features:

- 4 large slender turbo-fan engines mounted on forward-projecting under-wing pylons with 'clam shell' thrust reversing exhaust outlets to rear
- swept high-wing configuration, large downward sloping tapered wings with large underwing flaps and projecting supporting fins
- large slender circular-section main fuselage bulging at wing junction, gently upward curving tail section tapering to rear tail gun turret, with large rear hinged loading ramp to cargo hold
- curved sponson arrangement on lower central fuselage with additional main undercarriage pod on underbelly
- swept T-tail configuration with large forward rectangular sectioned projection atop
- distinctive smoothly rounded tapering nose section incorporating glazed observation station, large radome section and wrap-around glazed cockpit
- retractable undercarriage with 16 fixed main wheels arranged on 4 axles at rear and 4 co-axial steerable nose wheels

Decoys:

- chaff
- flares



Game notes:

- radar symbol: ◆
- ground radar priority: **medium**

RUSSIAN ARMOURED VEHICLES

Type: Main battle tank

T-80U

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- long and low flat-sided hull with front and rear splashers curving down over track ends, front top-side of hull slopes down between side-skirts, distinctive pair of fuel barrels mounted on rear
- distinctive low circular domed turret with hatch mounted MG and stowed snorkel on brackets at rear
- long high calibre main gun barrel overhangs hull front

Armament:

- 125mm gun
- 12.7mm machine gun
- AT-11 Sniper laser beam riding anti-tank missiles

Decoys:

- smoke grenades

Game notes:

- radar symbol:
- ground radar priority: **medium**
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment

Type:Infantry fighting vehicle

BMP-2

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- angular low-profile hull with sloping underside and sharply pointed leading edge, flattened rear with bulged access doors, curved-ended splashers to tracks projecting along sides
- small circular turret with sloping sides and flat top offset to aft, long slender low calibre main gun barrel and turret mounted tubular missile launcher

Armament:

- 30mm cannon
- AT-5 Spandrel radar guided anti-tank missiles

Decoys:

- smoke grenades

Game notes:

- radar symbol:
- ground radar priority: **high**
- surface-to-air ceiling 2,000m
- surface-to-air range 4,000m
- armoured
- night vision equipment

RUSSIAN ARMOURED VEHICLES

Type: Infantry fighting vehicle

BMP-3

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- high-sided box shaped hull, sloping underside to front with pointed leading edge and flattened rear end, troop compartment main access doors on rear topside and rear end of hull
- small circular flat-topped turret, high calibre main gun barrel with box-shaped laser sight mounted over base and side-mounted co-axial cannon

Armament:

- 100mm gun
- 30mm cannon
- AT-10 Stabber laser beam riding anti-tank missiles

Decoys:

- smoke grenades

Game notes:

- radar symbol: ■
- ground radar priority: **high**
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment

Type: Armoured personnel carrier

BTR-80

Recognition features:

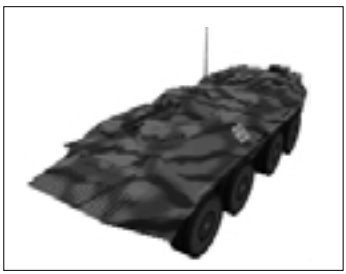
- high 8-wheeled chassis, 2 pairs of 4 wheels
- angular long narrow hull with sloping underside to front, flattened rear end and sloped upper sides with angular wheel arches below
- very small circular flat-topped MG mounted turret

Armament:

- 14.5mm machine gun

Decoys:

- smoke grenades



Game notes:

- radar symbol: ●
- ground radar priority: **medium**
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment

RUSSIAN ARMOURED VEHICLES

Type: Scout car

BRDM-2

Recognition features:

- high 4-wheeled chassis
- angular small and narrow hull, sharp leading edge and sloping underside to front, sloping upper sides with curved wheel arches below, flattened rear end
- very small circular flat-topped MG mounted turret

Armament:

- 14.5mm machine gun

Game notes:

- radar symbol: ●
- ground radar priority: **medium**
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment

RUSSIAN SELF-PROPELLED ARTILLERY

Type: Artillery (howitzer)

2S19 (152mm)

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side
- long and low flat-sided hull with front and rear splashers curving down over track ends, front top-side of hull slopes down between side-skirts
- very large high-sided box-shaped turret with hatch-mounted MG and distinctive rear-mounted SAM launcher tube
- very long high calibre main gun extending well forward of hull front

Armament:

- 152mm howitzer
- 12.7mm machine gun

Decoys:

- smoke grenades

Game notes:

- radar symbol: ▬
- ground radar priority: **medium**
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m
- armoured
- night vision equipment

RUSSIAN SELF-PROPELLED ARTILLERY

Type: Multiple rocket systems

BM-21 Grad MRS (122mm)

Recognition features:

- high 6-wheeled truck chassis - 2 wheels at front, 4 at rear
- low wide radiator grille, smooth curved tapering bonnet and short upright cab with backward sloping windshield, vertical faced mud guards over front wheels with integral headlights, flatbed platform behind with launcher turret over rear axle
- box-shaped grouped rocket tubes stowed on turret at rear, turned and pitched to firing position

Armament:

- 122mm rockets

Game notes:

- radar symbol: ●
- ground radar priority: low

RUSSIAN AIR DEFENCE VEHICLES

Type: SAM

SA-13 Gopher

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on either side, no side-skirts
- long low-profile flat-topped hull with tapering cab sides and sloping top/underside to front, box-shaped side-mounted stowage lockers along upper sides, flattened rear end
- centred circular turret mount for launcher arm with side-mounted box-section rocket launchers, stowed laid flat on hull top and pivoted on arm to firing position

Armament:

- SA-13 Gopher IR guided surface-to-air missiles

Game notes:

- radar symbol: ▲
- ground radar priority: high
- surface-to-air ceiling 3,000m
- surface-to-air range 5,000m
- armoured
- night vision equipment
- Flat Box passive radar

RUSSIAN AIR DEFENCE VEHICLES

Type: SAM/AAA

SA-19 Grison

Recognition features:

- tracked - 6 road wheels plus drive sprocket and idler on each side, no side-skirts
- box-section hull, downward sloping front, flattened and slightly inward sloping rear end
- long and narrow rectangular main turret section over-hanging circular turret base at rear, frontal radome mounting, curved rectangular radar dish mounted on elevated section at turret rear top
- twin-barreled cannon and quad SAM tubes mounted on either turret side

Armament:

- 4x30mm cannons
- SA-19 Grison radio command guided surface-to-air missiles

Game notes:

- radar symbol: ▲
- ground radar priority: high
- surface-to-air ceiling 4,000m
- surface-to-air range 8,000m
- armoured
- night vision equipment
- surveillance and tracking radar

RUSSIAN TRANSPORT VEHICLES

Type: Light 4x4 vehicle

UAZ-469B

Recognition features:

- high 4-wheeled chassis,
- small compact appearance, distinctive rounded bonnet, headlights and radiator grille, backward sloping windshield, canvas roof

Game notes:

- radar symbol: ●
- ground radar priority: low

RUSSIAN TRANSPORT VEHICLES

Type: Utility vehicle (truck)

Ural-4320

Recognition features:

- high 6-wheeled truck chassis - 2 wheels in front, 4 at rear
- low wide radiator grille, smooth curved tapering bonnet and short upright cab with backward sloping windshield, vertical faced mud guards over front wheels with integral headlights
- high sided canvass covered cargo area to rear

Game notes:

- radar symbol: ●
- ground radar priority: low

Type: Fuel tanker

Ural-4320 Fuel Tanker

Recognition features:

- high 6-wheeled truck chassis - 2 wheels in front, 4 at rear
- low wide radiator grille, smooth curved tapering bonnet and short upright cab with backward sloping windshield, vertical faced mud guards over front wheels with integral headlights
- squat flat-sided curved-topped fuel tank at rear

Game notes:

- radar symbol: ●
- ground radar priority: low

RUSSIAN WARSHIPS

Type: Amphibious assault ship

Kiev Class

Recognition features:

- slender hull with sharp raked bow profile and broad square front deck, angled square stern with stepped sunken aft deck sections
- large cylindrical missile launch tubes on forward deck
- angled flight deck overhangs port hull side
- large angular multi-leveled starboard side superstructure, tall lattice mast with spherical radome aft of main radar dish, large angular funnel to rear, side-mounted radomes
- numerous smaller radar sensors, missile launchers and gun turrets
- stowed pilot boats in aft hull recesses

Armament:

- SA-N-4 Gecko radio command guided surface-to-air missiles
- 30mm cannons • 76mm gun

- SA-N-3 Goblet radio command guided surface-to-air missiles

Game notes:

- radar symbol:
- ground radar priority: high
- surface-to-air ceiling 5,000m
- surface-to-air range 10,000m
- air search radar

Type: Frigate

Krivak II Class

Recognition features:

- slender low-profile hull, raked bow with curved front deck, low flat sunken aft deck with broad curve to stern
- large box-shaped missile launcher on forward deck with angular canted blast shields to fore
- broad rectangular forward superstructure with large squat lattice mast and radar dishes atop
- low aft superstructure with squat rectangular funnel
- aft twin stepped gun turret arrangement

Armament:

- 100mm guns
- SA-N-4 Gecko radio command guided surface-to-air missiles

Game notes:

- radar symbol:
- ground radar priority: high
- surface-to-air ceiling 5,000m
- surface-to-air range 10,000m
- air search radar

RUSSIAN WARSHIPS

Type: Hovercraft

AIST

Recognition features:

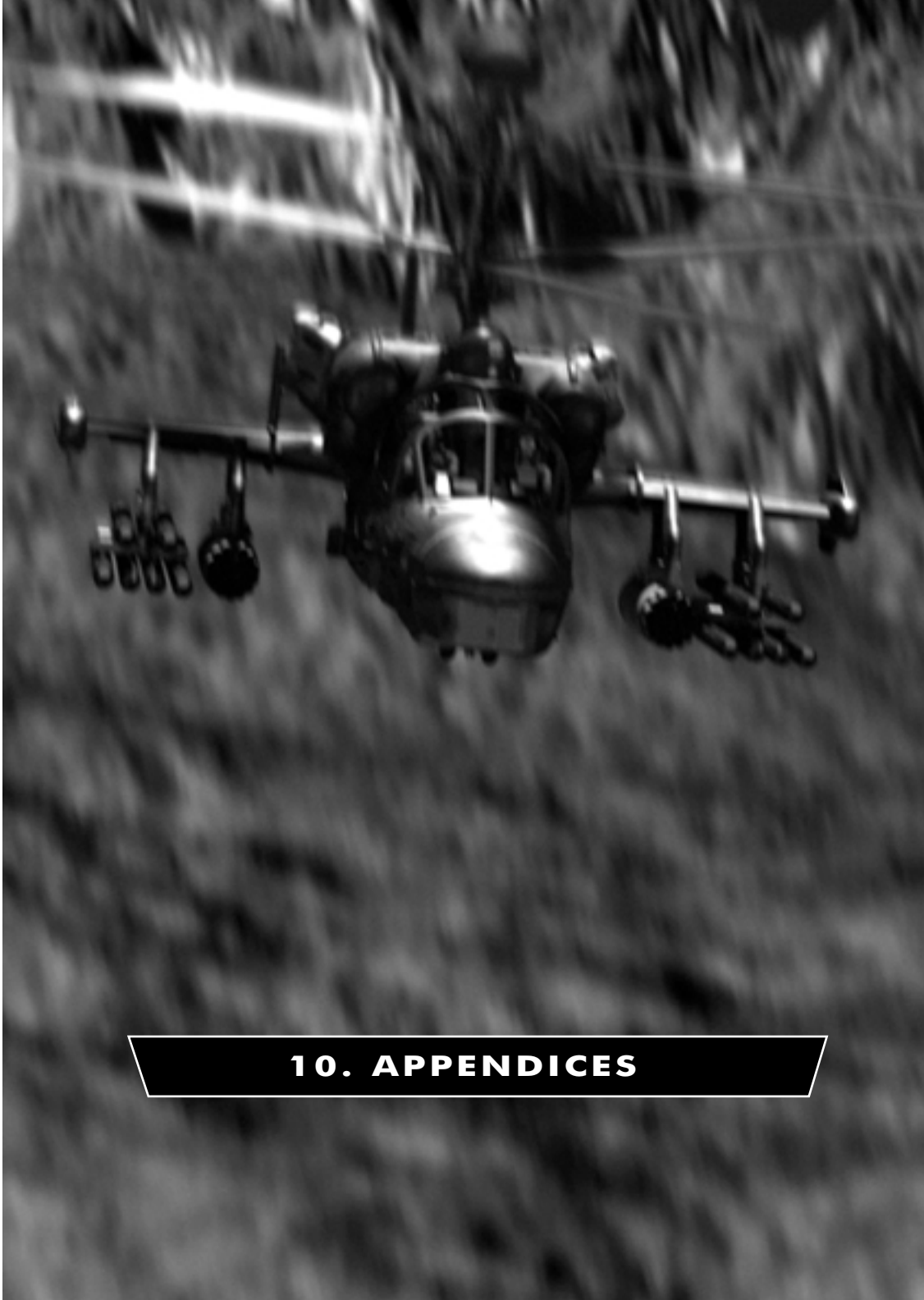
- long and wide high-sided hull with curved upper edge and rounded overhanging bow section over loading ramp below, high-sided all-round inflatable skirt with enlarged curved bulge under bow door
- twin forward-mounted gun turrets either side of bow
- low and wide forward bridge section with squat lattice mast to rear, large low square structure amidships
- aft mast-mounted twin pairs of face-to-face 4-blade propeller sets forward of tall twin tail fins/rudders

Armament:

- 30mm cannons

Game notes:

- radar symbol:
- ground radar priority: high
- surface-to-air ceiling 1,000m
- surface-to-air range 2,000m



10. APPENDICES

Trouble shooting

Updates

For latest news and information visit www.razorworks.com

Graphics Drivers

If you are experiencing problems with Comanche Hokum graphics, we have included some graphics cards drivers for you to install. These are located on your CD in the directory called 'Graphics Drivers\Drivers'.

Please note that these drivers should only be used if you have problems with your graphics card. Whilst we have taken care to ensure that the drivers are the latest versions available, they are being constantly updated by the graphics card manufacturers.

These drivers are not necessarily from the card manufacturers, but from the chipset manufacturers, so it is possible you may lose features added by your originally installed drivers.

To get the latest chipset drivers you will need to visit the following websites:-

For 3Dfx drivers:	www.3dfx.com
For 3Dlabs drivers:	www.3dlabs.com
For ATI drivers:	www.atitech.ca
For Chromatic Research drivers:	www.chromatic.com
For Matrox drivers:	www.matrox.com
For NVIDIA drivers:	www.nvidia.com
For Real3D drivers:	www.real3d.com
For Rendition drivers:	www.rendition.com
For S3 drivers:	www.s3.com

Re-Installing

If you re-install Comanche Hokum on to your PC then please ensure that the previous installation was completely removed. That is, in addition to un-installing Comanche Hokum delete the Razorworks\cohokum folder as well.

Cannot Find Comanche Hokum CD

If Comanche Hokum reports that it cannot find the CD then please ensure that you have closed any CD Player applications that may have captured the CD.

Loading ... "Comms System" Crash

On the rare occurrence that the program hangs while initialising the ‘Comms System’ then you will need to reboot your PC.

‘Sticky’ Keys

Occasionally you may experience problems with 'sticky' keys.

For example, the torque value may continue to rise or fall even though you have released the collective keys. Pressing and releasing the appropriate key will solve the problem (press Q if the torque value is continuously rising, or press A if the torque value is continuously falling).

Multiplayer Connection Problems in Windows 98

If your network card uses a Realtek 8029 chipset then you may experience an unstable connection in Windows 98 (not Windows 95). You can get updated drivers from the Realtek website (www.realtek.com.tw).

Graphics

If you are experiencing problems with Comanche Hokum graphics then please ensure that you have the latest drivers for your 3D graphics card.

Comanche Hokum terminates with "Unable to find a 3D graphics card ..."

Comanche Hokum requires that your PC has a 3D graphics card. If the program terminates with the message "Unable to find a 3D graphics card. Please ensure you have the latest drivers for your 3D card and have installed DirectX 7" then please ensure that you have a 3D graphics card with the appropriate drivers.

PowerVR

Comanche Hokum does not support some older PowerVR cards. A PowerVR card may be present if the program terminates with the message "Unable to create Zbuffer surface: DDERR_NOZBUFFERHW".

RivaTNT

3D graphics cards which use the RivaTNT chipset must have 'VSYNC' enabled otherwise flickering will occur. This may occur on other chipsets which have a switchable 'VSYNC'.

Riva128

The Riva128 chipset exhibits a graphical artefact in that the right hand and bottom edges of the 3D display have a 'dirty' edge. This can be rectified by running the program with the ‘/3dce’ command line option.

Hardware Geometry Acceleration (TnL)

If your graphics card supports geometry acceleration (transformation and lighting – ‘TnL’) then Comanche Hokum will use this by default. However, more data is required and this may cause excessive memory paging on some machines. If this occurs then disable the geometry acceleration using the ‘/notnl’ command line option.

TADS and EOS 3D display is missing from MFD page

The TADS and EOS MFD pages require your 3D card to be able to render a 3D scene to a texture. Some cards do not support this feature. In which case the 3D display will be absent from the MFD page. The 3D display will be displayed on the full screen MFD views (use F3 and F4 to see these).

Command Line Options

Comanche Hokum is customisable to some degree by the user. Some flight model, visual and most communication elements can be altered by passing command line parameters when launching the game.

Command line parameters can be entered into a DOS box or program shortcut ('Target' field).

As an alternative to using command line or shortcuts options, you can specify the commands you want with the COMANCHE_HOKUM environment variable and SET command.

For example:-

SET COMANCHE_HOKUM=/cgs:1 /cig:1 /cbar:1000

This can be included in your AUTOEXEC.BAT file.

Visual		
Switch	Meaning	Description
/mfr:n	max_frame_rate	n = max visual frame rate (defaults = 30)

Flight Dynamics		
Switch	Meaning	Description
/drbs:n	dynamics_retreating_blade_stall	n = floating point scaling factor for RBS effect (default = 1.0)
/drv:n	dynamics_rudder_value	n = scaling factor for drag on tail rotation (default = 1.0)
/dra:n	dynamics_rudder_acceleration	n = scaling factor for tail rotation acceleration (default = 0.8)
/drd:n	dynamics_main_rotor_drag	n = scaling factor for drag caused by main rotor (default = 1.0)
/dtrd:n	dynamics_tail_rotor_drag	n = scaling factor for drag caused by tail in forward flight (default = 1.0)
/dczd:n	dynamics_cyclic_dead_zone	n = percentage dead zone for the cyclic (default = 0.0)
/vfm:1	vector_flight_model	activates viewer or 'UFO' flight mode

Graphic Cards		
Switch	Meaning	Description
/3dreset	3d_reset	reset screen resolution to 640x480
/3dce	3d_clean_edge	cleans up the graphical artefact exhibited by Riva128 chipsets
/cbt	cpu_blit_textures	try specifying this option if you experience slowdowns during rain
/notnl	no_transformation_and_lighting	disable hardware geometry acceleration

Sound Cards		
Switch	Meaning	Description
/ns	no_sound	bypass sound card, useful for tracking hardware conflicts

Communications		
Switch	Meaning	Description
/ccrs:n	comms_connection_receive_size	n = Initial guess of campaign data size. If campaign data is larger then this can slow things down (default = 200k)
/cdrs:n	comms_data_record_size	similar to above…
/cpbs:n	comms_pack_buffer_size	similar to above…
/cgs:1	comms_guaranteed_send	force the comms to use DirectPlay guaranteed send instead of its own n = 1 (turn on) n = 0 (turn off – default)
/crls:n	comms_resend_list_size	n = packet history list size, increase if client keeps getting kicked out by server (default = 1000)
/crl:n	comms_rerequest_limit	n = number of times a client can re-request the same packet. Increase this for poor connections (default = 10)
/cpt:n	comms_packet_timer	n = time delay in seconds the comms will wait for a packet before re-requesting it (default = 5s)

Communications

Switch	Meaning	Description
/crt:n	comms_resend_timeout	n = time comms will wait before assuming re-requested packets was lost (default = 2s)
/mur:n	max_update_rate	n = network frame rate for a server, n/a for a client (default = 5fps for TCP/IP, 15fps for IPX)
/cig:1	comms_interpolate_gunships	program will interpolate a players helicopter position for smoother visuals n = 0 (off / default) n = 1 (on)
/cvc:1	comms_validate_connection	removes dead player husks when client crashes n = 0 (off / default) n = 1 (on)
/cto:n	comms_time_out	the amount of time to wait before removing dead player husks n = 0 (off / default) n = 1 (on)
/cist:n	comms_initial_sleep_time	sets the length of time (in milliseconds) the program will wait before sending packets (default = 500)
/cpt:n	comms packet timer	sets the length of time (in seconds) the program will wait for a packet before re-requesting it (default = 5)
/crto:n	comms_resend_timeout	sets the length of time (in seconds) the program will wait for a re-requested packet before asking for it again (default = 1)

Miscellaneous

Switch	Meaning	Description
/goto:1	planner_goto_button	activates 'GOTO' teleport button on the campaign map
/psr:n	player_start_rank	n = start rank for new pilots
/uit:n	user_invulnerable_time	invulnerable time allowed after entering the cockpit (default = 5 seconds)

Notes

Acronyms

AAA	Anti-Aircraft Artillery ('Triple A')
AFAPD	Air-Force Applications Program Development
AFTDS	Advanced Field Artillery Tactical Data System
AGM	Air to Ground Missile
AP	Armour Piercing
APC	Armoured Personnel Carrier
APU	Auxiliary Power Unit
ASE	Air Survivability Equipment
ATGM	Anti-Tank Guided Missile
BAI	Battlefield Air Interdiction
BARCAP	Barrier Combat Air Patrol
BDA	Battle Damage Assessment
CAP	Combat Air Patrol
CAS	Close Air Support
CMW	Centimetric Wave
CP/G	Co-Pilot/Gunner
DTV	Daylight TV
DVO	Direct View Optics
ECM	Electronic Countermeasures
EO	Electro Optics
EOS	Electro-Optical System
EWS	Electronic Warfare Suite
FAC	Forward Air Controller
FARP	Forward Arming And Refueling Point
FFAR	Folding Fin Aerial Rocket
FLIR	Forward Looking Infra-Red
HE	High Explosive
HEAT	High Explosive Anti-Tank
HEDP	High Explosive Dual Purpose
HF	High Frequency
HIDSS	Helmet Integrated Display and Sight System
HMS	Helmet Mounted Sight
HOCAS	Hands On Collective And Stick
HSI	Horizontal Situation Indicator
HUD	Head Up Display
IDM	Improved Data Modem
IFV	Infantry Fighting Vehicle
IOC	Initial Operating Capability
IR	Infra-Red
I-RAMS	Integrated Retractable Munitions System
LLLTV	Low Light Level TV
LO	Low Observable
LOAL	Lock On After Launch
LOBL	Lock On Before Launch
LOS	Line Of Sight
LZ	Landing Zone
MBT	Main Battle Tank
MFD	Multi-Function Display
MMW	Millimeter Wave
MPSM	Multi-Purpose Sub-Munitions
MRLS	Multiple Rocket Launch System
MTS	Marine Tactical Systems
NBC	Nuclear Biological Chemical
NOE	Nap Of the Earth
NVG	Night Vision Goggles
OCA	Offensive Counter Air
PNVS	Pilot Night Vision Sensor
POV	Point Of View
RCS	Radar Cross Section
RWR	Radar Warning Receiver
SAM	Surface to Air Missile
SEAD	Suppression of Enemy Air Defences
TACFIRE	TACtical FIRE direction system
TADS	Target Acquisition and Designation System
TOW	Tube-Launched, Optically-tracked, Wire-guided
TSD	Tactical Situation Display
TWD	Threat Warning Display
VMF	Variable Message Format
VSI	Vertical Speed Indicator

Credits

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