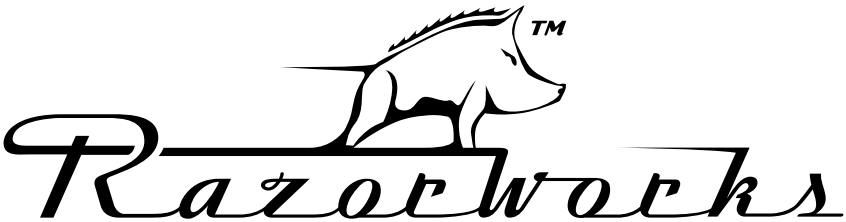
USER GUIDE



www.razorworks.com

TECHNICAL SUPPORT:

Should you require technical support in the installation or use of this product please contact:

By Post: Technical Support
Empire Interactive
580 California Street
16th Floor
San Franscisco
CA 94104

By Email: support@empire-us.com

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1. INTRODUCTION

Getting Started

Installation

Apache Havoc is a Windows ®95/98 product. Insert your *Apache Havoc* 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 *Apache Havoc* CD.

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

Please note that a Direct3D compatible graphics accelerator card is required to run *Apache Havoc*.

Starting

Apache Havoc needs the full resources of your computer so terminate all other running applications before starting.

The program requires the *Apache Havoc* CD in your drive at all times during use.

Click on the *Apache Havoc* shortcut created by the installation program. The first time that you run *Apache Havoc*, the program converts graphics files to match your graphics accelerator card. This process takes about 3 minutes but will depend on the speed of your processor. Thereafter this process is not required and loading times will be significantly shorter.

Exiting

To exit *Apache Havoc* return to the Main Menu screen and click on the left arrow.

Alternatively, press Ctrl + X at any time.

Getting in the Air – Fast!

If you want to get in the air quickly, from the Main Menu screen:-

1. Click on 'Combat Missions'
2. Click on 'Free Flight'
3. Select a scenario: 'Caspian Black Gold', 'Cuban Crisis' or 'The Opium War'
4. Click on the right arrow at the bottom of the screen
5. Select a gunship: 'Apache' or 'Havoc'

You will be transferred to a base and placed in the cockpit. You have infinite weapons and fuel and are invulnerable to crashes. The enemy will not fire at you. These options may be changed by clicking 'Setup' after selecting the scenario.

First Flight

The keyboard controls for flight are the same for both the Apache and Havoc.

Take-off sequence:-

1. Release rotor brake [R]
2. Release the wheel brake [B]
3. Increase Collective to 65%–75% [Q] (the % value is displayed on the head-up display).
4. The helicopter will rise slowly, check altitude and rate of ascent
5. Align the helicopter to the desired heading by applying the tail rotor [Z] and [X]
6. Push the cyclic forward gently [↑] to initiate forward movement
7. Adjust the collective to maintain a constant altitude [Q] and [A]
8. The tail rotor will have a reduced effect as you increase speed to around 60 knots (Apache) or 110 km/h (Havoc). To turn you must use the cyclic to bank the helicopter left or right [←] and [→]
9. Reduce forward speed by gently pulling back on the cyclic [↓] and adjusting the collective to prevent the helicopter from climbing [Q] and [A]
10. Try to come to a hover by reducing forward speed to zero. Alternatively, at speeds below 20 knots (40 km/h) engage 'hover hold' [H]. Hover hold is disengaged with any cyclic input or by pressing [H]

Landing Sequence:-

1. From the hover position adjust collective [Q] and [A] to give a slow rate of descent, approximately 60%
2. Use the cyclic to maintain position [←] [→] [↑] [↓]
3. Use the tail rotor to align the helicopter to the desired heading [Z] and [X]
4. Settle gently on the ground taking care to avoid ground objects and parked aircraft
5. Reduce collective to zero [A]
6. Apply wheel brake [B]
7. Apply rotor brake [R]

Apache Havoc

Apache Havoc is a combat flight simulator showcasing two adversary helicopters, namely; the American AH-64D Apache Longbow and the Russian Mi-28N Havoc-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.

Apache Havoc provides an accurate simulation of both helicopters including realistic flight dynamics, authentic weapons systems and detailed cockpits, displays and instruments.

There are three huge, real world combat zones, accurately modelled from digital data. The terrain is rugged and covered in dense forest canopy, making 'line of sight' tactics a real part of the game play. The forest is penetrated by roads, rivers and electricity pylons creating a landscape ideally suited to low-level helicopter combat.

Apache Havoc features in excess of 50 different vehicles all of which are highly detailed and articulated and have realistic payloads.

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. Your skill and judgement will determine success or failure.

Variable weather conditions create atmosphere. Flying combat missions in adverse weather and poor lighting conditions adds another dimension to the game.

The player may choose to fly from either an American or Russian standpoint. In multiplayer games players may choose to fly co-operatively or competitively.

Menu Screens

All selections are made with the mouse unless stated otherwise.

Yellow text indicates selected options, white text indicates available options and grey text indicates unavailable options.

Large right arrows select the next screen and large left arrows select the previous screen.

Main Menu

Select Pilot

Choose this option to select or create a different pilot.

Game Options

Choose this option to alter the game settings.

Multiplayer Setup

Choose this option to setup a multiplayer connection.

Combat Missions

Choose this option to select a game type.

Select Pilot

Pilots

Apache Havoc allows up to 16 pilots. Each pilot has their own 'Pilot Log'. If more than one

person uses the computer with *Apache Havoc* installed then it is a good idea to create a pilot for each player.

Add

To add a pilot click 'Add' and then type the pilot's name at the prompt. Press ↵ to enter the name.

Rename

To rename a pilot select the pilot's name and then click 'Rename'. Edit the pilot's name and press ↵.

Delete

To delete a pilot select the pilot's name and then click 'Delete'.

Pilot's Log

The Pilot's Log is displayed on the right side of the Pilots screen. The Pilot's Log has different statistics for each gunship. Select either 'Apache' or 'Havoc'.

'Air', 'Ground' and 'Sea' show the total number of kills that the pilot has made for each of the force types.

'Failed Tours' and 'Successful Tours' show the number campaigns completed resulting in either success or failure. If you quit a campaign or are removed from active duty these do not count as failed tours.

'KIA' shows how many times the pilot has been killed in action.

'Hours Flown' shows the total number of hours flown.

'Missions Flown' shows the number of missions completed.

'Success Rate' shows the percentage of successful missions to failed missions.

'Total Points' shows the total points that the pilot has been awarded for missions successfully completed and for the number of enemy kills.

The Pilot's Rank and Date Commissioned are shown at the bottom of the Pilot's Log.

Promotion

As your total points increase you will be promoted. Gaining promotion allows you to select more difficult missions in campaign games. Points are only awarded for Dynamic Missions and Dynamic Campaigns. However, if you have selected any of the realism cheats (see 'Game Setup Options') then you will not be awarded any points.

Points required for promotion:-

Lieutenant	0
Captain	5,000

Major	50,000
Lt Colonel	200,000
Colonel	1,000,000

Points are awarded according to your mission rating. Extra points are gained for enemy kills but points are lost for allied kills.

Game Options

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.

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

All hardware graphics devices are listed. Choose the hardware which has the best Direct3D support.

Controls

You must ensure that you have calibrated your joystick and other equipment before launching *Apache Havoc* (from the Start menu select Settings/Control Panel/Game Controllers).

Cyclic

Select Keyboard or Joystick for Cyclic Stick.

Collective

Select Keyboard or Throttle for Collective Lever.

Pedal

Select Keyboard or Rudder Pedal for Yaw Pedals.

Device

All of the game controller devices are listed. Select the required device.

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.

Realism

Co-Pilot Counter Measures

Set Co-Pilot operating counter measures on or off. When selected 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.

Co-Pilot Target ID

Sets the method in which target identifications are reported. Refer to 'CP/G Assistance: Target ID' in the 'Apache Cockpit' and 'Havoc Cockpit' sections.

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.

This difficulty level option should not be confused with the mission difficulty level on the 'Mission' screen.

Flight Dynamics

Wind

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

Retreating Blade Stall

Set retreating blade stall effect on or off (see Ground School 2.20). 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 Coupling

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.

Reverse Throttle Input

Set reverse throttle input on or off. This option allows you to reverse the throttle input if you prefer a 'jet style' throttle.

A helicopter's collective lever operates in the opposite sense to that of a jet's throttle.

Keyboard Assistance

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.

Multiplayer Setup

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 supplied.

You can join a multiplayer game 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 Setup screen in order to connect to an incoming call.

Combat Missions

There are four different game types offered in the Combat Missions screen plus a Demo mode.

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.

Main screen

Select ‘Combat Missions’.

Game Types screen

Select ‘Free Flight’.

Scenario screen

Select a scenario. New games are shown in white text while existing multiplayer games are shown in orange text.

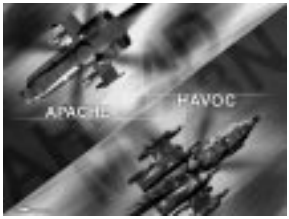
If you select a new game a 'Setup' button is displayed at the bottom of the screen. Select Setup to change the game options. If you are joining an existing multiplayer game the Setup button is not available as you cannot change the options.

The default setup for Free Flight games is a passive environment where the enemy do not fire at you (although they will track you with their radar). You have infinite fuel and weapons and you cannot crash.

Setup screen

See 'Game Setup Options'

Gunship screen



Select either gunship; 'Apache' or 'Havoc'.

If you are joining a multiplayer game the message 'Connecting' is displayed while the mission data is transmitted. The time this takes will depend on the bandwidth of the connection method.

Transferring to Base screen

Please wait while the mission data is generated.

In Cockpit

You are now in the cockpit and should follow the take-off procedure.

When you land at a base and apply the rotor brake you will automatically enter the Re-arm, Refuel and Repair screen.

Press ↵ to enter the Map screen at any time

Map screen

Press ↵ to enter the cockpit.

When you are landed at a base select 'Weapons' to enter the Re-arm, Refuel and Repair screen.

See 'Map Screen'.

Re-arm, Refuel and Repair screen

Press ↵ to return to the Map screen or cockpit.

See 'Re-arm, Refuel and Repair Screen'.

Debriefing screen

See 'Mission Debriefing'.

To quit the mission press Ctrl + Q at any time.

The Debriefing screen is displayed (unless you quit from the Map screen).

Respond to the 'Quit Mission? (Y/N)' prompt Y or N .

Dynamic Missions

Dynamic Missions allow you to fly missions as though you were in the middle of a campaign. Every mission from all allied airbases, carriers and FARPs is available to you. Access to missions is not restricted by your rank.

Main screen

Select ‘Combat Missions’.

Game Types screen

Select 'Dynamic Missions'.

Scenario screen

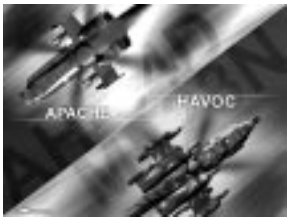
Select a scenario. New games are shown in white text while existing multiplayer games are shown in orange text.

If you select a new game a 'Setup' button is displayed at the bottom of the screen. Select Setup to change the game options. If you are joining an existing multiplayer game the Setup button is not available as you cannot change the options.

Setup screen

See 'Game Setup Options'.

Gunship screen



Select either gunship; 'Apache' or 'Havoc'.

If you are joining a multiplayer game the message 'Connecting' is displayed while the mission data is transmitted. The time this takes will depend on the bandwidth of the connection method.

Dynamic Missions screen

The mission types available are listed under the flashing 'Receiving Orders ...' message. See 'Mission Types' for a description of each.

Select a mission type and all of the available missions of that type are displayed in the 'Tasks' list. The task list shows the mission reference and status (reference:status). The reference is used in the mission briefing. The status shows whether the mission is in progress or not. Tasks which other players are flying are marked 'Multiplayer'.

The mission briefing is displayed in the bottom left corner. See 'Mission Briefing' for a description of the text.

Select 'Map' to view the Map screen.

To start the mission select 'Commit'. If the mission is in progress you will be placed in the cockpit otherwise you will be taken to the Map screen.

Map screen

Press ↵ to enter the cockpit.
When you are landed at a base select 'Weapons' to enter the Re-arm, Refuel and Repair screen.
See 'Map Screen'.

In Cockpit

When you land at your designated base and apply the rotor brake you will will automatically enter the Debriefing screen.
Press ↵ to enter the Map screen at any time.

Debriefing screen

The Debriefing screen is displayed when you land at your designated base (see 'Map Screen') and engage the rotor brake. Press Spacebar to return to the Dynamic Missions screen and select your next mission.

If you land at a base which is not your designated base and engage the rotor brake then you will be taken to the Re-arm, Refuel and Repair screen. It is assumed that you have made an unscheduled stop to load weapons and fuel and to repair damage.

To quit the mission press Ctrl + Q at any time.

The Debriefing screen is displayed (unless you quit from the Map screen).

Respond to the 'Quit Mission? (Y/N)' prompt Y or N .

Re-arm, Refuel and Repair screen

Press ↵ to return to the Map screen or cockpit.

See 'Re-arm, Refuel and Repair Screen'.

Dynamic Campaign

The Dynamic Campaign is the heart of *Apache Havoc*. There are no scripted events or outcomes. Campaigns tend to start off slowly while the forces get mobile and then the conflict escalates.

When you enter a campaign you will be transferred to a base and can join one of the 'Flight Groups' attached to the base, whether they are landed or actually flying a mission. Each base receives mission orders.

To complete a campaign you must take-over the 'objective sectors' (outlined in black on the Map screen). An objective sector is considered to be taken when there are no enemy forces within the sector and allied forces have occupied the sector (you can accomplish this by flying through the sector). Also, you must exceed the 'Balance of Power' criteria shown on the Status screen.

Your progress within a campaign is monitored and if you persistently fail missions or continually fire upon friendly forces you will be relieved from active duty.

Campaigns have a 'Tour of Duty' time which adds a time limit challenge. The Tour of Duty time is the amount of time that you have remaining in the campaign. Successfully completing missions will increase your time as will killing enemy targets. Failing missions or causing friendly fire incidents will reduce your time. If your time reaches zero you will be relieved from active duty.

Getting 'killed' during a mission does not necessarily end the campaign although it will reduce your Tour of Duty time.

The Tour of Duty time only applies to single player games and is optional (see 'Game Setup Options').

Main Screen

Select ‘Combat Missions’.

Game Types screen

Select 'Dynamic Campaign'.

Scenario screen

Select a scenario. New games are shown in white text while existing multiplayer games are shown in orange text. Saved games are shown in green text. You can delete a saved game by selecting it and then clicking the 'Delete Game' button that appears.

If you select a new game a 'Setup' button is displayed at the bottom of the screen. Select Setup to change the game options. If you are joining an existing multiplayer game or loading a saved game the Setup button is not available as you cannot change the options.

Setup screen

See 'Game Setup Options'.

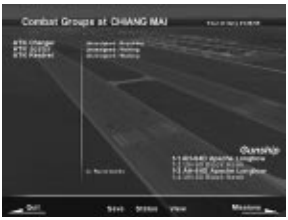
Gunship screen

Select either gunship; Apache or Havoc.

If you are loading a saved game it is possible to switch sides.

If you are joining a multiplayer game the message 'Connecting' is displayed while the mission data is transmitted. The time this takes will depend on the bandwidth of the connection method.

Combat Groups screen



See 'Game Setup Options'.

After entering a campaign you will be transferred to either an airbase or aircraft carrier. The base name appears at the top of the screen as does the remaining Tour of Duty time. You should be aware that time is ticking away.

All of the Flight Groups stationed at the base which contain attack helicopters are listed on the left hand side of the screen. Their current status and kills and losses are indicated. Groups that contain other players are marked 'Multiplayer'.

After selecting a Flight Group its members are listed at the bottom right of the screen. You are automatically assigned an attack helicopter, indicated by your pilot's name being placed along side the selection. You are free to choose any helicopter that is listed in white text. Helicopters listed in grey text are not available.

The 'Save' button allows you to save the campaign. In multiplayer games only the host can do this. Saved games are listed on the Scenario screen.

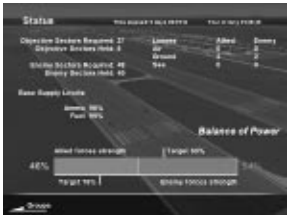
You can watch any helicopter by selecting it and then selecting 'View'. You may view helicopters listed in grey text as well as white. Press ↵ to return to the Combat Groups screen.

Selecting 'Status' displays the Status screen. The Status screen is only available from the Combat Groups screen.

If the Flight Group is currently flying a mission then you will advance to the cockpit, otherwise you will advance to the Missions screen.

When Flight Groups are reduced in size due to losses they may be combined with other Flight Groups. This occurs after they land at bases and you may notice that the Flight Group disappears.

Status screen



The Status screen shows the current state of the campaign and the supply levels at the base.

The campaign information includes the elapsed time, the remaining Tour of Duty time, the objective sectors held and required and the total kills and losses.

The base supply levels show remaining ammunition and fuel levels. You cannot re-arm or refuel at a base where the respective levels have reached 0%.

The large bar indicates the campaign 'Balance of Power'. The target levels required for victory are indicated for both sides.

Mission screen

The mission types available are listed under the flashing 'Receiving Orders ...' message. See 'Mission Types' for a description of each. After starting a campaign you may have to fly Scout or CAP missions while the conflict escalates. Bases nearer the frontline tend to be more active.

Select a mission type and all of the missions of that type are displayed in the 'Tasks' list. The task list shows the mission reference, difficulty level and status (reference (level):status). The reference is used in the mission briefing. The status shows whether the mission is in progress or not. If the difficulty level is too high for your rank then the mission is not available and is listed in grey text.

The maximum difficulty level available to each rank is as follows:-

Lieutenant	6
Captain	7
Major	8
Lt Colonel	9
Colonel	10

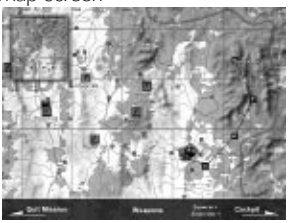
If you prefer you may create a mission. This may be necessary if there are no other missions available (due to the nature of a dynamic campaign).

The mission briefing is displayed in the bottom left corner. See 'Mission Briefing' for a description of the text.

Select 'Map' to view the Map screen.

To start the mission select 'Commit'. If the mission is in progress you will be placed in the cockpit otherwise you will be taken to the Map screen.

Map screen



Press ↵ to enter the cockpit.

When you are landed at a base select 'Weapons' to enter the Re-arm, Refuel and Repair screen. See 'Map Screen'.

In Cockpit

When you land at your designated base and apply the rotor brake you will automatically enter the Debriefing screen.

Press ↵ to enter the Map screen at any time.

Debriefing screen

The Debriefing screen is displayed when you land at your designated base (see 'Map Screen') and engage the rotor brake. Press Spacebar to return to the Combat Groups screen and select your next mission.

If you land at a base which is not your designated base and engage the rotor brake you will be taken to the Re-arm, Refuel and Repair screen. It is assumed that you have made an unscheduled stop to load weapons and fuel and to repair damage.

To quit the mission press Ctrl + Q at any time.

The Debriefing screen is displayed (unless you quit from the Map screen).

Respond to the 'Quit Mission? (Y/N)' prompt Y or N .

Re-arm, Refuel an Repair screen

Press ↵ return to the Map screen or cockpit.

See 'Re-arm, Refuel and Repair' screen.

Special

Special games are intended for multiplayer 'Deathmatch' style missions. Refer to 'Game Setup Options' for all of the available options.

Main Screen

Select ‘Combat Missions’.

Game Types screen

Select 'Special'.

Scenario screen

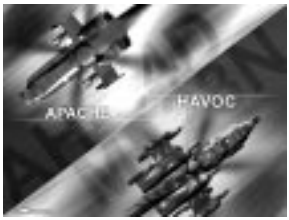
Select a scenario. New games are shown in white text while existing multiplayer games are shown in orange text.

If you select a new game a 'Setup' button is displayed at the bottom of the screen. Select Setup to change the game options. If you are joining an existing multiplayer game the Setup button is not available as you cannot change the options.

Setup screen

See 'Game Setup Options'.

Gunship screen



Select either gunship; 'Apache' or 'Havoc'.

If you are joining a multiplayer game the message 'Connecting' is displayed while the mission data is transmitted. The time this takes will depend on the bandwidth of the connection method.

In Cockpit

You are now in the cockpit and should follow the take-off procedure.
Press ↵ to enter the Map screen at any time.

Map screen

Press ↵ to enter the cockpit.
When you are landed at a base select 'Weapons' to enter the Re-arm, Refuel and Repair screen.
See 'Map Screen'.

Re-arm, Refuel and Repair screen

Re-arm, Refuel and Repair screen.

Press ↵ to return to the Map screen or cockpit.

See 'Re-arm, Refuel and Repair Screen'.

Debriefing screen

In Special games the Debriefing screen is a high score table where the player with the highest number of kills is listed first. Apache pilots are listed in blue and Havoc pilots are listed in red. The Debriefing screen is displayed after you have been killed or when you quit.

To quit the mission press Ctrl + Q at any time.

The Debriefing screen is displayed (unless you quit from the Map screen).

Respond to the 'Quit Mission? (Y/N)' prompt Y or N .

Demo

Demo mode allows you to watch a Dynamic Campaign in action.

Press Ctrl + Q or Esc to quit the demo.

Game Setup Options

After selecting a scenario in any of the game types, a 'Setup' button is displayed at the bottom of the screen. Click on this button for the available options.

The available options depend on the game type.

The full list of options are as follows:-

Time Of Day (start time of mission or campaign)

- Random
- Dawn
- Midday
- Afternoon
- Dusk
- Midnight

Weather

- Variable (variable weather conditions)
- Good (continuous good weather)
- Light rain (continuous light rain)
- Heavy rain (continuous heavy rain)

Realism

- Infinite weapons
- Infinite fuel
- Invulnerable (players cannot be killed)
- Suppress AI fire (AI entities do not fire but will track you)

Tour of Duty (campaign 'Tour of Duty' timer)

- On
- Off

These options are for Special games only:-

Game Type

- Deathmatch (every man for himself)
- Co-operative (Apaches verses Havocs, allied kills lose points)

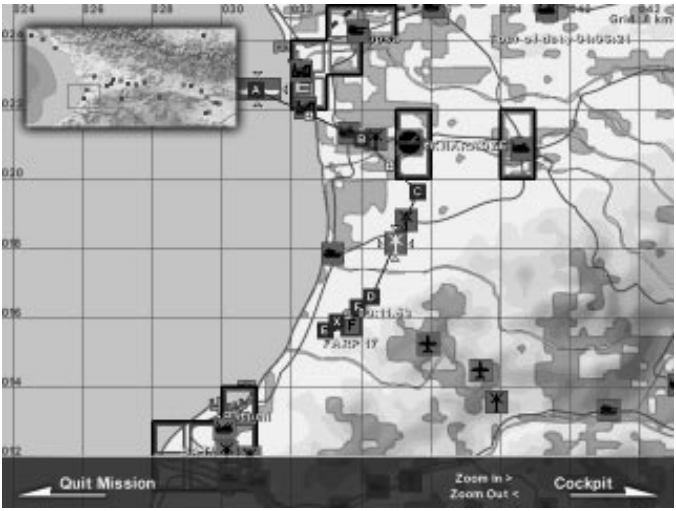
Time Limit

- minutes (enter time limit where 0 is no time limit)

Kill Limit

- kill limit (enter kill limit where 0 is no kill limit)

In multiplayer games the Setup options are defined by the host (server) and cannot be altered by the clients.



Map Screen

The Map screen shows the current situation of the campaign. Red and blue icons show the forces, bases and key sites.

Objective sectors are outlined in black and have an inner coloured line indicating which side the sector belongs to.

The grid shows the map sectors. In mission briefings, sectors are referenced as xxx:yyy where the 'xxx' value refers to the grid reference along the top edge of the map and 'yyy' refers to the grid reference along the left edge of the map. The grid scale is shown in the top right corner of the screen.

Click the mouse pointer anywhere on the map to centralise the map around that point. You can also drag the position of red box in the 'inset' map using the mouse.

Your designated base icon flashes and is highlighted by a yellow marker. You cannot see your helicopter icon until you are airborne. Your helicopter icon is coloured yellow and has the same marker as the base.

The disposition of all of your own forces are shown accurately and are updated every 10 seconds. Enemy forces are shown only when they have been spotted by your air or ground forces.

It is possible to make an unscheduled stop at an allied airbase, carrier or FARP in order to re-arm, refuel and repair. You cannot be assigned missions from that base. You can only be assigned missions from your designated base. A base with insufficient supplies will appear as a grey icon.

Icons


Helicopter unit. The player's helicopter is coloured yellow and has a marker. Other multiplayer helicopters have reversed colours (an Apache has a blue helicopter on a black background, a Havoc has a red helicopter on a black background).


The player's helicopter with marker.


Close air support aircraft.


Interceptors (fast movers).


Primary frontline forces.


Secondary frontline forces.


Artillery.


Transport vehicles.


Air defence units.


Sea forces.


Carrier where the player's helicopter is landed. Carriers which have a yellow border have missions available. Carriers which are coloured grey have been destroyed.


Airbase.


Airbase where the player's helicopter is landed. Airbases which have a yellow border have missions available. Airbases which are coloured grey have been neutralised.


Forward Arming and Refuelling Point (FARP).


FARP where the player's helicopter is landed. FARPs which have a yellow border have missions available. FARPs which are coloured grey have been neutralised.


Key site such as an oil refinery or factory.

Waypoint Route

The waypoint route is shown as a blue line with small squares at each waypoint. If these squares are lettered then you may edit the route.

Waypoints may be moved, inserted and deleted.

To move a waypoint, click on the waypoint symbol and drag it to the new location. The first waypoint ('A') may not be moved. The last waypoint in a 'return' task cannot be moved.

To insert a waypoint click on the '+' symbol between the waypoint symbols. There are a maximum of 20 waypoints per route.

To delete a waypoint select it by left clicking on the waypoint symbol (the selected waypoint has a yellow surround) and then right click on the waypoint symbol to delete it. The first and last waypoints cannot be deleted.

Return routes are generated when the mission is complete. You may not necessarily return to the base that you started from. If the base is very busy you may enter a holding pattern.

Keyboard Shortcuts

During flight you can toggle between the cockpit and the Map screen by pressing ↵ .

To pan the map use ← → ↑ ↓ .

Shift + ← → ↑ ↓ key will move the map in larger steps.

Alt + ← → ↑ ↓ will move the map in smaller steps.

< zooms the map out and > zooms the map in.

Press ⇥ to move the inset map around the screen.

Re-arm, Refuel And Repair

Both gunships have configurable weapon loads and you should select the weapons most suited to the current mission. A full description of each weapon is given in the 'Apache Cockpit' and 'Havoc Cockpit' sections.

You must land within close proximity of a base, FARP or carrier in order to re-arm, refuel or repair.

Press F1 to enter the cockpit.

Press F2 to load a preset air-to-air weapon configuration.

Press F3 to load a preset air-to-ground weapon configuration.

Press ↵ to return to the cockpit or Map screen.

To choose your own weapons configuration use ← and → keys to select a hardpoint and then use ↑ and ↓ keys to select a weapon for that hardpoint.

Details of the currently selected weapon are displayed in the bottom left corner and the base supply levels are shown in the bottom right corner.

Refuelling is automatic once landed unless a fuel leak needs to be repaired. The fuel load is shown on the right side of the screen.

Repairs to a damaged helicopter are automatic but will take some time. Check the progress indicator on the left side of the screen.

Mission Types

The following mission types are available to the player.

Note that 'key sites' are any tactical or strategic sites such as airbases, FARPs, aircraft carriers, ports, oil refineries, factories, etc.

Key sites are neutralised when 70% of the buildings that make up the site are destroyed. Obviously in the case of carriers there are no buildings but just the carrier itself. When this has been accomplished the base icon will turn grey on the map. Eventually the icon will disappear.

Battlefield Air Interdiction (BAI), Close Air Support (CAS) and Tank Busting

These missions are created when advancing ground forces encounter strong opposition and require assistance or when a player requests an airstrike using the radio message.

The goal is to reduce the enemy ground forces in the given sector.

The player must inform the flight group to return to base using the radio message in order to complete the mission.

Combat Air Patrol (CAP)

CAP missions are created periodically around key sites or as a reaction to intelligence reports of planned enemy airstrikes.

The goal is to patrol allied airspace around the key site and neutralise any enemy air threats.

The mission is complete when the entire waypoint route has been flown.

Deep Strike

Deep Strike missions are periodically launched against known enemy key sites or when a player requests an airstrike using the radio message.

The goal is to reduce the key site to an inoperable state by destroying at least 70% of the structure(s).

The player must inform the flight group to return to base using the radio message in order to complete the mission.

FARP Recon

A FARP Recon mission is created when an enemy airbase or FARP is weakened to such an extent that an allied air force can visit the site and establish a base there and so advance the battle towards the enemy.

The mission is complete when the entire waypoint route has been flown.

Intercept

An Intercept mission is created when an enemy air force is detected in allied airspace.

The goal is to intercept the air force and destroy it.

Recon

Reconnaissance missions are created as a response to aggressive actions made by the enemy. Recon missions are also created to explore unknown areas of the map, improving intelligence data.

The first pilot to reach the reconnaissance waypoint (within 500 metres) is required to transmit the 'recon data' back to the local base. This is handled via a radio message. Computer controlled wingmen will do this automatically if they reach the waypoint first. The player(s) will get a radio message to confirm that contact has been made. **The recon data must be transmitted for a successful mission.**

Scout

Scout missions are created as a response to enemy aggression and periodically to scout out sectors that are known to have high levels of enemy activity.

The mission is complete when the entire waypoint route has been flown.

Suppression of Enemy Air Defences (SEAD)

SEAD missions are created against known enemy air defences or when a player requests an airstrike.

The goal is to reduce the enemy air defences in the given area.

The player must inform the flight group to return to base using the radio message in order to complete the mission.

Transfer

Transfer missions are created to manage air force resources.

The mission is complete when the entire waypoint route has been flown.

Mission Briefing

The mission briefing appears in the bottom left corner of the Missions screen.

Example mission briefing:-

Due to an enemy Recon (REC449) at sector 029:018

(ITC820) Intercept enemy forces last sighted at sector 029:018

Intercept from BODRY

Objective: Attack Helicopters

Difficulty Level: 3/10. (Estimated threats:0, Enemy sectors:0)

Estimated Flight time: 15 mins

The first line of the briefing explains what caused the mission to be created. In this example some enemy helicopters were spotted on reconnaissance in sector 029:018 (where the sector location is given as xxx:yyy). The cause of the mission is not always given.

The second line is the mission instructions. In this case intercept the enemy forces last sighted at sector 029:018.

The third line shows the mission type and origination point.

The fourth line indicates the target or target area.

The fifth line shows the mission difficulty based on the number of known enemy threats and sectors.

The sixth line shows the estimated flight time for the out-going route.

Return routes are generated once the mission has been completed.

Briefings for 'Create Mission' are different in that they give a general outline for the mission that you should create.

Mission Debriefing

The Debriefing screen details your performance.

'Mission' shows the mission type.

'Mission Rating' indicates the success or failure of your mission. Refer to 'Mission Types'.

'Difficulty level' shows the mission difficulty level as defined in the briefing.

'Flight time' shows the total time for the mission.

'Targets Destroyed' is the number of enemy targets that you destroyed.

'Friendly Fire' is the number of allied targets that you destroyed.

'Mission Losses' is the number of helicopters lost from your Flight Group during the mission.

'Points Awarded' is the number of points awarded to you for this mission.

'Time Bonus' is the amount of time added to your 'Tour of Duty' time.

The 'Tour of Duty' time shows the new time including the Time Bonus.

Your Rank and Total Points are shown in the bottom right corner of the screen.

Radio Communications

Sending Messages

The radio communications menus are activated by hitting the [→|] key. The menus are displayed in the top left corner of the screen. Use the numeric keys to make selections. [Esc] will exit the menus.

First you must select the destination for the message and then you must select the message. The type of messages displayed depend on the chosen destination.

Receiving Messages

Received messages are displayed in the top left corner of the screen. The message will be cleared after a short period. To repeat the message hit [Ctrl] + [→|] .

Destinations

FLIGHT GROUP - send a message to all pilots in your flight group.

WINGMEN - send a message to individual members of your flight group.

LOCAL BASE - send a message to the nearest base.

OTHER PLAYERS - send a message to other human players.

Flight Group / Wingman Messages

ATTACK MY TARGET - instructs the selected wingmen to attack your current target. This

instruction will only be carried out if it is an enemy target and the wingmen are capable of attacking it. This order cancels 'weapons hold'.

If this instruction is sent to a human player, he will receive a text message giving details of the target type, range and heading from him.

HELP ME - instructs the selected wingmen to assist you by attacking your current air and ground threats (anything which is targeting you). This order cancels 'weapons hold'.

RETURN TO BASE - instructs the flight group to abort the current mission and return to base. This message is also required to manually terminate some missions. See 'Mission Types'.

WEAPONS HOLD - instructs the selected wingmen to hold firing weapons. This order is implicitly cancelled by other orders such as 'help me' and also if the wingman is fired upon.

WEAPONS FREE - instructs the selected wingmen to cancel the 'weapons hold' state.

REQUEST TARGET LIST - instructs the wingman to transmit his 'target list' to you. This is only applicable to other players. The target list comprises the targets detected by the gunship's target acquisition systems. Refer to the 'Apache Cockpit' and 'Havoc Cockpit' sections.

KEYBOARD MESSAGE - type your own message to send to other players. Press [↵] to send the message.

Local Base Messages

REQUEST AIRSTRIKE - instructs the local base to create a strike task on your current target. The type of task will depend on your target but may be 'Deep Strike', 'SEAD' or 'Close Air Support'. These tasks will only be performed if suitable aircraft are available.

REQUEST ASSISTANCE - instructs the base to request that any local groups come to your assistance.

TRANSMIT RECON - this is only available when your current waypoint requires 'recon data' to be transmitted to the local base. You must be within 500 metres of the waypoint for the recon data to be useful.

High Resolution Support

The first time that you play Apache Havoc the 'in-flight' 3D visual resolution is set to 640x480 and the cockpit graphics are drawn. If you prefer to fly without the cockpit graphics then press [Ctrl] + [F1] .

When the cockpit graphics are not drawn the IHADSS display is still visible in the Apache and the HUD and HMS displays are still visible in the Havoc. In addition, vital displays are overlaid on the screen. The Apache multi-function displays (MFDs) appear in the bottom

left and right corners. The Havoc TV display appears in the bottom left corner (when in use) and the Threat Warning Display appears in the bottom right corner. If you prefer that these displays are not drawn then press Ctrl + F2 .

If your 3D card can support display resolutions higher than 640x480 you can increase the resolution by pressing Ctrl + F4 . The new display resolution appears momentarily in the top centre of the screen (width x height).

Press Ctrl + F4 to increase the resolution further.

Apache Havoc will allow you to increase the display resolution to the highest resolution supported by your 3D card. However, the highest resolution may be limited as *Apache Havoc* requires a certain amount of memory for textures.

To decrease the display resolution press Ctrl + F3 .

If increasing the screen resolution leaves you looking at a blank screen it is likely that the display resolution has exceeded the refresh rate of your monitor. Press Ctrl + F3 to reduce the resolution.

If the program crashes whilst attempting to switch to an unsupported display resolution, re-run the program using the /3dreset command line option. Referto 'Trouble Shooting'.

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

Please note that changing displays may take a few seconds and may cause the display to glitch.

Apache Havoc only supports a 'full screen' cockpit at 640x480 resolution. As you increase the display resolution the cockpit appears as an inset in the centre of the screen. You may prefer to turn off the cockpit graphics at higher resolutions and use the overlaid displays. The inset cockpits are useful to see other cockpit instruments (especially if your IHADSS or HUD displays are damaged).

You can restore the default display resolution with cockpit graphics enabled by pressing Shift + F1 .

Some 3D cards are able to switch to higher resolutions but may exhibit some texture mapping problems. In this case you are advised to return to the 640x480 resolution.

The menu screens are always displayed at 640x480 resolution.

Cockpit view and display resolution switching keys:-

F1	Forward view
Ctrl + F1	Toggle cockpit graphics
Shift + F1	Default cockpit configuration (640x480 resolution)

F2	Instrument view
Ctrl + F2	Toggle overlaid cockpit displays
F3	Left MFD (Apache), TV (Havoc)
Ctrl + F3	Decrease display resolution
F4	Right MFD (Apache), large HUD (Havoc)
Ctrl + F4	Increase display resolution

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.

Select Object To View:-

F5	Select player's gunship
Shift + F5	Select player's target
Alt + F5	Toggle IHADSS or HUD display on 'Chase' camera
F6	Select next force (air/ground/sea)
Shift + F6	Select previous force
Ctrl + F6	Toggle side
F7	Select next object in force
Shift + F7	Select previous object in force
Ctrl + F7	Select nearest object to player in force
Alt + F6	Toggle object text

Select Camera:-

F9	Chase camera
Alt + ← → ↑ ↓	Pan View
Alt + <	Zoom out
Alt + >	Zoom in
Shift + F9	Reset camera position behind object
Alt + F9	Toggle lock/unlock camera to object

F10	Fly-by camera
Shift + F10	Drop camera
F11	Auto-action camera (seeks out action and uses a mix of cameras)
Shift + F11	Cinematic camera (cinematic camera moves)

Additional 'In-flight' Documentation

Hover-hold

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

Hover-hold disengages with any cyclic input. Yaw and collective do not disengage it.

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.

Auto-pilot

Engaging auto-pilot will fly the helicopter around the waypoint route and eventually land back at base.

Auto-pilot cannot be used if the helicopter control systems are damaged or the helicopter is out of fuel.

The auto-pilot cannot be engaged when the helicopter's radar altitude (height above ground) is below 25 metres.

Auto-pilot is automatically engaged when the player selects a helicopter which is already in-flight.

Bob-up Overlay

The bob-up overlay appears on the IHADSS and HUD displays. It 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 symbology is the same for both the Apache and the Havoc.

The IHADSS and HUD displays represent a 200 m x 200 m 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 on the Apache and up to 20 Km/h on the Havoc.

The bob-up command heading appears on the heading strip as an up arrow 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

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 target 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).

Navigation Lights

Navigation lights are switched on and off using the [V] key. At night time these lights are useful for flying in close formation but may increase your visibility to the enemy.

Joystick Configurations

Programmable joystick configuration files are located in the 'Joystick' folder on the Apache Havoc CD. They are grouped by manufacturer.

Trouble Shooting

Re-Installing

If you re-install *Apache Havoc* on to your PC then please ensure that the previous installation has been completely removed. That is, in addition to un-installing *Apache Havoc* delete the Razorworks\aphavoc folder as well.

Cannot Find The Apache Havoc CD

If *Apache Havoc* reports that it cannot find the CD then please ensure that you have closed any CD Player applications that may have captured the 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 key. Pressing and releasing the appropriate key will solve the problem (press if the torque value is continuously rising, or press A if the torque is continuously fall).

Multiplayer Connection Problems With Windows 98

If your network card uses a Realtek 8029 chipset then you n experience an unstable connection in Windows® 98 (not Windows® 95). You can get pdated drivers from the Realtek website (www.realtek.com.tw).

3D Graphics Cards

If you are experiencing problems with *Apache Havoc* graphics we have included some graphics cards drivers for you to try installing. These are located your CD in the directory called 'DRIVERS'.

Please note that these drivers should only be used if you have p blems with your graphics card. Whilst we have taken care to ensure that the drivers are the l st versions available, they are being constantly updated by the graphics card manufacturers

These drivers are not from the card manufacturers, but from the pset manufacturers, so it is possible you may lose features added by your originally installe drivers.

To get the latest chipset drivers you will need to visit the followin 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

Apache Havoc terminates with "Unable to find a 3D graphics card ..."

Apache Havoc 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 6" then please ensure that you have a 3D graphics card with the appropriate drivers.

Apache Havoc terminates with "Unable to allocate any hardware slot ..."

The 3D graphics cards has run out of video memory. This may be because:-

1. The 3D graphics card has less than 4Mb of video memory. *Apache Havoc* requires the 3D graphics card to have a minimum of 4Mb of video memory.

2. It is possible that a previous application has not freed-up video memory and therefore that memory is not available to *Apache Havoc*. Rebooting the PC will clear the video memory.

PowerVR

Apache Havoc does not support some 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 byrunning the program with the /3dce command line option.

Command Line Options

/3dce"3D	clean edge" Cleans up the graphical artefact exhibited by Riva128 chipsets (see 'Riva128' above).
/3dreset	"3D reset" Sets the default screen resolution to 640x480. This may be required if the game crashed whilst attempting to use an unsupported display resolution.
/cbar:[value]"	city block approximation range" Sets the distance (in metres) at which city buildings approximate. The default value is 500 metres (/cbar:500). On faster PCs you can increase this value to reduce the 'pop-up' effect.
/cg	"clean graphics" Re-installs the graphics files from the CD.

/dcdz:[value] "dynamics cyclic dead zone"
Sets the joystick dead zone as a percentage. The default value is 0 (/dcdz:0).

/ns "no sound"Disables sound if the program has problems with your sound card.

If you are experiencing poor connection reliability in multiplayer games the following options may help:-

/cdrs:[value] "comms data record size"
Sets the initial estimate for the maximum size of the campaign data (in bytes). If the value is too low the program will be slower connecting, too large will waste memory. The default value is 200000 (/cdrs:200000).

/cist:[value] "comms initial sleep time"
Sets the length of time (in milliseconds) the program will wait before sending packets. This is to allow DirectPlay to establish a stable connection and may vary with proprietary service providers. The default value is 500 (/cist:500).

/cpt:[value] "comms packet timer"
Sets the length of time (in seconds) the program will wait for a packet before re-requesting it. The default value is 5 seconds (/cpt:5).

/crls:[value] "comms re-send list size"
Sets the number of packets kept in the history buffer. This is required for re-sending lost or corrupt packets. The default value is 1000 (/crls:1000). Increasing this value may improve reliability but requires more memory.

/crl:[value] "comms re-request limit"
Sets the number of times a missing packet will be re-requested. The default value is 10 (/crl:10).

/crto:[value] "comms re-send timeout"
Sets the length of time (in seconds) the program will wait for a re-requested packet before asking for it again. The default value is 1 second (/crto:1). This value may vary with service providers.

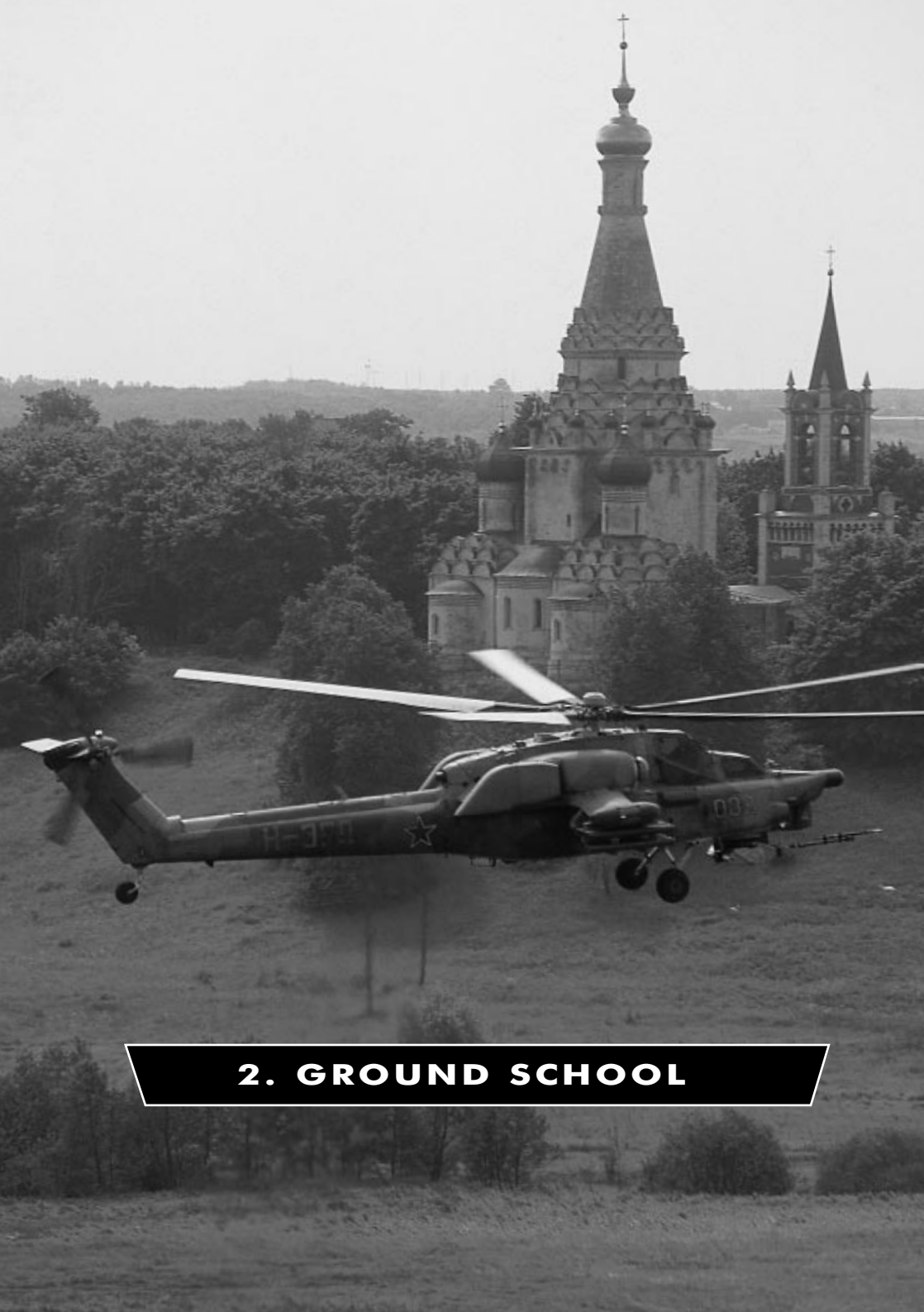
/mur:[value] "maximum update rate"
Sets the maximum update rate (in iterations per second) for the communication system. This is independent to the visual frame rate but will never exceed it. This may be used to limit the amount of packets sent and help avoid 'swamping' a connection. The default values vary according to the connection method:-

IPX : 15 (/mur:15)
Serial : 15 (/mur:15)
Modem : 5 (/mur:5)
TCP/IP : 5 (/mur:5)

Contacts

Razorworks

For the latest news and information visit www.razorworks.com



2. 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

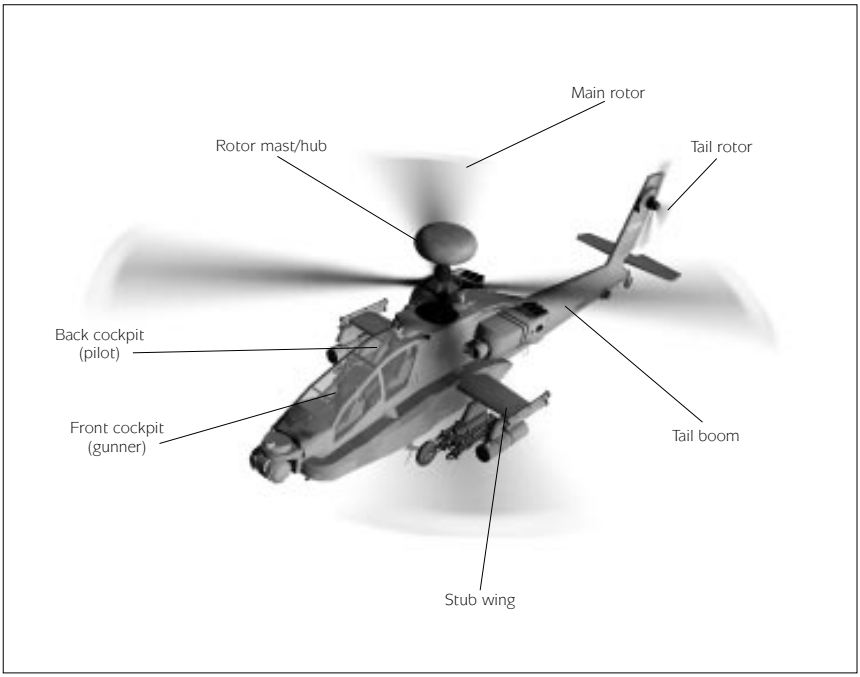


Diagram 2.1: *Conventional attack helicopter layout*

The Apache and the Havoc are both entirely conventional helicopters in their general layout; they have 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 2.20 – 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.

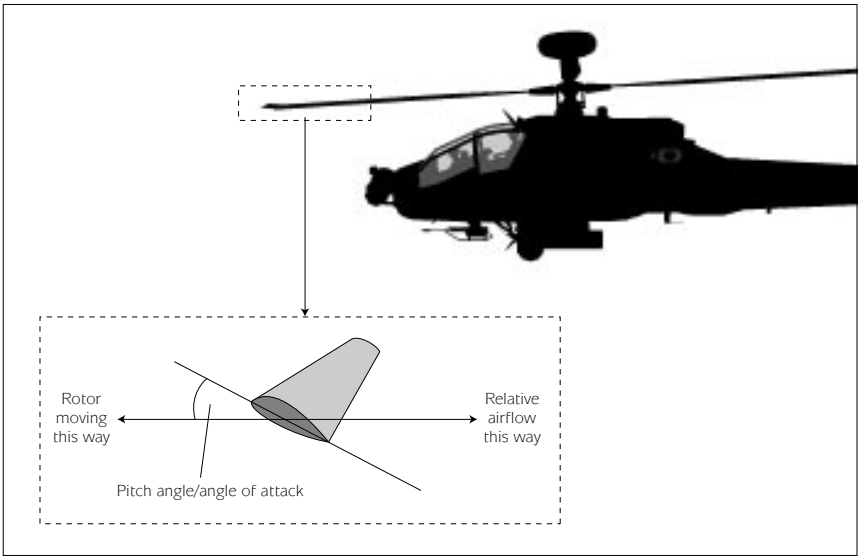


Diagram 2.2: *Rotor pitch angle/angle of attack in still air*

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 2.2]. 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 2.3].

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 2.4]. 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 2.5].

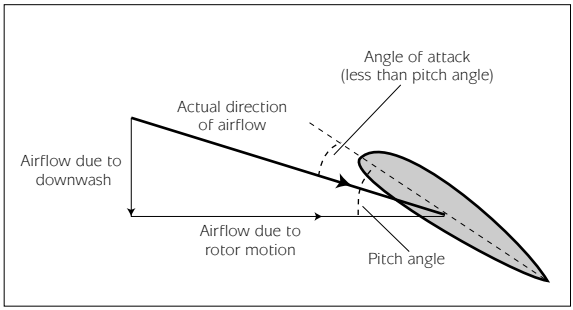


Diagram 2.3: *Pitch angle/angle of attack with rotor downwash*

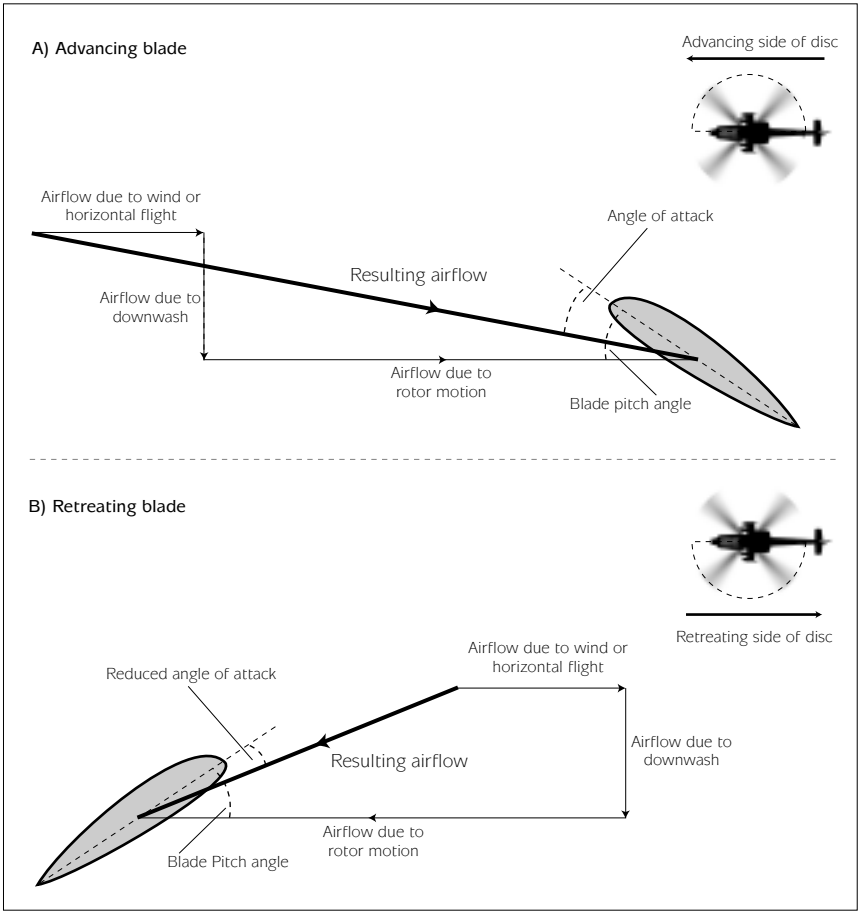


Diagram 2.4: *Pitch angle/angle of attack with airflow across rotor disc*

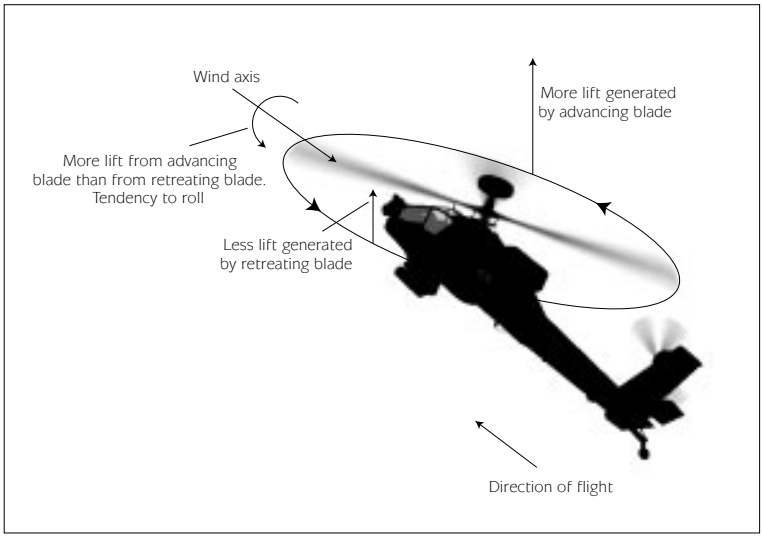


Diagram 2.5: *Rolling moment with airflow across rotor disc*

Flying Controls of a Helicopter

Three controls are used to fly a helicopter; the collective lever, the cyclic stick, and the yaw pedals [diagram 2.6]. 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

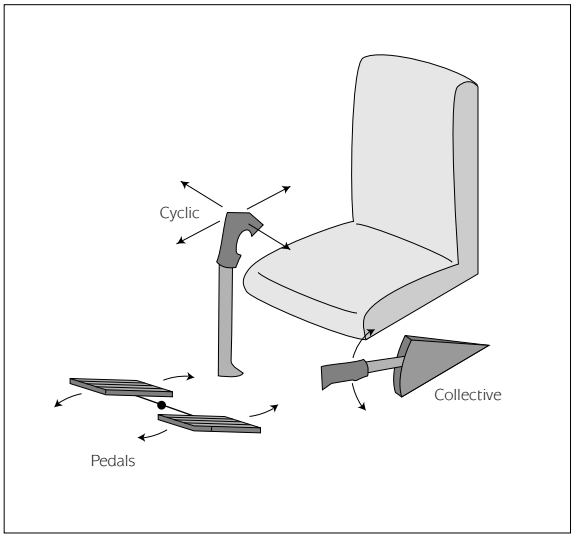


Diagram 2.6: *Main flying controls*

engine must develop more or less power, the main rotor torque effect becomes larger or smaller and the whole helicopter tends to start rotating one way or the other. The yaw pedals [see page 2.7 – 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.

One awkward complication arises when it comes to deciding which pedal to use. From the swivel-chair example, you know that the main rotor torque effect acts to turn the helicopter in the opposite direction to the rotor. The problem is that Apache and Havoc main rotors turn in opposite directions, as is, regrettably, traditional for Western and Russian helicopters. Seen from above, the Apache's main rotor turns anti-clockwise, so the torque effect is clockwise, and you need to feed in left pedal as you raise the collective, while the

opposite is true for the Havoc. In either case, as the helicopter lifts off you'll need to balance out the pedal forces to maintain your chosen heading. Here's a table to summarise how the pedals are used to balance collective changes in both helicopters:

	Apache	Havoc
Collective Up	Left Pedal	Right Pedal
Collective Down	Right Pedal	Left Pedal

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.

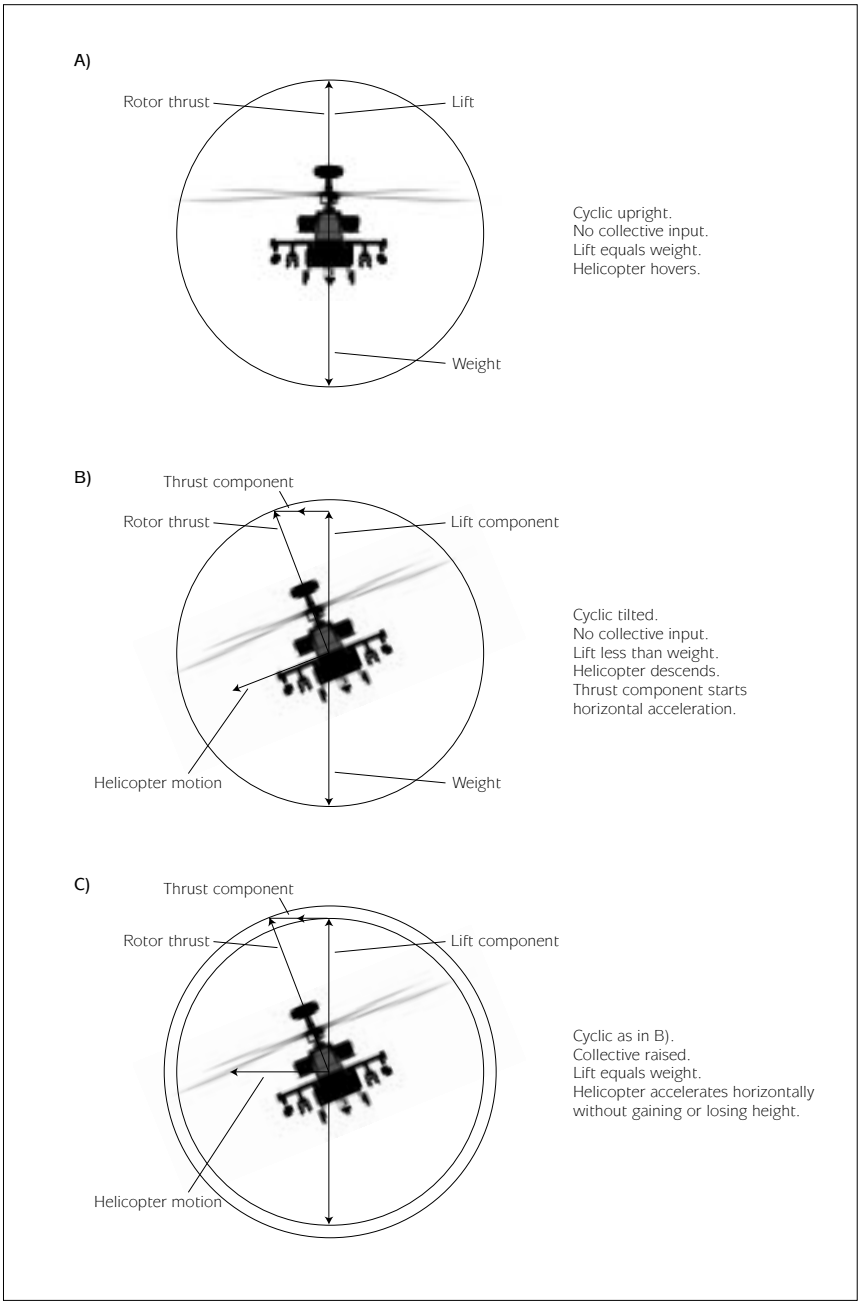


Diagram 2.7: *Lift and thrust components*

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 2.7].

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 2.8] 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.

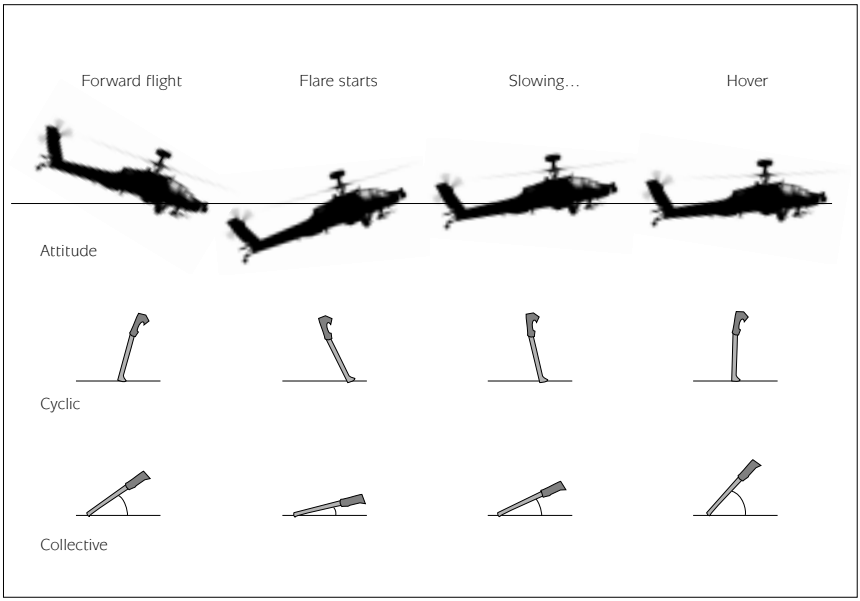


Diagram 2.8: *Coordinating cyclic and collective in the flare*

Visibility Factors

In a combat helicopter like the Apache or Havoc with classical crew arrangement (gunner in front of pilot, both on 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 2.20 – 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 2.9 and 2.10].

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 2.18 – 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

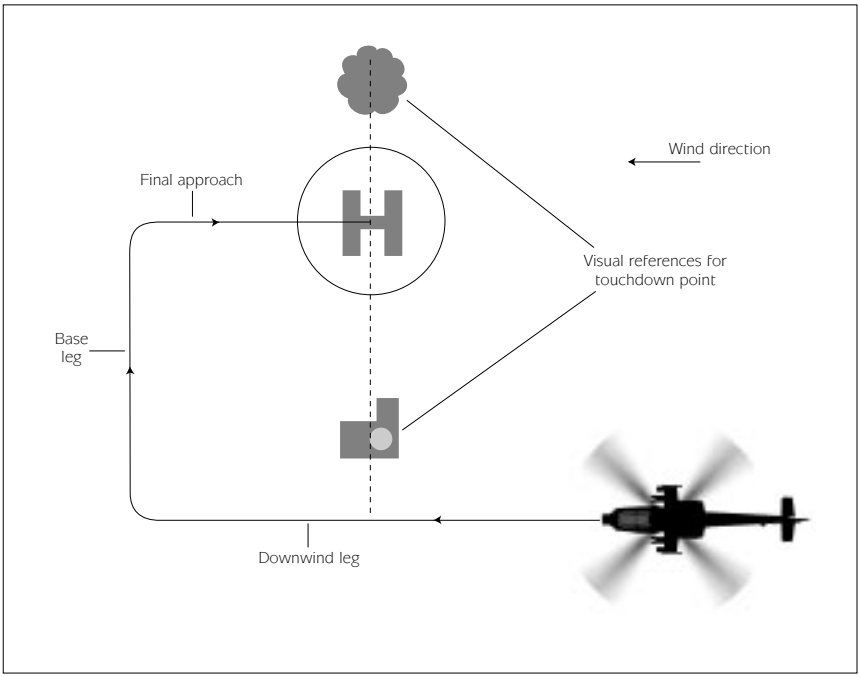


Diagram 2.9: *Circuit pattern for a clear landing area*

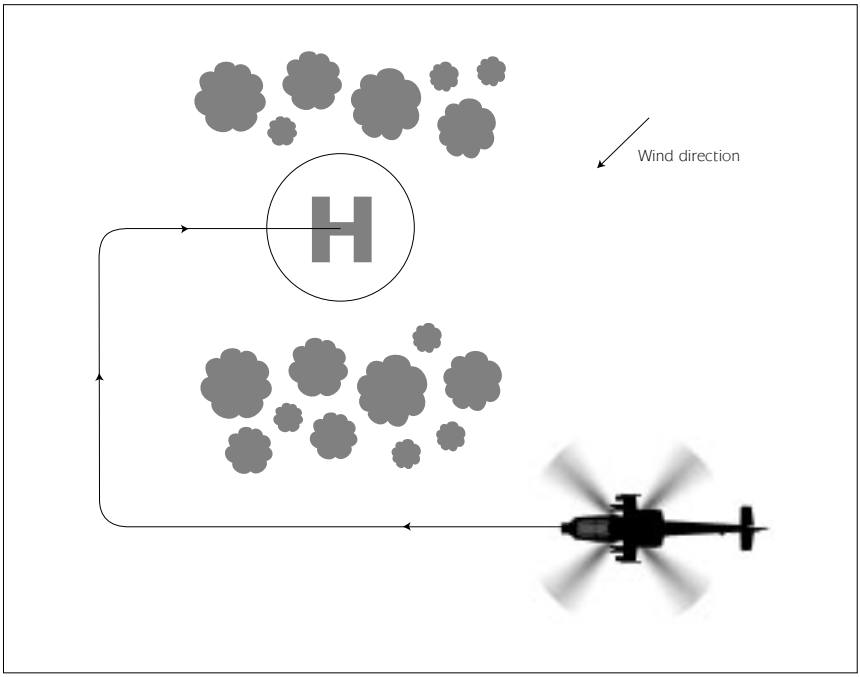


Diagram 2.10: *Circuit pattern for an obstructed landing area*

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.

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 2.11]. 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.

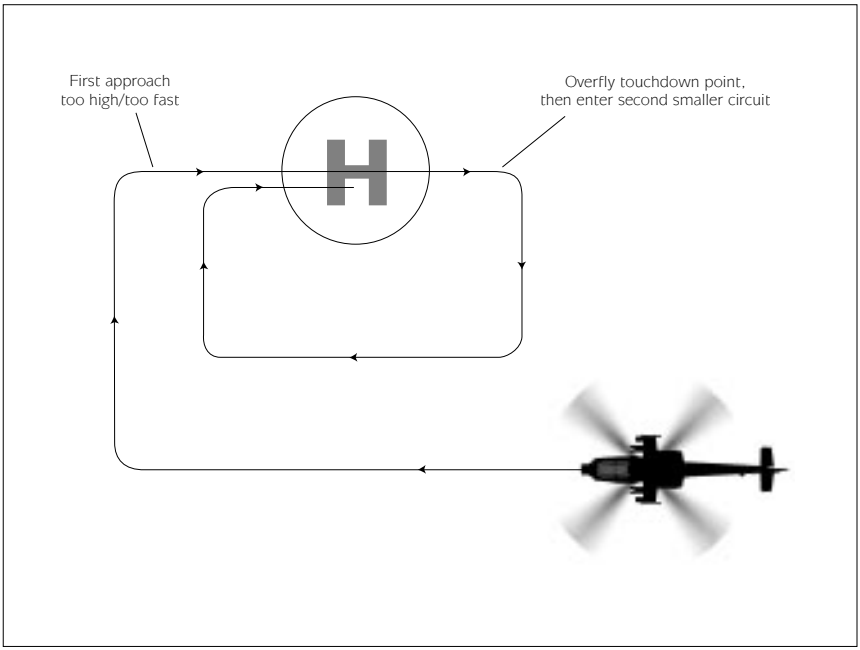


Diagram 2.11: *Going around again*

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

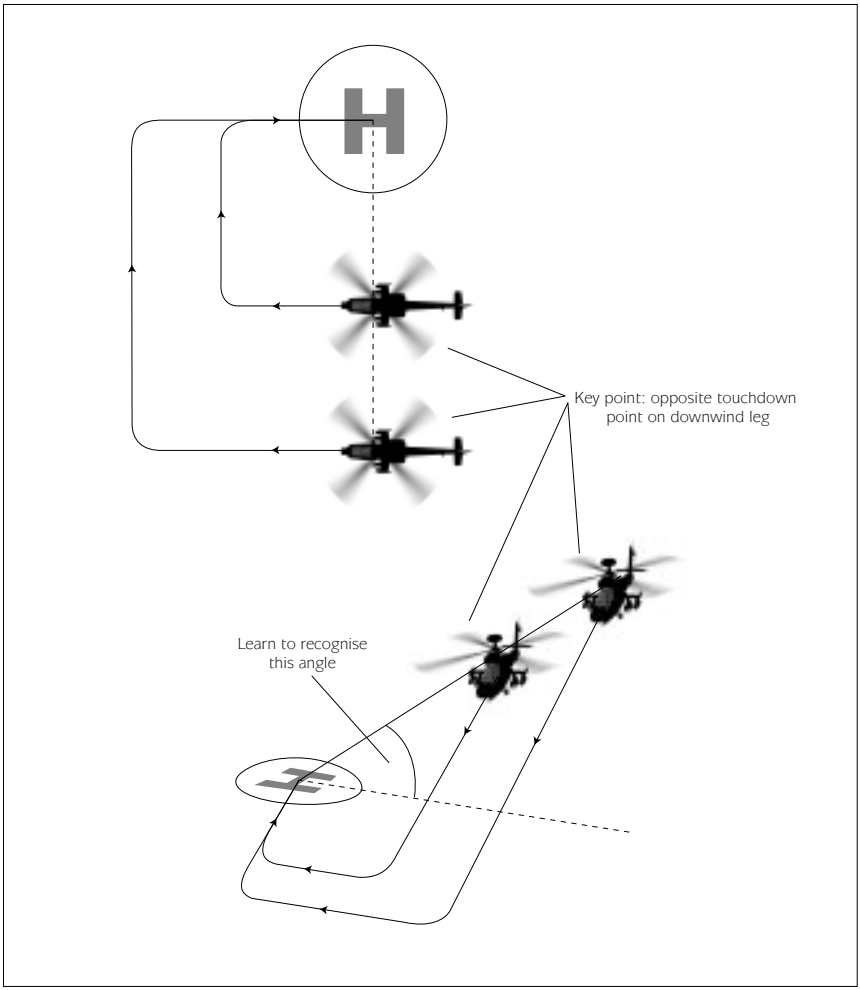


Diagram 2.12: *Judging offset and height in the circuit*

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.

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.

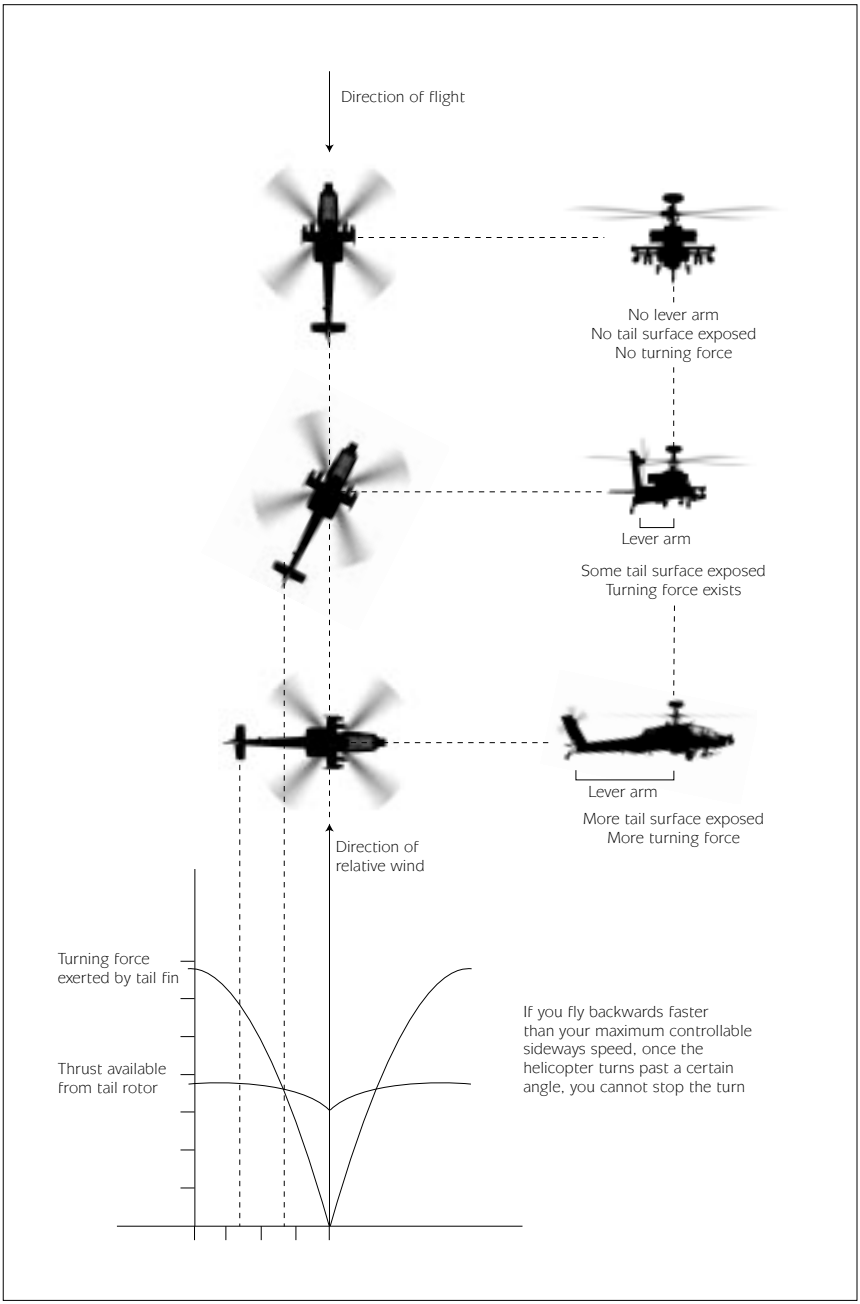


Diagram 2.13: *Turning forces in backwards flight*

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

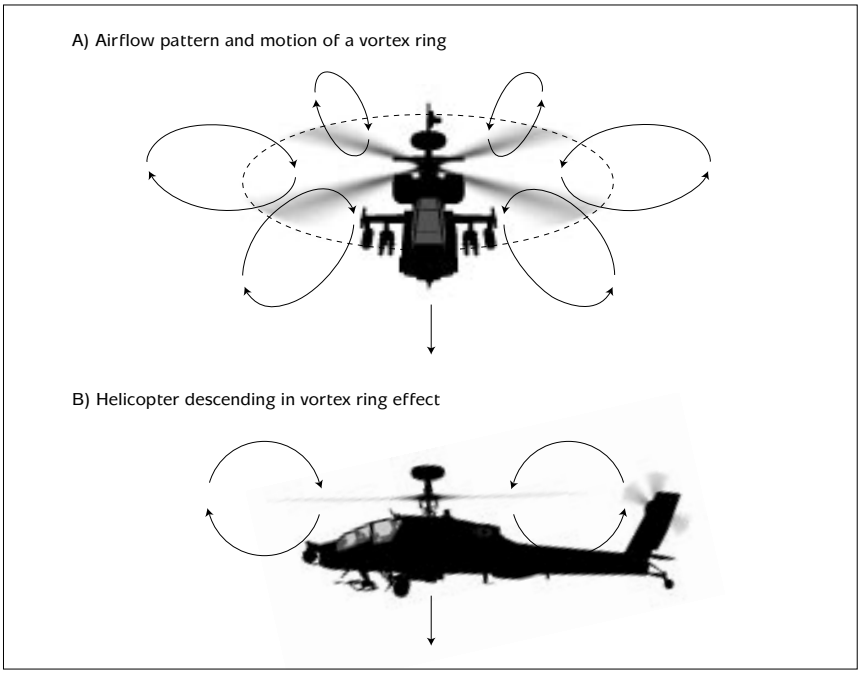


Diagram 2.14: *Vortex rings*

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 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 Apache or the Havoc 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 Apache, or the radio-guided Ataka missile in the Havoc, 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.

3. APACHE VERSUS HAVOC

AH-64D Apache Longbow

The basic Apache design represents the second, or perhaps the third generation of American attack helicopter development. Though helicopters have been used for anti-submarine work ever since they first became practical, the first combat helicopter - a helicopter which was primarily a air-to-ground weapons platform rather than a utility type - was the HueyCobra. Though its development may have been influenced by early experience in Vietnam, it was a natural element of the US Army's Airmobile concept.

If you exploit the helicopter's mobility to move troops and supplies rapidly and flexibly, then you need an equally mobile and flexible source of fire support. Ever since 1916, infantry have increasingly operated with tanks and lighter armoured vehicles mounting heavy weapons. Lightly-armed troops who have just piled out of a helicopter are highly vulnerable. The helicopter gunship can provide instant, accurate heavy fire support under close control.

Though the HueyCobra gave good service and its descendants are still in widespread use, early versions were distinctly underpowered, making them slower than the troop-carrying 'slicks' they escorted, and limiting the size of the weapons load and the weight of armour the airframe could carry. The next step forward should be a more powerful, faster and altogether nastier helicopter.

The result was the development of the Lockheed AH-56 Cheyenne. This was an ambitious and unconventional design that straddled the boundary between helicopter gunship and

ground attack aircraft. Its most novel design feature was the pusher propeller at the tip of the tail-boom, aft of the tail-rotor. The Cheyenne's outstanding performance feature was speed - a prototype reached 220 knots (407 km/hour), but it was over-complex and mechanically unreliable. The design emphasis on speed, together with its large size and weight, robbed it of the agility necessary to exploit ground cover in a period when SAMs of all sorts and radar-laid anti-aircraft cannon were coming into widespread service.

The Cheyenne project was cancelled, and a new Advanced Attack Helicopter requirement issued, specifying well-chosen and demanding criteria for performance, weapon load, endurance, toughness and crew protection. Electro-optical systems (infrared cameras, laser rangefinding and designation) were to be fitted to allow target detection and attack at longer ranges, and at night. Faced with the numerical superiority of the Warsaw Pact, NATO needed to multiply the effectiveness of its smaller forces. One direct and obvious way to do this was to develop night-fighting equipment and techniques. An additional advantage of this approach was that it posed a technical and industrial as well as a military challenge to the Soviet Union.

Five designs were submitted, by Bell, Boeing/Grumman, Hughes, Lockheed and Sikorsky. Bell and Hughes were selected to build their designs for a fly-off. Bell's YAH-63, a tubby, rounded, subtly dated-looking machine, was eventually rejected after these tests. With the benefit of hindsight, it seems clear that the Hughes YAH-64 was superior in the functionality and development potential of its design. It also undoubtedly looks the part, which is a real asset to any weapon.

After a troubled production run and service introduction, assailed by political agitation and some principled scepticism about the concept of the 'flying tank', the Apache decisively proved itself in Iraq in 1991 fighting very much the same equipment and systems it was designed against in the seventies.

Vindication in combat and export orders from discriminating customers in Europe gave impetus to the Longbow development program. The Longbow radar can see further, over a wider angle, in worse weather than the optical sensors, and the datalink allows crews to communicate and cooperate more effectively than ever before. The cockpit is updated with multi-functional displays displacing analogue instruments, the avionics and services are modernised and streamlined, and the engines are replaced with an uprated version. Despite all the new features, the parts count has been substantially reduced, which strongly suggests that maintainability has actually improved.

When the AH-64D was tested in realistic combat exercises against the AH-64A, the loss ratio in favour of the D-model was seven to one, and the A-models made many fratricidal kills. The margin was so decisive that the exercises were cut short. Among those who have flown and evaluated the AH-64D Apache Longbow, the common verdict seems to be that the new capabilities represent a revolutionary change, and the possibilities they open up will take years to explore. The Main Battle Tank may no longer be the master of the battlefield.

Specifications - AH-64D Apache Longbow

Country Of Origin	USA
Type	Attack helicopter
Manufacturer	The Boeing Company

Dimensions

Main rotor diameter	15.25 m (50.0 ft)
Tail rotor diameter	2.89 m (9.48 ft)
Overall length (turning rotors)	17.74 m (58.2 ft)
Height	5.18 m (17.0 ft)
Fuselage width (at engine nacelles)	2.82 m (9.25 ft)
Wing span	4.99 m (16.37 ft)

Weight

Normal take-off weight	7,270 kg (16,028 lbs)
Maximum take-off weight	10,107 kg (22,282 lbs)

Power plant

Turboshafts	2 x General Electric T700-GE-701C
Take-off power	2 x 1889 shp (shaft horse power)

Performance

Maximum speed	273 km/h (147 kts)
Cruise speed	273 km/h (147 kts)
Hover ceiling (in ground effect)	4,465 m (14,649 ft)
Hover ceiling (out of ground effect)	3,206 m (10,518 ft)
Maximum vertical rate of climb at sea level	541 m/min (1,775 ft/min)
Maximum rate of climb at sea level	803 m/min (2,635 ft/min)
Range	400 km (216 nm)

Avionics

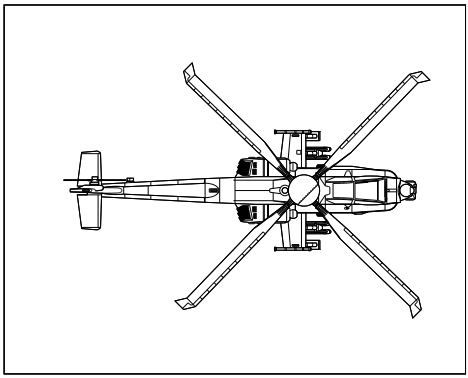
- Mast-mounted Longbow fire-control radar (FCR)
- Target acquisition and designation system (TADS)
- Integrated helmet and display sighting system (IHADSS)
- Pilot night vision system (PNVS)
- Doppler navigation system and global positioning system

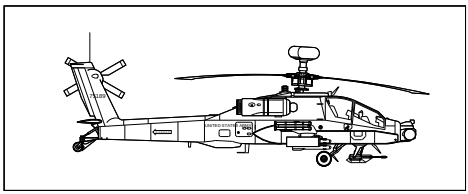
Armament

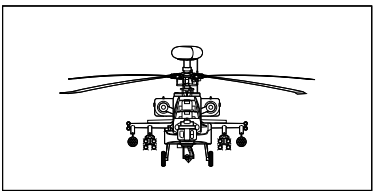
- M230 30mm Chain Gun
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114L Longbow Hellfire radar guided anti-tank missiles
- AGM-114K Hellfire II laser guided anti-tank missiles
- Hydra 70 M255 unguided rockets (HE)
- Hydra 70 M261 unguided rockets (MPSM)

Combat Survivability

- Radar and laser warning receivers
- Chaff and flare dispensers
- Electronic counter measures (IR and radar jammers)
- Armour protected key components
- Airframe designed for crash-survival
- Energy absorbing seats
- Crash-resistant and self-sealing fuel cells







MIL Mi-28N Havoc B

Though Russian interest and experiments in helicopter development go back to the early 1930s, it was not until the US Army demonstrated the military applications of helicopters, first in Korea and then in Vietnam, that the resources were committed for serious development of military helicopters. Russian commanders faced with the daunting task of defending the long, desolate border with China seized on the Airmobile Infantry concept with both hands. The military version of the Mi-8 Hip medium transport helicopter, introduced in 1967, could carry 24 armed troops, and strap a respectable load of rockets or bombs onto its external ordnance racks.

For the same reasons as the US army, magnified by the need to be able to concentrate firepower rapidly at any point along a border thousands of miles long, Russian forces also needed a heavily armed and armoured helicopter with real anti-tank capability. The result was the Mi-24 Hind. Possibly driven by the long-proven interdependence of tanks and infantry, or by the reflection that while a helicopter can dominate territory, only infantry can hold it, Mil's designers included a cabin holding up to eight troops. Just as the Russians had upped the stakes in armoured personnel carrier (APC) design by combining the roles of battle-taxi and tank destroyer to produce the BMP series of infantry fighting vehicles (IFV), so the Hind could be seen as a flying IFV, combining the roles of battle-taxi and armoured ground-attack aircraft.

The Hind was a near-contemporary of the ill-fated Cheyenne project, and both aircraft

display a similar emphasis on high speed and aircraft-like attack profiles. Unlike the Cheyenne, though, the Hind evolved into a very practical aircraft, and extensive combat experience in Afghanistan amply demonstrated the value of its heavy armament and armour. Though the troop compartment was rarely used for its intended purpose, it made the Hind an exceptionally versatile machine, with a range of capabilities no other helicopter could match.

By the late seventies, however, Russian army aviation had come to accept the American conclusion that small size and agility were the essential attributes of a battlefield helicopter, and issued a requirement for a helicopter to counter the Apache. The Mil and Kamov design bureaux produced the Mi-28 Havoc and the Ka-50 Hokum which both flew for the first time in 1982. While Kamov used the bureau's trademark coaxial rotor system to produce a novel design, the Havoc's layout corresponds almost point-for-point with the Apache's.

The Havoc's general layout is much like the Apache's, but it is more powerful and carries a heavier weapon-load. Though perhaps not quite as agile in all respects as its US counterpart, the difference in performance is minor, and the two helicopters are well-matched. One interesting legacy of the Hind design is the Havoc's small cargo compartment. As well as its general utility, this can also permit one Havoc to rescue the crew of another. Like the Havoc's elaborate automated system for canopy jettison and escape slide inflation, this should be seen as part of the admirable Russian aviation tradition of making the best possible provision for crew escape.

When the Havoc and Hokum were evaluated against each other in 1986, the Mil bureau, which had designed all the Soviet Army's helicopters to date, was shocked to find that Kamov's Hokum was preferred, on the grounds of cost-effectiveness, performance, survivability and weapon effectiveness. Mil's considerable political influence was exerted to the utmost in an effort to force the reversal of this verdict, but the result stood. The only concession extracted was permission to continue Havoc development for possible export sales.

In the event, the disintegration of the Soviet Union and the collapse of the Russian defence budget left both helicopters without real volume production orders, and a vicious propaganda war between the Mil and Kamov bureaux continues to this day. Both helicopters have been substantially developed in the interval, but neither has yet found a true launch customer. Many potential users are sceptical about the safety of the Hokum's coaxial rotors (a point loudly trumpeted by Mil), but on the other hand, the Havoc may well have suffered in part because it is undeniably one of the ugliest helicopters ever to fly, possessing neither the sleek menace of the Hind nor the functional brutality of the Apache.

Specifications - MIL Mi-28N Havoc B

Country Of Origin	CIS
Type	Attack helicopter
Manufacturer	MIL Moscow Helicopter Plant

Dimensions

Main rotor diameter	15.65 m (51.3 ft)
Tail rotor diameter	4.15 m (13.6 ft)
Overall length (turning rotors)	21.02 m (69.0 ft)
Height	4.85 m (15.9 ft)
Fuselage width (at engine nacelles)	3.61 m (11.8 ft)
Wing span	5.94 m (19.49 ft)

Weight

Normal take-off weight	10,700 kg (23,589 lbs)
Maximum take-off weight	11,660 kg (25,706 lbs)

Power plant

Turboshafts	2 x Klimov TV3-117VMA
Take-off power	2 x 2,200 shp (shaft horse power)

Performance

Maximum speed	300 km/h (162 kts)
Cruise speed	270 km/h (146 kts)
Hover ceiling (in ground effect)	4,760 m (15,617 ft)
Hover ceiling (out of ground effect)	3,600 m (11,811 ft)
Maximum vertical rate of climb at sea level	580 m/min (1,903 ft/min)
Maximum rate of climb at sea level	816 m/min (2,677 ft/min)
Range	450 km (243 nm)

Avionics

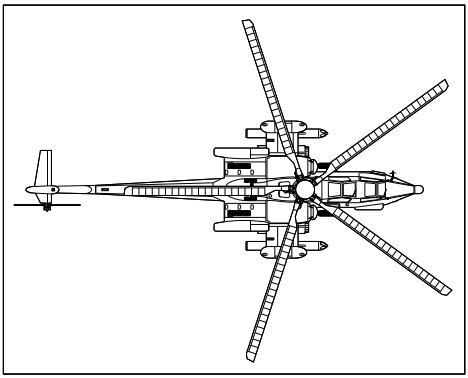
- Mast-mounted millimetric radar
- Stabilised surveillance and sighting system with thermal and TV channels
- Helmet-mounted target designation and indication system
- Night vision goggles
- Inertial navigation system and global positioning system
- Communications facilities

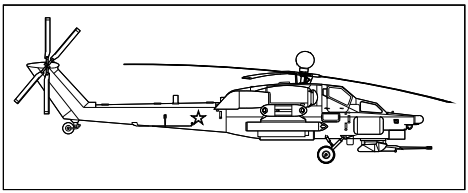
Armament

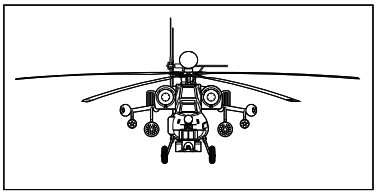
- 2A42 30mm cannon (armour piercing and high explosive rounds)
- Igla-V IR guided air-to-air missiles
- Ataka radio command guided anti-tank missiles
- 80mm unguided rockets
- 130mm unguided rockets
- GSh-23L 23mm cannon pods

Combat Survivability

- Radar and laser warning receivers
- Chaff and flare dispensers
- Electronic counter measures (IR and radar jammers)
- IR engine exhaust suppressors
- Redundancy and shielding of vital components
- Ballistically tolerant cockpits (up to 20mm calibre ammunition)
- Energy absorbing seats and airframe







4. CAMPAIGN SCENARIOS

Cuban Crisis

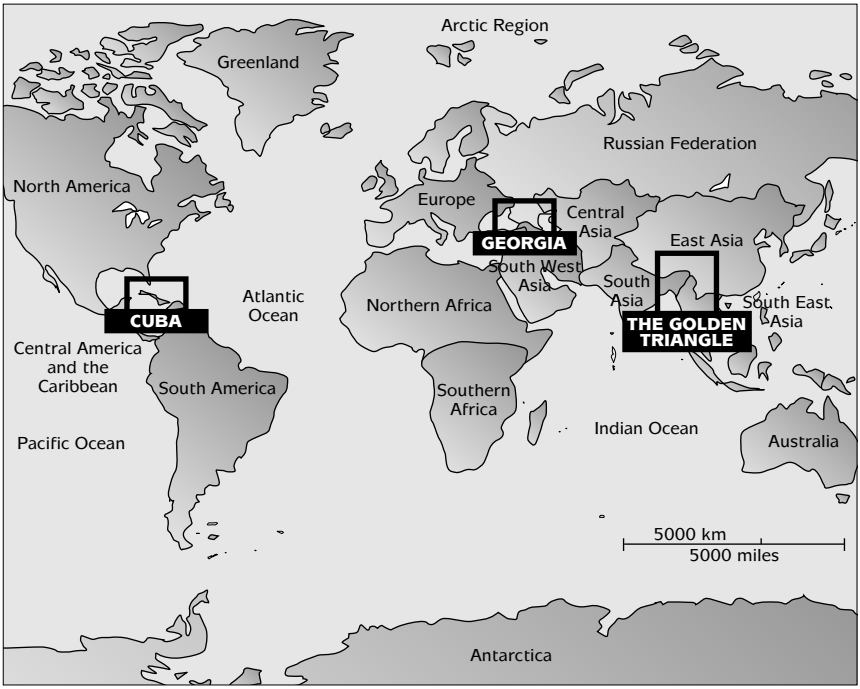
In CUBA, Fidel Castro's heirs want the US out of Guantánamo Bay, and they're saying it with artillery. The USA has only two options, evacuate or invade, and one of those is unthinkable ...

The Opium War

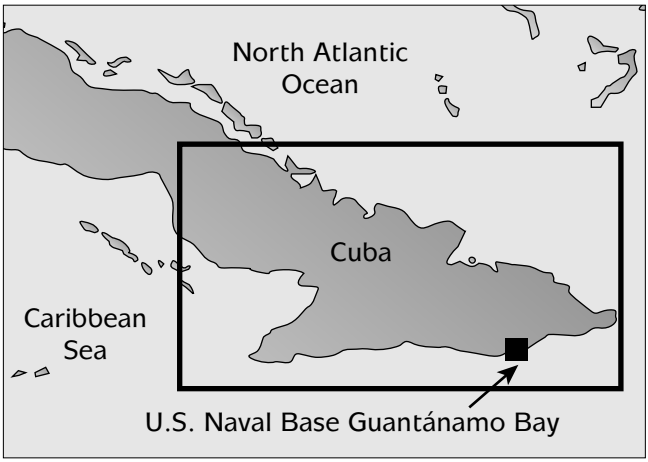
In THE GOLDEN TRIANGLE where Myanmar, Laos and Thailand come together and most of the world's opium poppies grow, the Chinese have mounted the biggest drugs bust of all time. But they didn't have a search warrant for Thailand. Can the US face down the spectre of Vietnam and come to the aid of its ally?

Caspian Black Gold

In GEORGIA a brand new hyper-nationalistic Russian government is determined to wipe out the humiliations of the post-Soviet era and take control of the Caspian Sea oilfields. The only force that can stand in the way of their whirlwind advance is a battalion of US attack helicopters in north-eastern Turkey.



Cuban Crisis



BLUE FORCE

From a general briefing document for officers of the US task force en route to Guantánamo

Situation

One month ago the Cuban Government announced that it was unilaterally tearing up the long-standing treaty by which the US Government leases the military base at Guantánamo, near the south-eastern tip of Cuba. The US Government was given twenty-eight days to evacuate. According to that treaty, the American government cannot be evicted against its will unless it violates the terms of the agreement, which it has not done.

The US Government has vigorously refused to recognise the notice to quit, but nonessential personnel have been rotated out, the base security detachment has been substantially reinforced, and the local defence plans reviewed. The elements of this amphibious force were also brought to readiness.

At 1200 local time yesterday the Cuban notice period expired. Two minutes later rocket and tube artillery concealed in the city of Guantánamo opened fire, cratering the midpoint of the main runway, then scattering anti-personnel mines. Twelve hours later, the airbase's ramp; the main parking area for aircraft, was also seeded with mines. At 1200 local time today the aviation fuel storage area was seeded, and the mines on the runway began detonating on time-delay fuses. Casualties and damage to this point have been light, but if every batch of mines is set to begin self-destructing 24 hours after landing, starting 1200 local time tomorrow, Guantánamo's fuel installations will also self-destruct. The Cuban artillery is well concealed in an urban area packed with civilians, so precision air attack is impractical. Direct assault is also ruled out by the civilian shield ...

Intentions

Before we can strike directly at the Cuban artillery we must strip away the civilian shield, without causing casualties. We shall land forces to create a wide defensive perimeter and blockade on the high ground around the Guantánamo area, anchored on the coast at both ends. At the same time we shall establish a cordon outside the city, preventing all inward traffic.

Unarmed civilians will be encouraged to leave the city; food, shelter and medical care will be provided to the best of our ability when they do. We estimate that food shortages will drive most of the population out into our hands within a week, and our intelligence of the artillery dispositions can only improve in that time. When we have the necessary information, and the time is right, we take the artillery out.

Cuban air and ground forces will certainly challenge the perimeter, and a full-scale assault is possible. The Cuban military has recently been re-equipped with brand-new first-line Russian systems, and many of their senior personnel have substantial combat experience from Angola and elsewhere. On the other hand, there is increasing popular resistance to the Cuban government, not least because of their decision to spend vast amounts on weaponry when their infrastructure is crumbling, and their inability to provide a convincing explanation of where the money came from in the first place. If we can throw back their attacks without using disproportionate force or causing civilian casualties, there is a strong possibility of popular uprisings against the government, which we may be able to assist and exploit. It is of the utmost importance that all US personnel at all levels treat prisoners and non-combatants with maximum courtesy, care and consideration, and that the news media can see this and report it ...

RED FORCE

Edited Transcript of a TV broadcast by the leader of the Cuban Junta

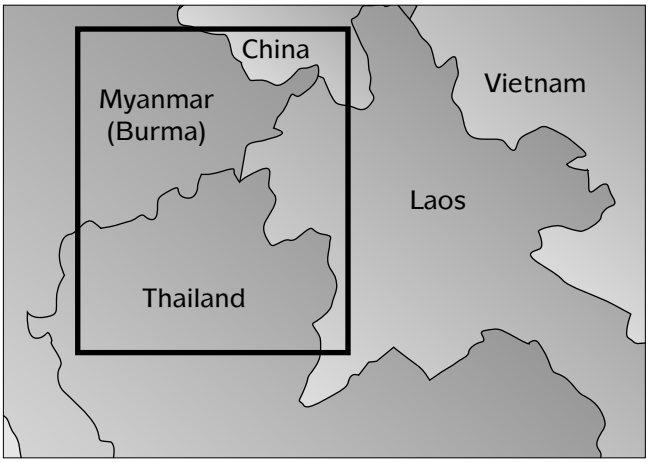
"Citizens and Soldiers of Cuba! One month ago we politely asked the Americans to leave the base at Guantánamo. When they refused, we told them again to leave, in terms they could not misunderstand. In response to our strictly limited use of force they have launched a full-scale invasion of our country, and besieged the city of Guantánamo!

We, the people of Cuba, have always known that the American government is greedy, arrogant and vengeful. The rich and powerful who jerk the strings of the puppets in Washington have always coveted this country as a captive market for their factories, its natural resources as a treasure to be plundered, and its people as a pool of cheap labour to be ruthlessly exploited.

Now these things are clear to all the freedom-loving people of the world. Now we must fight for our lives and our independence, but we will not fight alone. Now we and our friends around the world will teach the American government and its corporate puppet-masters that they cannot conquer Cuba, just as they could not conquer Vietnam.

For the sake of our beloved country, for the cause of justice, in the name and the memory of Fidel Castro and all the other heroes of the revolution, Cubans, rise up and fight!"

The Opium War



RED FORCE

From a Chinese Government press release

With full cooperation from the governments of Laos and Myanmar, Chinese forces have taken control of the region commonly known as The Golden Triangle, near the point where the borders of Laos, Myanmar and Thailand meet. The purpose of this action is to restore law and order in a region controlled only by local warlords, and to destroy the opium trade which enriches them at the expense of all other Asians. Regrettably, the Thai government has declined to sanction this police action, or to act themselves against the drug trade within their own borders. We will not speculate as to why this should be so, but unbiased observers will no doubt draw their own conclusions.

The People's Republic of China has not taken this step lightly, or without good reason. We urge the international community to recognise that we act in the common interest of all Asia, in a region that falls within our legitimate sphere of influence, and where we are the only power with both the strength and the will to act against an urgent problem. Any attempt at intervention by outside forces must invite comparison with the shameful Opium War fought by the British in the nineteenth century solely to protect their own lucrative drug trade and enslave the people of China.

BLUE FORCE

From a US news network bulletin

"... US government spokesmen have declined to comment on widespread rumours that the President will shortly announce the deployment of US forces to South-East Asia in response to urgent requests from the government of Thailand. No western reporters have been

allowed access to the area of northern Thailand now occupied by Chinese forces, but refugees say that the Chinese are there in force, and are rounding up the entire local population for processing through internment camps.

Since China is a permanent member of the UN Security Council, there is no prospect of United Nations endorsement for US intervention, but several members of ASEAN, the Association of Southeast Asian Nations, have already agreed to send military aid to Thailand, and have let it be known that they would welcome US participation in an alliance to return the affected areas to their respective national governments.

Though the military government of Myanmar, like the Laotian government, has officially invited and endorsed the Chinese occupation, there have been widespread popular protests in Rangoon and other cities. These have led to violent confrontations with the security forces, who have reacted harshly even by the standards of a country where brutal suppression of civil disorder is an everyday fact of life. Reports speak of hundreds of demonstrators shot down on the streets, but details are scanty since the military government recently expelled all foreign reporters and shut down most international communications. Other unconfirmed reports suggest that elements of the ruling junta are also outraged at the Chinese intervention, and their colleagues' role in sanctioning it. The situation is ripe for an all-out civil war ..."

Caspian Black Gold

RED FORCE

From a videotaped presidential address to the Russian armed forces

"Soldiers, Sailors and Airmen of the Motherland, this is the day all patriots have longed for, the day when Russia reclaims its independence and its rightful place among the world's greatest powers. Since the end of the Soviet Union our wealth has been stolen, our pride

and power lost and our people impoverished and exploited by an unholy alliance of despicable politicians, criminals and greedy western capitalists. This ends now, today.

The Russian people gave this government a mandate to restore all we have lost, and you, the long-suffering, uncomplaining defenders of the Motherland, are the key to achieving this. Our enemies have lectured us for a decade about the supremacy of market forces, and the survival of the fittest. I know that every one of you will take the greatest pleasure in demonstrating to them just what the law of the jungle really means.

Your mission is to close the oil pipeline through Georgia to Turkey, as a first step towards recovering for the Motherland the vast resources of the Caspian oilfields. The oil flowing through this pipeline is rightfully ours, but at the moment it enriches only the traitor Shevardnadze and his cronies, and the oil corporations of the West.

Yours is the burden, but also the honour and the privilege of reminding the world that Russians are no-one's lackeys or poor relations. We are a great nation, and you are our champions. Remember this day, for it will go down in history as the day when Russia reclaimed its soul."

BLUE FORCE

Verbal orders to the CO of a US attack helicopter battalion on detachment to the Turkish Army

"... you are hereby authorised to deploy across the Georgian border under Turkish command in aid of the government of Georgia, and assist in defending the pipeline against the Russian forces advancing from the Black Sea coast. Your first objective will be to seize the natural chokepoint west of the pipeline junction at Khashuri and delay the Russian advance while Georgian forces redeploy from the north and we try to put together some reinforcements. The amphibious landing and blitzkrieg took us all by surprise, and the Spetsnaz operations have tied the Georgians in knots, but it's all straight out of the old Soviet manuals.

We haven't taken our eyes off the massed Russian forces north of the Caucasus mountains, since we believe that these will probably also cross the border sooner or later. We intercepted a pep-talk for the Russian troops from their new president, and it's scary stuff. These people mean business.

We should have additional forces with you in a few days at most, but for the moment yours is the only unit with any chance to stop the Russians short of the pipeline. Good luck and Godspeed."

5. APACHE COCKPIT

Cockpit Views

There are 28 'fixed' cockpit views which are panned by pressing:-

Ctrl + ← → ↑ ↓ keys.

There is also a 'virtual' cockpit view which is panned by pressing:-

Alt + ← → ↑ ↓ keys.

When the virtual cockpit keys are released the view snaps to the nearest fixed cockpit view.

The virtual cockpit can be 'padlocked' to the selected target by pressing Ctrl + Enter .

To return to a fixed cockpit view press Ctrl + Enter again.

Additionally there are large left and right multi-function display (MFD) fixed views.

There are shortcut keys to the most frequently used fixed cockpit views:-

F1 selects the forward view

F2 selects the instrument view

F3 selects the large left MFD view (pressing F3 again selects the instrument view)

F4 selects the large right MFD view (pressing F4 again selects the instrument view)

In wet weather conditions the wiper should be used. The Y key operates the wiper. Alt + Y toggles 'intermittent' wipe which is useful in lighter rain.

The blurred main rotor blades visible from the cockpit can be switched off in the 'Graphics' 'Game Options' menu.

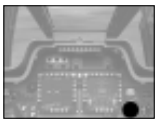
Instrument Panel

The Apache Longbow has a modern 'glass' cockpit with two multi-function displays (MFDs) and a few backup instruments.

The instruments and displays use a mixture of imperial and metric values.

Airspeed Indicator

The airspeed indicator shows the indicated airspeed of the helicopter.



Indicated Airspeed	
Scale	knots
Full scale deflection	0 to 250 knots

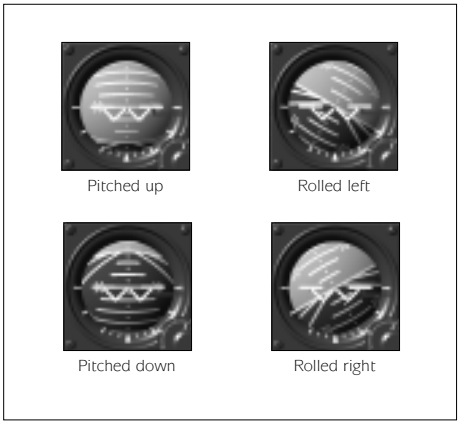
Barometric Altimeter

The barometric altimeter shows the barometric altitude (height above sea level). The needle reading should be added to the digital readout to get the barometric altitude.

Barometric Altitude	
Scale	feet x 100 (one revolution = 1,000 feet)
Digital readout	feet x 1,000

Artificial Horizon

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



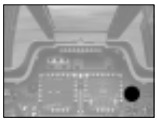


Diagram 5.1: *Pitch up/down rolled left/right*

Standby Compass

The standby compass shows the helicopter's heading. The cardinal points North, South, East and West are indicted as 'N', 'S', 'E' and 'W'.

Mission Clock

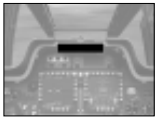
The mission clock is an analogue clock and shows the time of day.

Fire Warning Lights

The fire warning lights indicate if an 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.

Ctrl + F activate fire extinguisher

Warning Lights



RBRK	rotor brake engaged
TRQ	engine over torque
RPM	low rotor RPM
WBRK	wheel brake engaged
AP	auto-pilot active
HVR	hover hold active
RDR	radar active
R JAM	radar jammer active
I JAM	infra-red jammer active

Upfront Display

The upfront display shows system messages.

Multi-Function Displays (MFDs)

The multi-function displays have 8 selectable 'pages':-

ground radar
air radar
target acquisition and designation sight (TADS)
tactical situation display (TSD)
aircraft survivability equipment (ASE)
weapon
system
engine

The pages can be cycled through on each display.

[select next left MFD page

Shift + [select previous left MFD page

] select next right MFD page

Shift +] select previous right MFD page

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 + 4 tactical situation display (TSD)

Ctrl + 5 aircraft survivability equipment (ASE)

Ctrl + 6 weapon

Ctrl + 7 system

Ctrl + 8 engine

Right MFD:-

Alt + 1 ground radar

Alt + 2 air radar

Alt + 3 target acquisition and designation sight (TADS)

Alt + 4 tactical situation display (TSD)

Alt + 5 aircraft survivability equipment (ASE)

Alt + 6 weapon

Alt + 7 system

Alt + 8 engine

Ground Radar MFD

See the 'Acquiring Targets' section.

Air Radar MFD

See the 'Acquiring Targets' section.

Target Acquisition and Designation Sight (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.

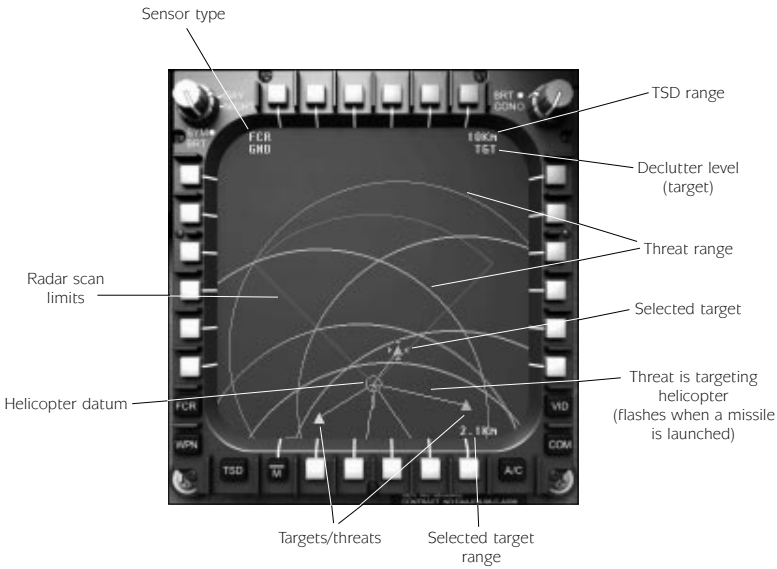


Diagram 5.2: *TSD MFD (target declutter)*

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 infra-red
TADS/DTV	TADS daylight TV
TADS/DVO	TADS direct view optics

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.

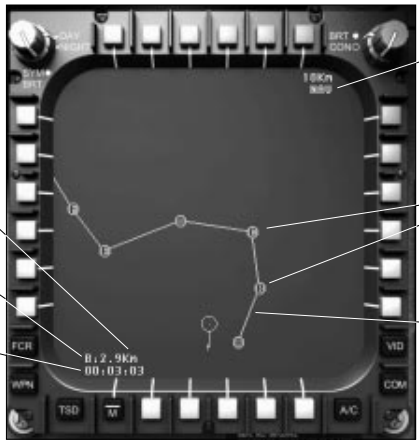


Diagram 5.3: *TSD MFD (navigation declutter)*

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. ASE auto-paging is enabled at the start of a mission but can be disabled.

Ctrl + A toggle ASE auto-page

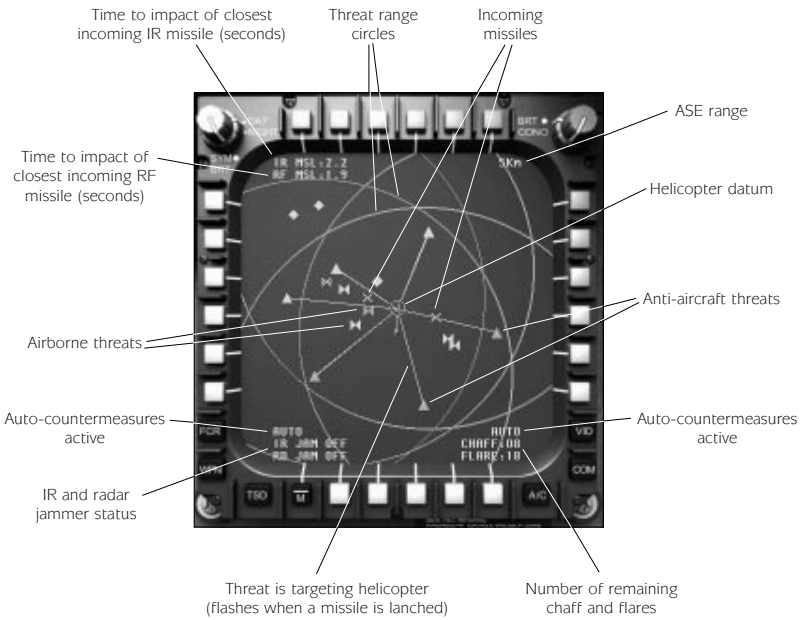


Diagram 5.4: *ASE MFD*

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.

When a threat is tracking the helicopter with radar a warning beep is emitted in the cockpit.

Incoming Missiles

Incoming missiles are shown as Xs. 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 IR and RF guided missiles.

When a missile is launced at the helicopter a high pitched warning beep is emitted in the cockpit.

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.

'RF' indicates RF Hellfires
'LSR' indicates laser Hellfires
'HE' indicates high explosive rockets
'MP' indicates multi-purpose sub-munition rockets

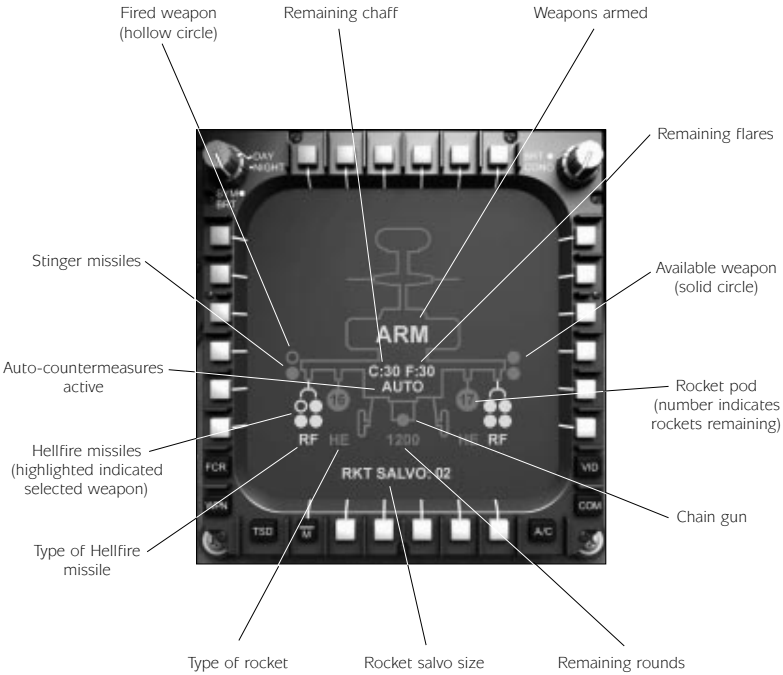


Diagram 5.5: *Weapon MFD*

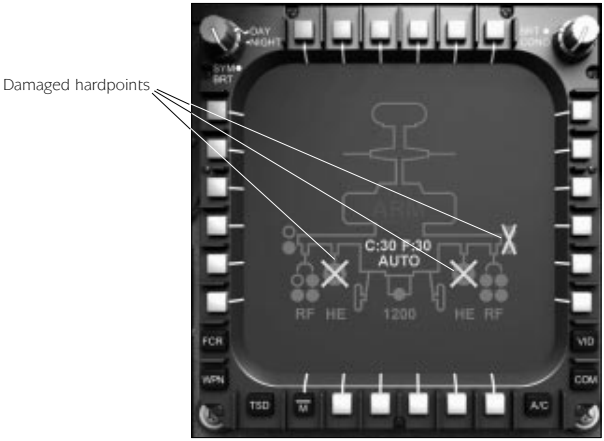


Diagram 5.6: *Weapon MFD showing damaged hardpoints*

System MFD

The System MFD displays the status of important helicopter components.

Diagram 5.7: *System MFD*

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

The fuel weight is measured in LBS and a full internal fuel load will last for approximately $2\frac{1}{2}$ hours.

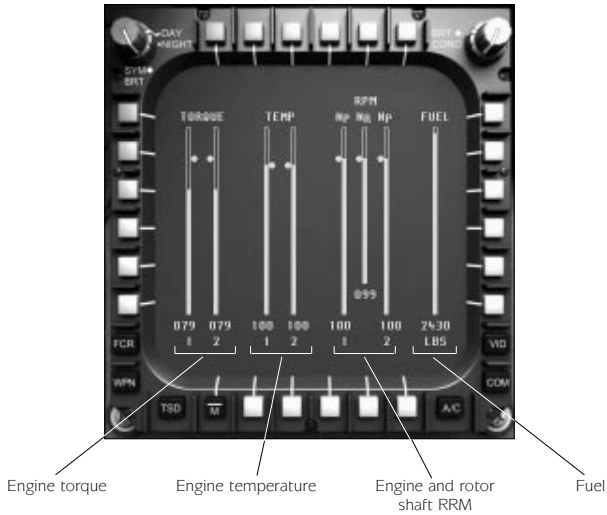


Diagram 5.8: *Emgine MFD*

Integrated Helmet And Display Sighting System (IHADSS)

The Apache pilot's helmet has a built-in display system known as the IHADSS. It is used much like a conventional "head up display" but has the advantage of always being in the pilot's view. A compact display screen is used to project the imagery into the pilot's right eye.

The TADS and PNVS (Pilot Night Vision Sensor) optical units are slaved to the IHADSS so that they 'look' where the pilot is looking. The IHADSS can be used to acquire targets simply by looking at them.

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

[H] select next HUD colour

[Shift] + [H] select previous HUD colour

The IHADSS has two display modes; 'navigation' and 'combat'.

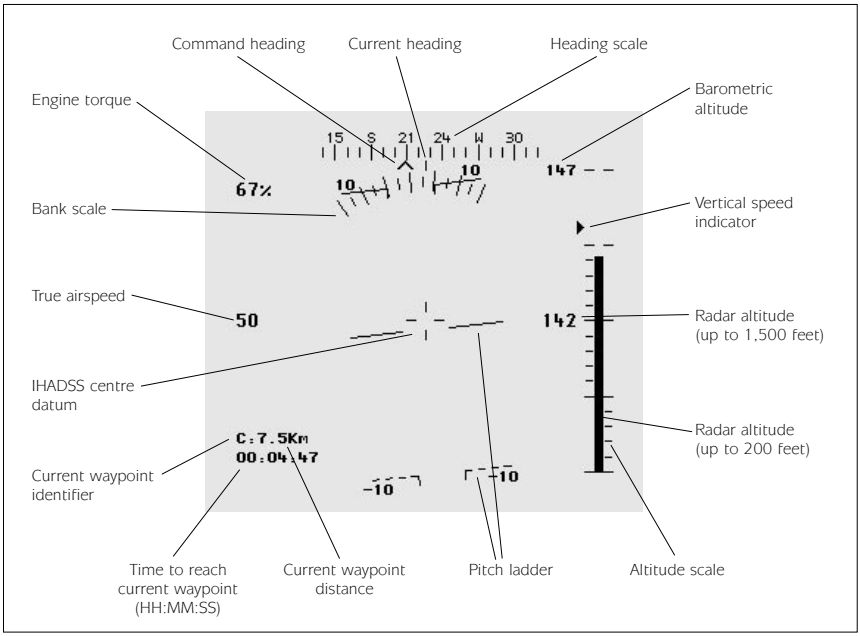


Diagram 5.9: *IHADSS in navigation mode*

IHADSS 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 helicopters pitch and bank attitude. Pitch bars are calibrated every 10°. 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°.

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.

IHADSS In Combat Mode

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

Acquiring Targets

The Apache Longbow 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. target acquisition and designation sight (TADS) with forward-looking infra-red (FLIR), daylight television (DTV) and direct view optics (DVO) channels plus a laser range-finder for accurately measuring distance to targets
3. the Integrated Helmet And Display Sighting System (IHADSS)

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.

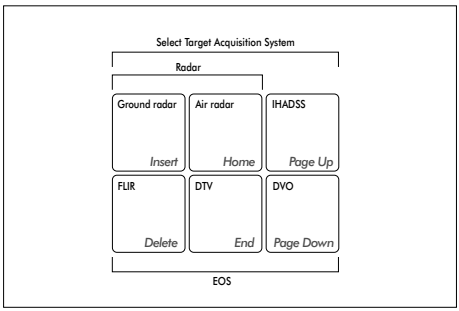


Diagram 5.10: *Select target acquisition system*

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 'Game Options' 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 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/DVO 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

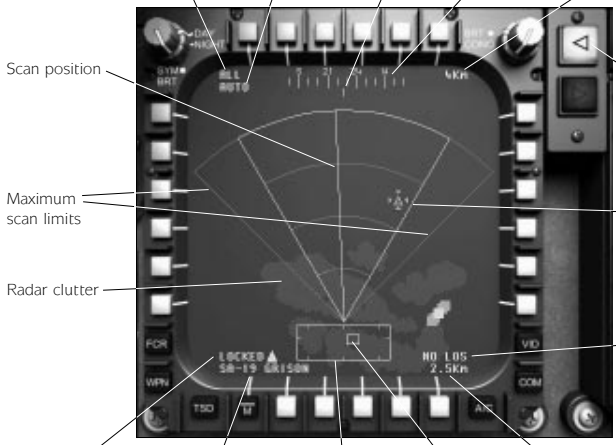


Diagram 5.11: *Ground radar display*

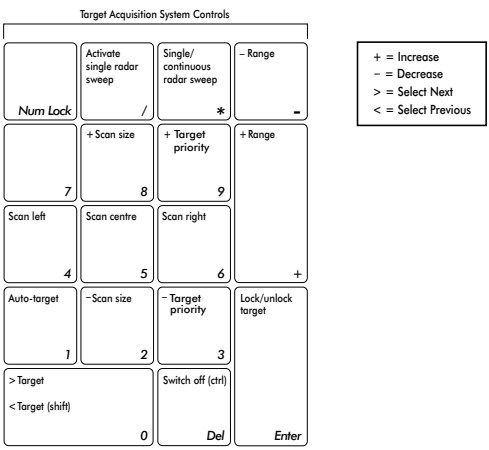


Diagram 5.12: *Ground radar controls*

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° 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

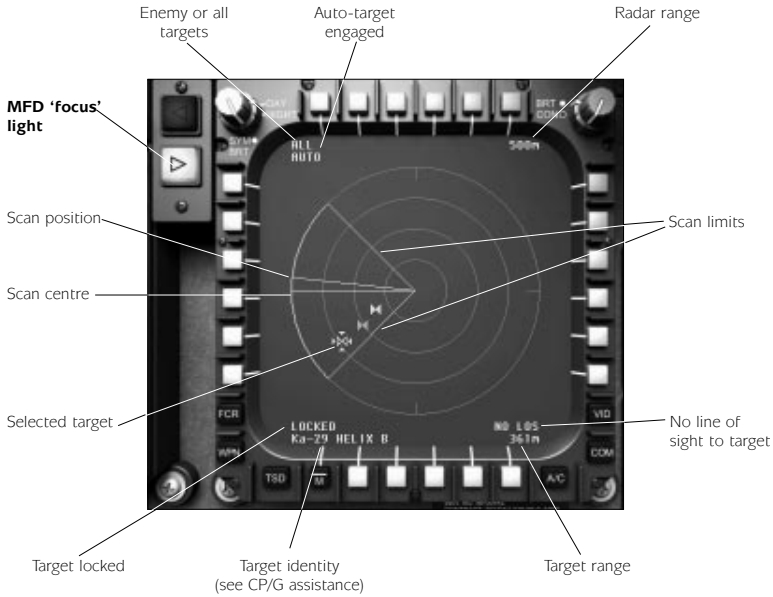


Diagram 5.13: *Air radar display*

Target Acquisition System Controls

Num Lock	Activate single radar sweep /	Single/ continuous radar sweep *	– Range -
Display allied aircraft 7	+ Scan size 8	9	+ Range +
Scan left 4	Scan centre 5	Scan right 6	
Auto-target 1	–Scan size 2	3	Lock/unlock target Enter
> Target < Target (shift) 0	Switch off (ctrl) Del		

+ = Increase
– = Decrease
> = Select Next
< = Select Previous

Diagram 5.14: *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°.

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)

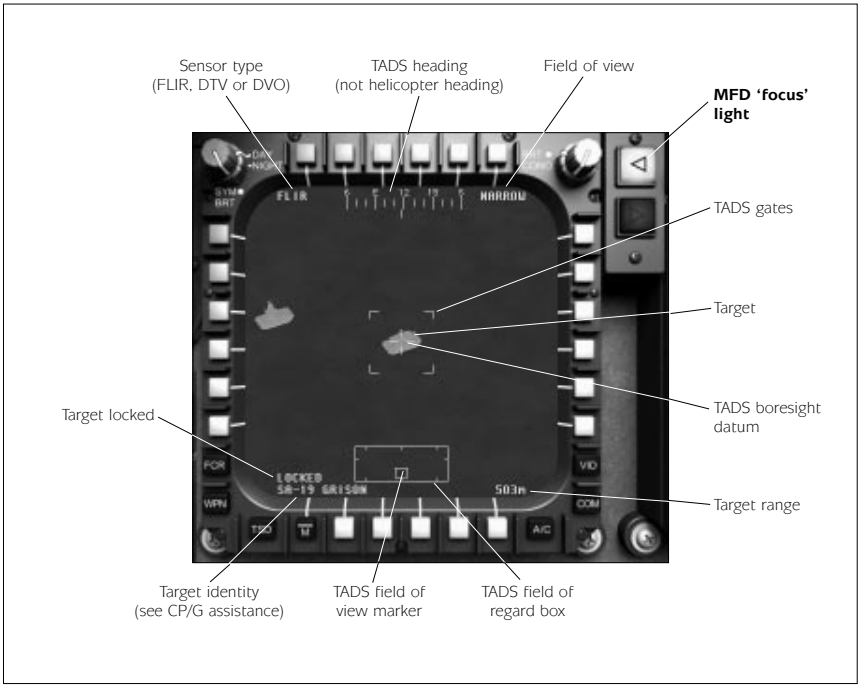


Diagram 5.15: *Electro-optical system display*

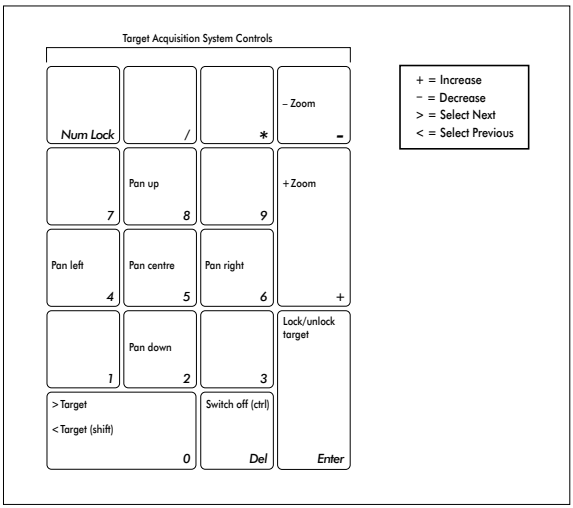


Diagram 5.16: *TADS system controls*

The TADS system is located at the front of the helicopter in the chin turret. The unit can move ±120° in azimuth (left or right) and from +30 to -60° in elevation (up or down). The system comprises a forward-looking infra-red (FLIR) channel, a daylight TV (DTV) channel, a direct view optics (DVO) channel and a laser range finder which provides target range data. The image from the TADS system is shown on either 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.

Direct View Optics (DVO)

The DVO has 2 fields of view; medium and narrow. The DVO 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 Apache 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.

Integrated Helmet And Display Sighting System (IHADSS) in Combat Mode

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

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

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

If you have a fixed cockpit view press Enter to lock the target and the fixed cockpit view will pan automatically keeping the target in view. If you pan the virtual cockpit to locate a target then when the target marker appears release the virtual cockpit keys to track (padlock) the target. Locking the target will ensure that a different target is not acquired. You can return to a fixed cockpit view by pressing Ctrl + Enter .

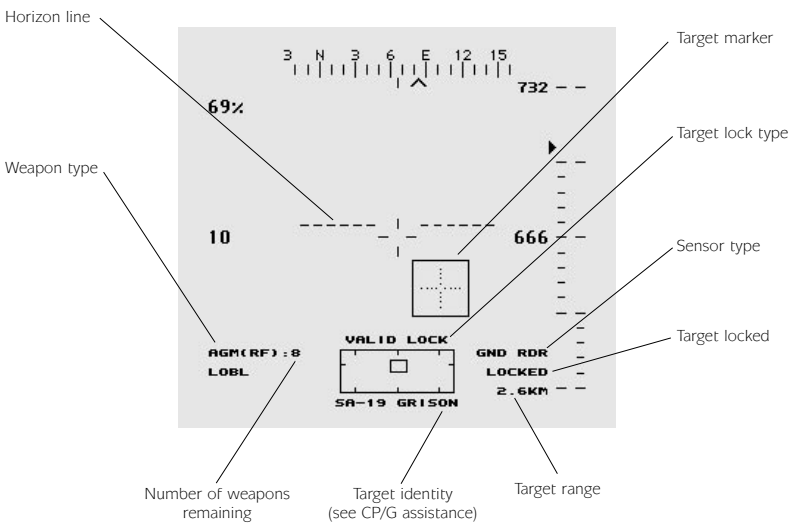


Diagram 5.17: *IHADSS in combat mode - weapons covered in detail in the 'Weapons' section*

The weapon type indicates the selected weapon:

Gun	30 mm Chain 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
DVO	direct view optics
IHADSS	IHADSS

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

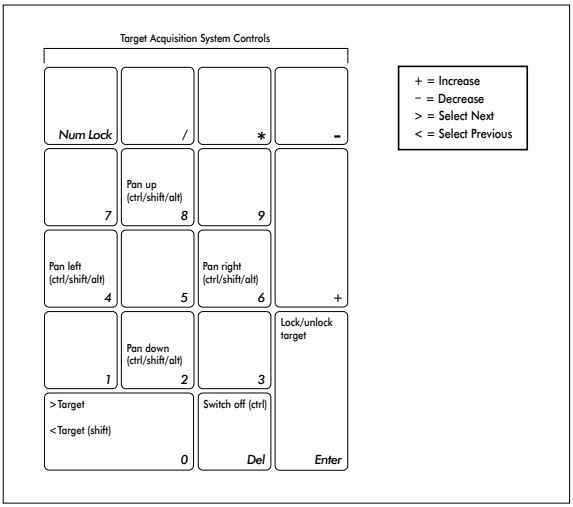


Diagram 5.18: *IHADSS controls*

Pan

Pan the HMS left, right up and down.

These keys should be used with Ctrl or Shift for panning the fixed cockpit views and used 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 IHADSS from selecting another target.

Switch off

Switch the IHADSS target acquisition mode off.

Weapons

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

The Apache has four hardpoints two on each stub wing and can carry many weapons mixes depending on the mission requirements. Stinger air-to-air missiles are carried in wingtip mounts.

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

Chain Gun

The Apache has a powerful 30mm Chain Gun in the chin turret and is loaded with 1200 high explosive dual purpose rounds.

The gun automatically tracks the selected target and can be rotated ±110° in azimuth (left or right) and from +11 to -60° in elevation (up or down).

The Chain Gun can be used against ground or air targets.

Type	30 mm Chain Gun
Rate of fire	625 rounds per minute
Maximum range	1,200 metres
Muzzle velocity	792 metres per second
Weight	0.495 Kg

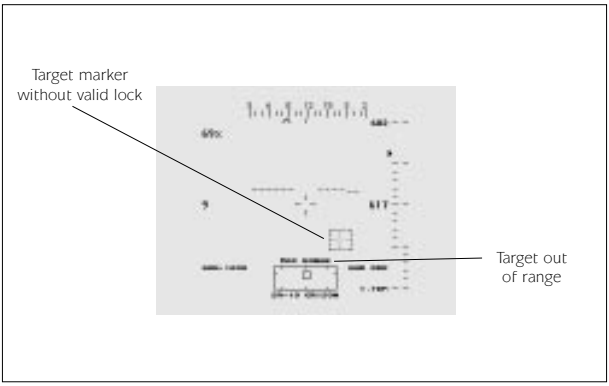


Diagram 5.19: *IHADSS Display for the Chain Gun showing an out of range target*

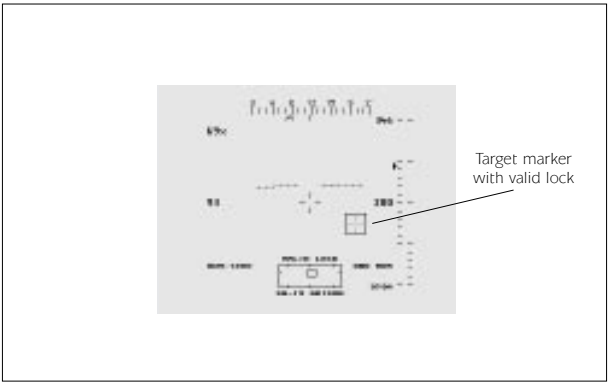


Diagram 5.20: *IHADSS Display for the Chain Gun showing a valid target lock*

AIM-92 Stinger

The Apache Longbow carries Stinger short-range air-to-air guided missiles. They are mounted in pairs on the wingtips and a maximum of 4 can be carried.

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 IHADSS 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 IHADSS 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. A tone is emitted to indicate the valid lock.

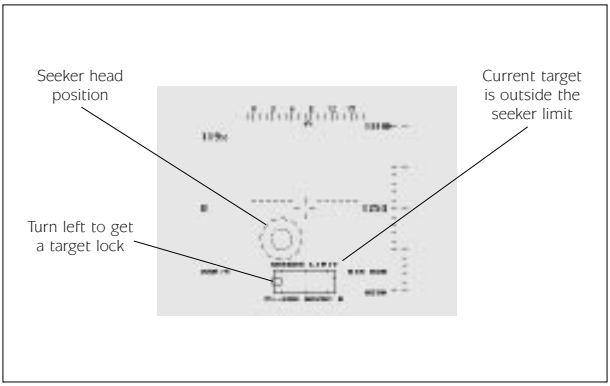


Diagram 5.21: *IHADSS display for the Stinger seeking a target*

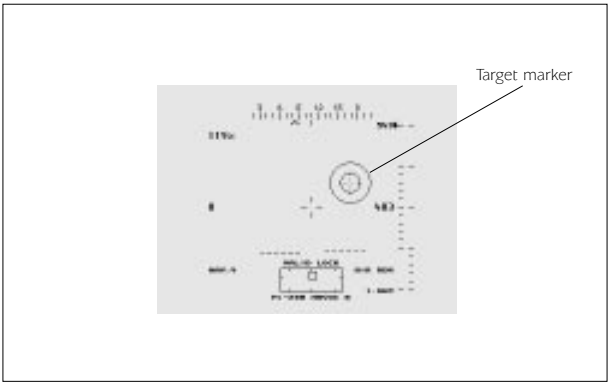


Diagram 5.22: *IHADSS display for the Stinger showing a valid target lock*

Hellfires

The Apache Longbow carries Hellfire short-range anti-tank guided missiles. They are mounted in racks of 4 so a maximum of 16 can be carried.

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 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.

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

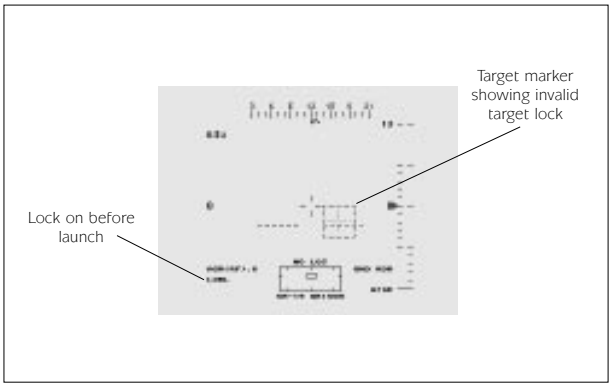


Diagram 5.23: *IHADSS display for a Hellfire missile in LOBL launch mode showing an invalid target lock*

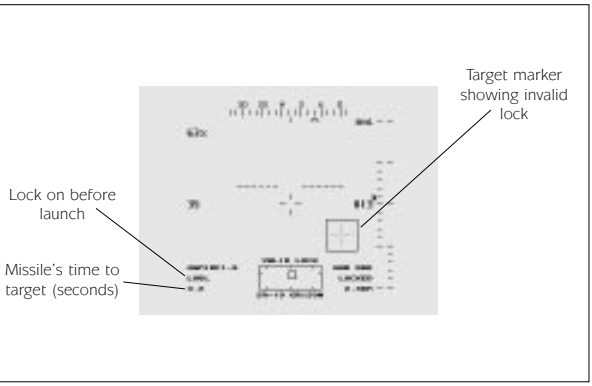


Diagram 5.24: *IHADSS display for a Hellfire missile in LOBL launch mode showing a valid target lock*

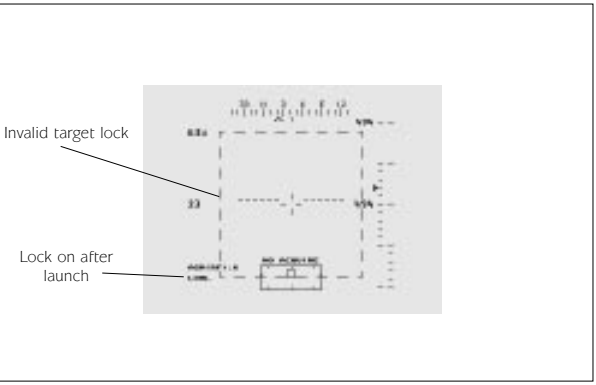


Diagram 5.25: *IHADSS display for a Hellfire missile in LOAL launch mode showing an invalid target lock*

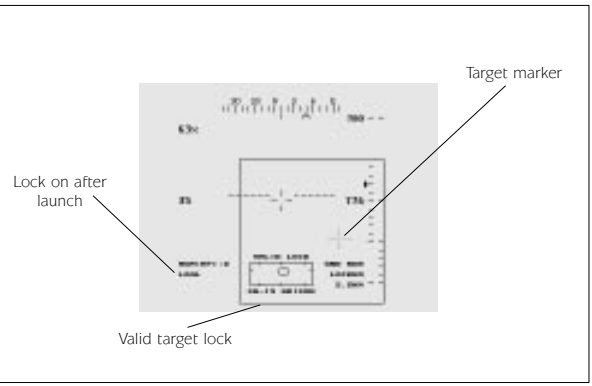


Diagram 5.26: *IHADSS display for a Hellfire missile in LOAL launch mode showing a valid target lock*

Hydra 70 Rockets

The Apache Longbow 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 are mounted in pods of 19 giving a maximum capacity of 76.

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° to -15.0°). 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 Apache far easier than in the Havoc and the kill probability is increased.

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

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

The IHADSS 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.

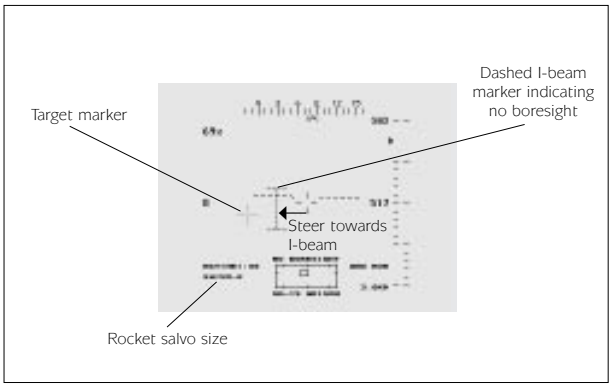


Diagram 5.27: *IHADSS display for unguided rockets showing I-beam not lined up with ground target*

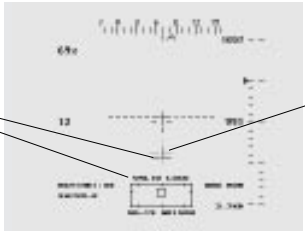


Diagram 5.28: *IHADSS display for unguided rockets showing I-beam lined up with ground target*

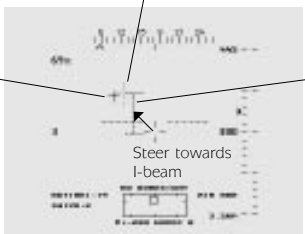


Diagram 5.29: *IHADSS display for unguided rockets showing I-beam not lined up with air target intercept point*

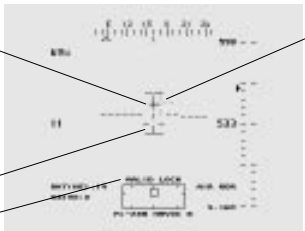


Diagram 5.30: *IHADSS display for unguided rockets showing I-beam lined up with air target intercept point*

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 Apache Longbow carries 30 of each.

Automatic Countermeasures

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

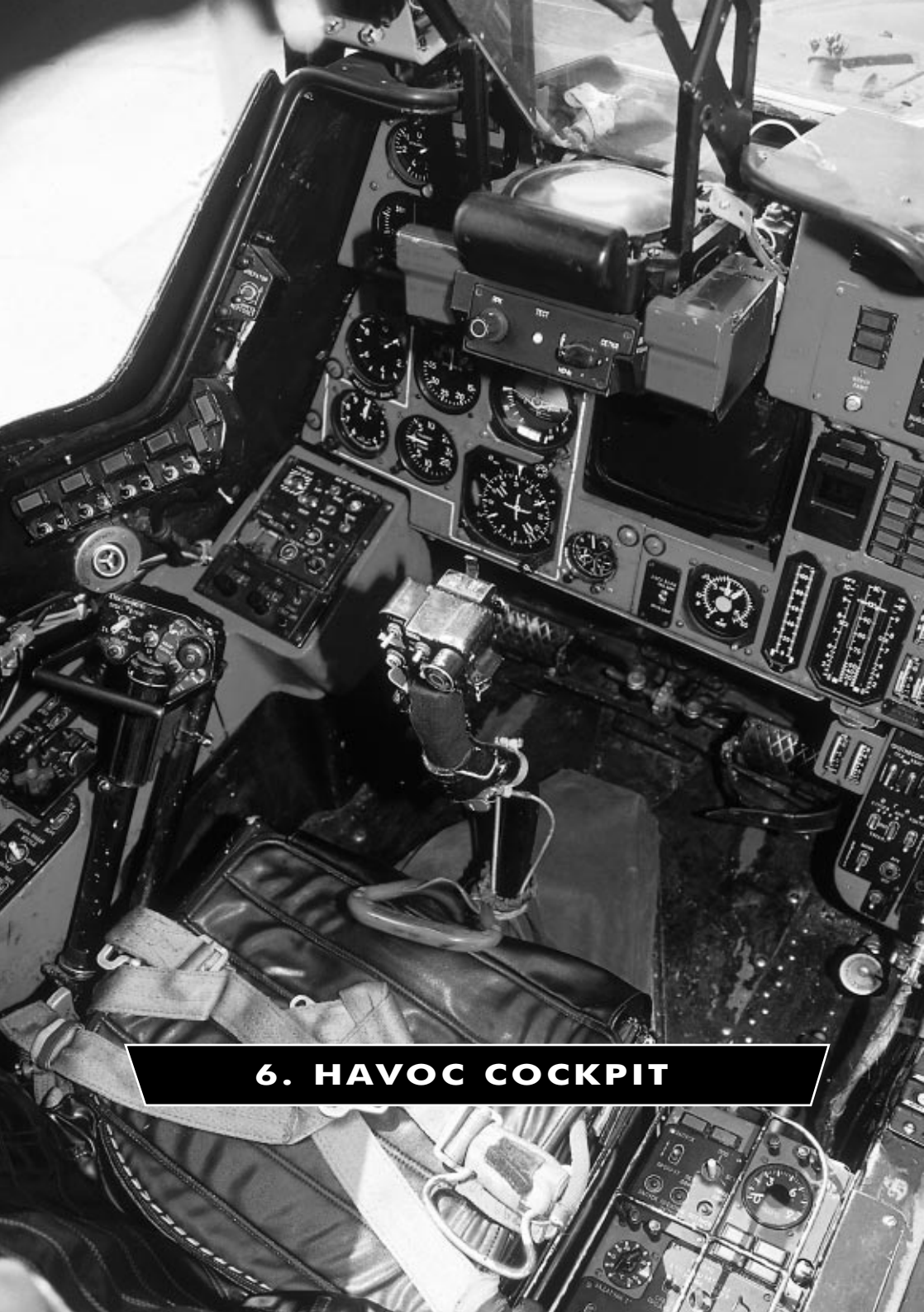
This option is selected in the 'Game Options' menu and can also be changed in-flight.

[Ctrl] + [C] automatic countermeasures on/off.

Pilot Night Vision Sensor (PNVS)

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

[N] PNVS on/off



6. HAVOC COCKPIT

Cockpit Views

There are 28 'fixed' cockpit views which are panned by pressing:-
Ctrl + ← → ↑ ↓ keys.

There is also a 'virtual' cockpit view which is panned by pressing:-
Alt + ← → ↑ ↓ keys.

When the virtual cockpit keys are released the view snaps to the nearest fixed cockpit view.

The virtual cockpit can be 'padlocked' to the selected target by pressing Ctrl + Enter .

To return to a fixed cockpit view press Ctrl + Enter again.

Additionally there is a large TV Display fixed view and a large HUD fixed view.

There are shortcut keys to the most frequently used fixed cockpit views:-

F1 selects the forward view.

F2 selects the instrument view.

F3 selects the large TV Display view (pressing F3 again selects the instrument view).

F4 selects the large HUD view (pressing F4 again selects the forward view).

In wet weather conditions the wiper should be used. The Y key operates the wiper.

Alt + Y toggles 'intermittent' wipe which is useful in lighter rain.

The blurred main rotor blades visible from the cockpit can be switched off in the 'Game Options' menu.

Instrument Panel

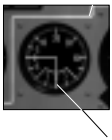
The Havoc cockpit differs considerably from the modern 'glass' cockpit of the Apache Longbow in that it has more traditional instrumentation and only a single TV display.

The blue cockpit panel with a bold white line highlighting the primary flight instruments is typical of Soviet aircraft.

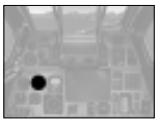
All of the instruments and displays use metric values.

Airspeed Indicator

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



Side slip



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

Sideslip	
Scale	km/h x 10
Full scale deflection	±100 km/h

Barometric Altimeter

The barometric altimeter shows the barometric altitude of the helicopter (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 of the helicopter.

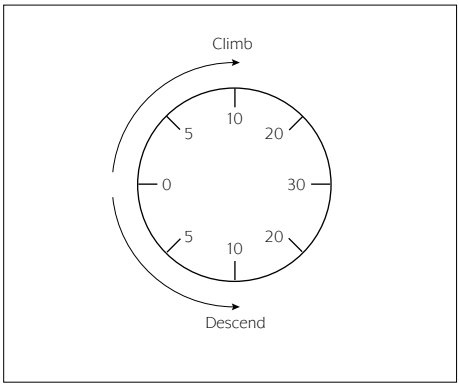


Diagram 6.1: *Direction of climb and descent*

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's pitch and roll attitude relative to the ground.

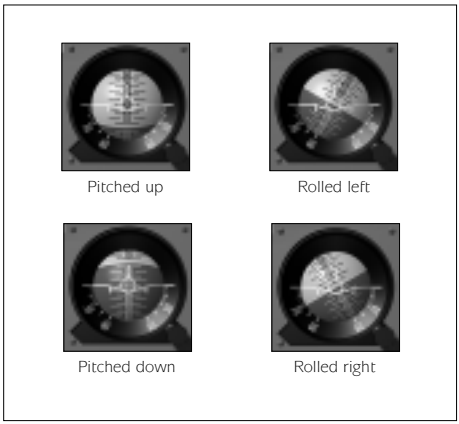


Diagram 6.2: *Pitch up/down rolled left/right*

Horizontal Situation Indicator (HSI)

The Horizontal Situation Indicator (HSI) aids the pilot in navigating the flight plan. The instrument is controlled by the helicopter's navigation computer.

The helicopter's heading is indicated by the rotary heading scale and the heading datum marker at the top dead centre of the dial. On the heading scale 'C' represents North, '9' East, '18' South and '27' West.

The automatic direction finder needle points in the direction of the current waypoint. When this needle is aligned with the heading datum then the helicopter is flying towards the current waypoint.

The designated flight path needle indicates the direction from the previous waypoint to the current waypoint. When both needles are aligned with the heading datum the helicopter is following the correct route.

The digital readout in the top left corner shows the distance to the current waypoint in kilometres (the yellow digit tenths of a kilometre). The readout in the top right corner shows the current waypoint identifier ('A', 'B', 'C', etc.).

In windy conditions crosswinds will cause the helicopter to drift off course. The navigation system computes the amount of heading correction required to compensate for the wind. The heading correction is indicated by the angle of drift needle. In windy conditions the automatic direction finder needle should be aligned with the angle of drift needle to fly to the current waypoint.

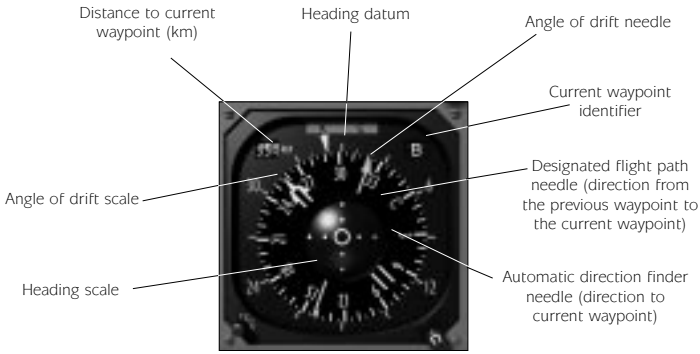
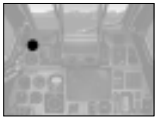


Diagram 6.3: *Horizontal situation indicator*

G Meter

The G meter shows the G force exerted on the helicopter. For straight and level flight the reading will be 1G.



G Force	
Scale	1G
Full scale deflection	-2 to 4Gs

Radar Altimeter

The radar altimeter shows the helicopter's altitude above ground.

Radar Altitude	
Scale	metres (the scale is non-linear)
Full scale deflection	0 to 300 metres

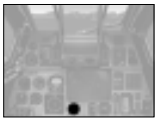
Main Rotor RPM Indicator

The main rotor RPM indicator shows the helicopter's main rotor RPM as a % of maximum RPM. The nominal operation main rotor RPM is 100% (which is approximately 240 RPM).

Main Rotor RPM	
Scale	% x 10
Full scale deflection	0 to 100%

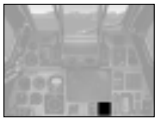
Mission Clock

The mission clock is an analogue clock and shows the time of day.



Fuel Gauge

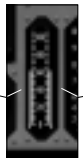
The fuel gauge shows the internal fuel load. The yellow dot in the centre of the dial helps locate the instrument. This is common in Soviet aircraft.



Fuel Weight	
Scale	kg x 100
Full scale deflection	0 to 1500kg

Engine Torque Indicator

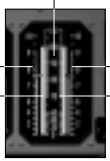
The engine torque indicator shows the left and right engine torque.



Engine Torque	
Scale	%
Full scale deflection	0 to 110%

Engine RPM and Temperature Indicators

The engine RPM indicator (inner scale) shows the left and right engine RPM. The engine temperature indicator (outer scale) shows the left and right engine temperatures.



Engine RPM	
Scale	%
Full scale deflection	0 to 110%

Engine Temperature	
Scale	°C x 100
Full scale deflection	0 to 1000 °C

Engine Oil Pressure Gauges

The oil pressure gauges show the left and right engine oil pressure.

Left  Right

Engine Oil Temperature Gauges

The oil temperature gauges show the left and right engine oil temperature.

Left  Right

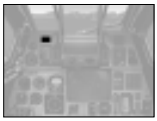
Standby Compass

The standby compass shows the helicopter's heading.

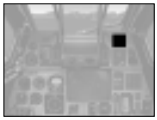
"C"	North
90	East
18	South
27	West

Master Caution Light

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



Warning Lights



L ENG	left engine fire
R ENG	right engine fire
TRQ	engine over torque
RDR	radar active
AP	auto-pilot active
HVR	hover hold active
R JAM	radar jammer active
I JAM	infra-red jammer active

L ENG	R ENG
TRQ	RDR
AP	HVR
R JAM	I JAM

Status Lights

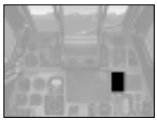
RDR	radar failure
FLIR	FLIR failure
LLLTV	LLLTV failure
LSR	laser range finder failure
R JAM	radar jammer failure
I JAM	infra-red jammer failure
NAV	navigation computer failure
COMM	communications failure
RWS	radar warning system failure
HUD	head up display failure
HMS	helmet-mounted sight failure
TV	TV display failure
TWD	threat warning display failure
NVG	night vision goggles failure
FRX	fire extinguisher used
RBRK	rotor brake engaged
WBRK	wheel brake engaged
AC	automatic counter measures active

RDR	FLIR	LLLTV
LSR	R JAM	I JAM
NAV	COMM	RWS
HUD	HMS	TV
TWD	NVG	FRX
RBRK	WBRK	AC

EKRAN Display

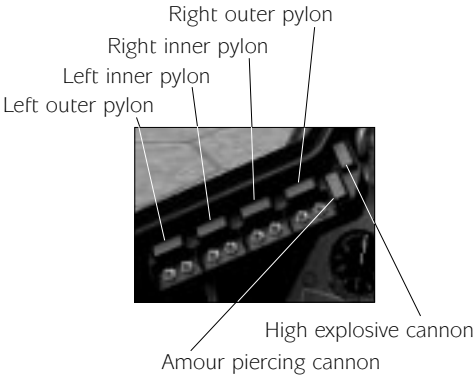
The EKRAN automatic check-up system monitors necessary systems and critical values and shows text warnings on this display and sends audible warnings to the pilot's headphones.

Alpha-numeric Display



Weapons Status Lights

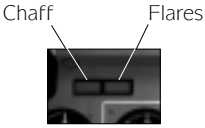
The weapon status lights indicate the weapon availability.



Unlit	none available
Green	available (flashes when armed)
Red	hardpoint damaged

Chaff and Flare Status Lights

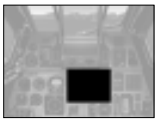
The chaff and flare status lights indicate their availability.



Unlit	none available
Green	available
Red	dispenser damaged

TV Display

The centrally mounted TV display is used with the radar and electro-optics sensors. See the 'Acquiring Targets' section.

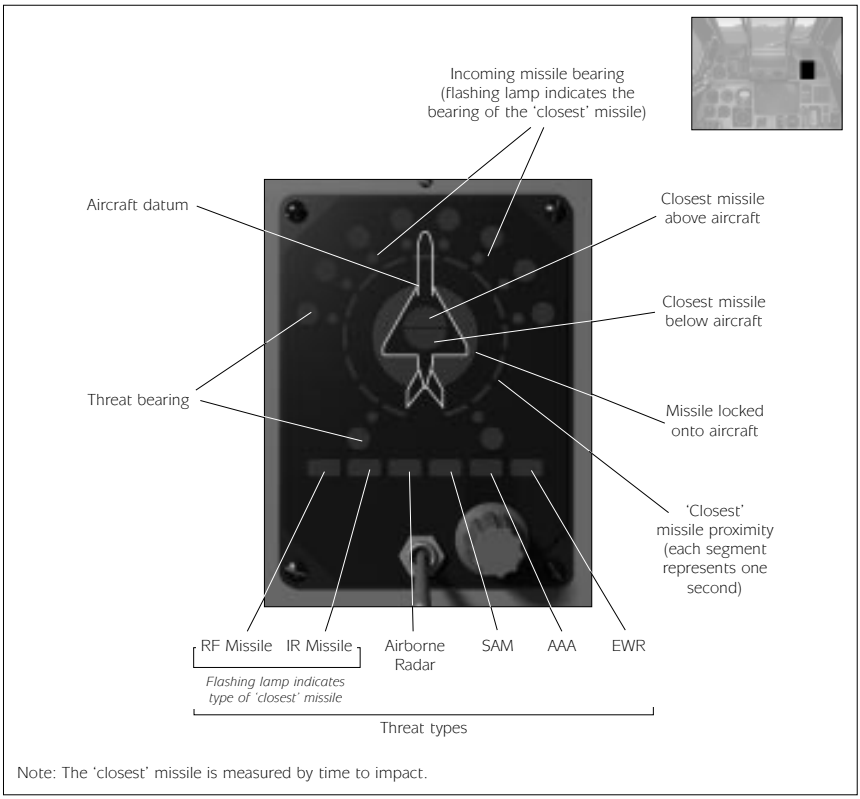


Threat Warning Display (TWD)

The Threat Warning Display (TWD) alerts the pilot to the direction of enemy threats and incoming missiles. The TWD is capable of indicating multiple threats simultaneously.

The warning systems detect if the helicopter is being illuminated by an enemy threat such as an aircraft or SAM launcher and displays the threat type and bearing. The threat bearing is indicated by the large orange lamps encircling the aircraft symbol.

If a missile is launched then the large red missile lock lamp behind the aircraft symbol illuminates and the missile's bearing is indicated by the small green lamps encircling the aircraft symbol. When there is more than one incoming missile the 'closest' missile is measured by time to impact. The missile bearing lamp flashes to indicate the bearing of the closest missile and the appropriate threat type lamp flashes to indicate if it is a radar guided or infra-red guided missile. The two semi-circular lamps in the centre of the aircraft symbol indicate if the closest missile is above or below the helicopter. As the missile approaches the helicopter the missile proximity lamps unwind in a clockwise direction to indicate time to impact. Each segment represents one second.



Note: The 'closest' missile is measured by time to impact.

Diagram 6.4: *Threat warning display*

Head Up Display (HUD)

The head up display (HUD) is located centrally above the instrument panel. The 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.

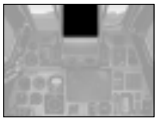
The helmet-mounted sight is activated when either a weapon or target acquisition system is selected. To return to the HUD navigation mode either make the weapons safe or switch off the target acquisition system.

The HUD display colour can be cycled to make it easier to read when the outside conditions change. In addition to the large HUD view the HUD size may be enlarged on the forward view.

K select next HUD colour

Shift + K select previous HUD colour

Alt + K toggle HUD size



Head Up Display in Navigation Mode

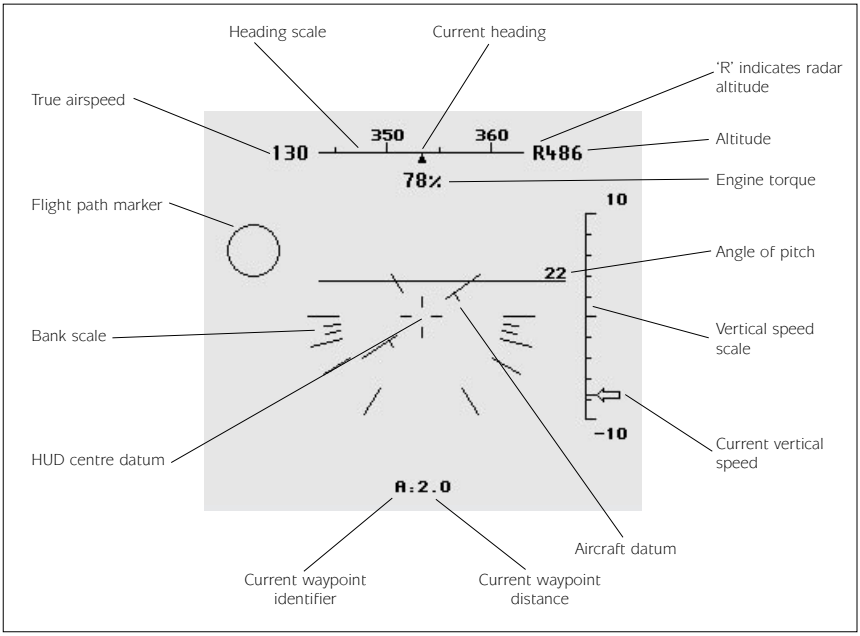


Diagram 6.5: *Head up display in navigation mode*

HUD Centre Datum

Indicates the centre of the display.

Heading Scale and Current Heading

The heading scale is marked every 10 degrees. The current heading is indicated by the triangular marker.

Angle of Pitch

The horizontal line indicates the direction of the horizon and digital readout shows the helicopter's 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).

Engine Torque

Digital readout of the engine torque.

Vertical Speed Scale and Current Vertical Speed

The full scale deflection of the vertical speed scale is ±10 metres per second. The current vertical speed is indicated by the arrow.

Flight Path Marker

The small circle indicates the bearing and relative altitude of the current waypoint.

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.

Acquiring Targets

The Havoc 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 range-finder for accurately measuring distance to targets
3. a helmet-mounted sight

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.

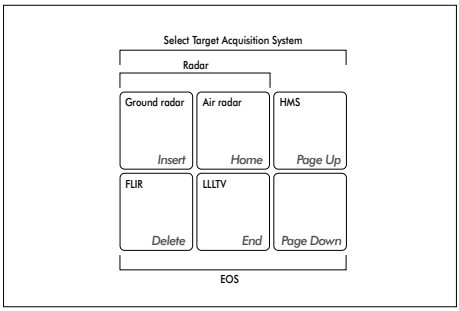


Diagram 6.6: *Select target acquisition system*

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 'Game Options' 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 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 FLIR or LLLTV 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 TV 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 is 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

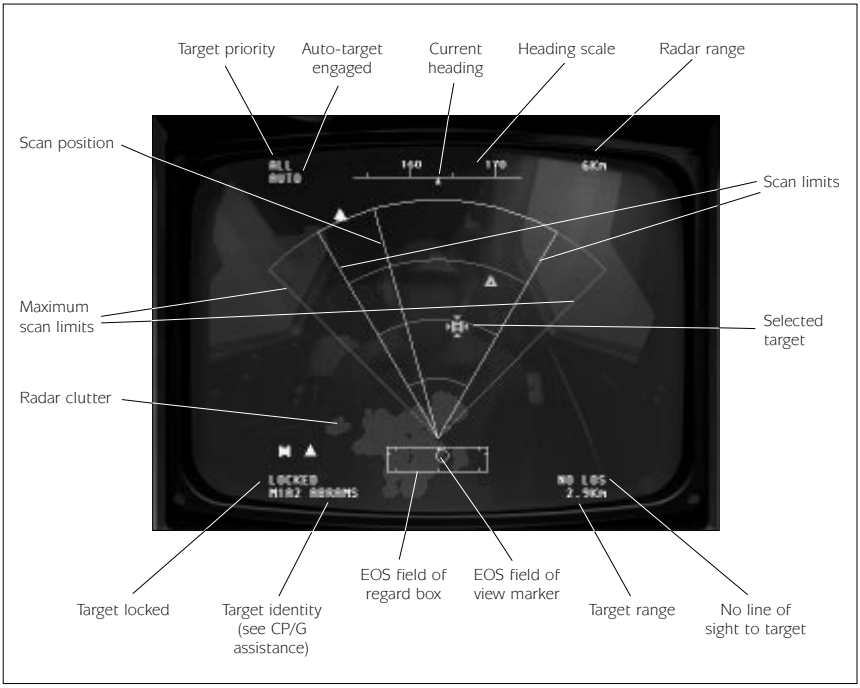


Diagram 6.7: *Ground radar display*

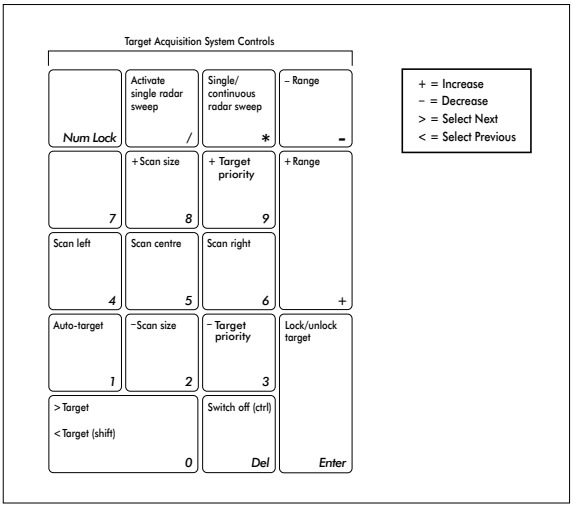


Diagram 6.8: *Ground radar controls*

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° 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 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 (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 and structures 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.

Air Radar

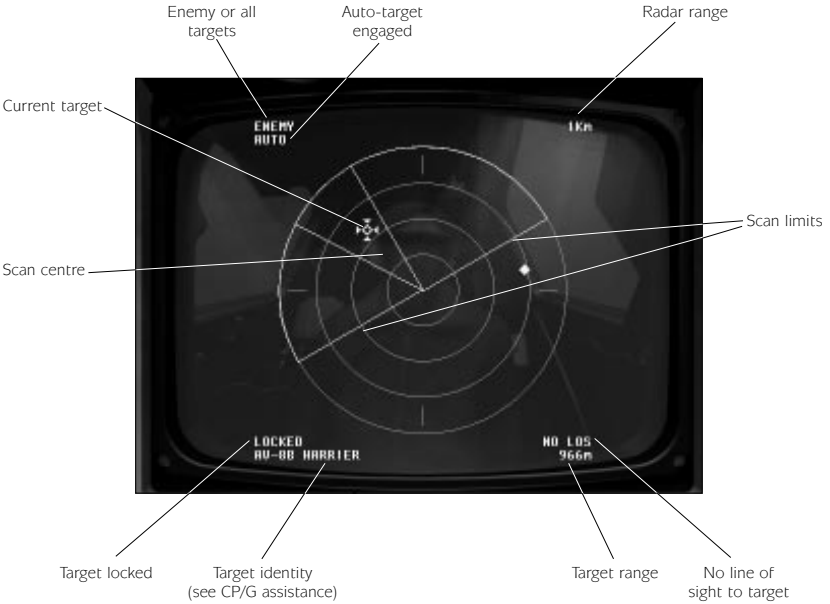


Diagram 6.9: *Air radar display*

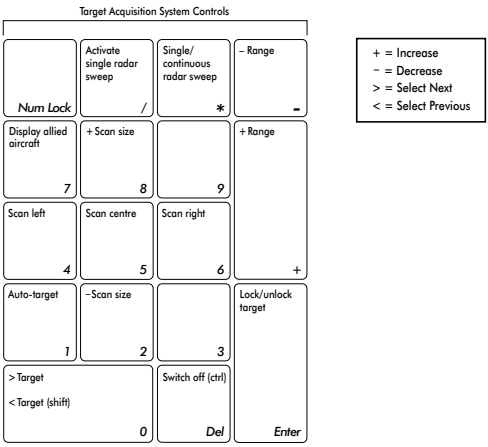


Diagram 6.10: *Air radar controls*

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

Range

Select air 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.

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.

Electro-Optical System (EOS)

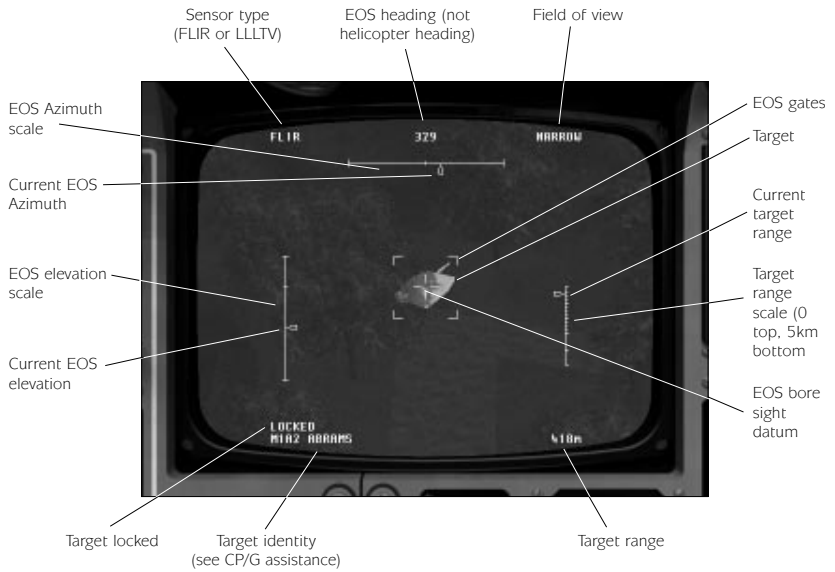


Diagram 6.11: *Electro-optical system display*

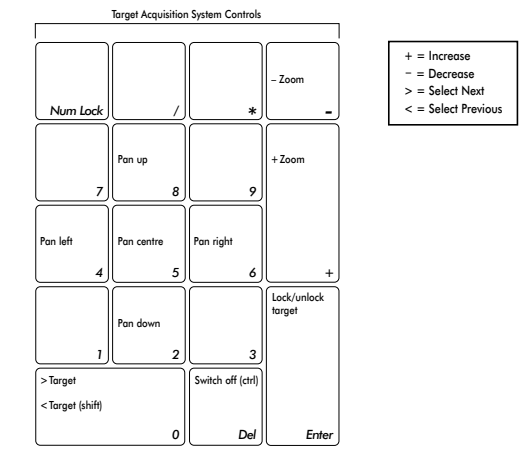


Diagram 6.12: *Electro-optical system controls*

The electro-optical surveillance system is located at the front of the helicopter below the distinctive rounded nose. The unit can move ±110° in azimuth (left or right) and from +13° to -40° in elevation (up or down). The turret gun can move the same amount and in synchronisation with the EOS. The system comprises a forward-looking infra-red (FLIR) channel, a low light level TV (LLLTV) channel and a laser range finder which provides target range data. The image from the EOS system is shown on the TV display.

The EOS is used to locate, identify and designate targets. If you have selected no target ID 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 "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 has 2 fields of view; medium and narrow. The LLLTV 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 Havoc you can see the EOS housing slew left and right as you steer it.

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.

Helmet-Mounted Sight (HMS)

The helmet-mounted sight enables the pilot to acquire targets simply by looking at them. Effectively the radar or 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 fixed cockpit or 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 helmet-mounted sight first select HMS mode Page Up and make sure that you have a weapon selected ←. The HMS will boresight targets near to the HMS datum. When a target is seen the target marker will appear.

If you have a fixed cockpit view press Enter to lock the target and the fixed cockpit view will pan automatically keeping the target in view. If you pan the virtual cockpit to locate a target then when the target marker appears release the virtual cockpit keys to track (padlock) the target. Locking the target will ensure that a different target is not acquired. You can return to a fixed cockpit view by pressing Ctrl + Enter .

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 is shown as a digital readout in kilometres.

The weapon type indicates the selected weapon:

Gun(HE)	30mm Turret Gun (high-explosive rounds)
Gun(AP)	30mm Turret Gun (armour piercing rounds)
Igla-V	Igla-V IR guided air-to-air missiles
Ataka	Ataka radio command guided anti-tank missiles
S-8	80mm unguided rockets
S-13	130mm 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
HMS	helmet-mounted sight

The target lock type indicates the weapon lock status:

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

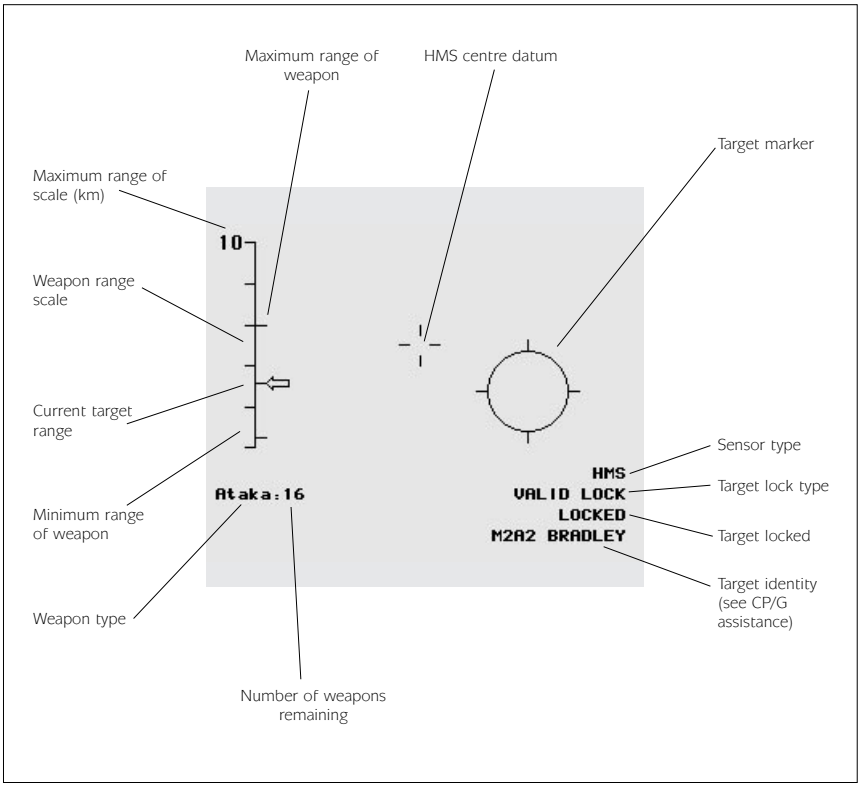


Diagram 6.13: *Helmet-mounted sight display – weapons covered in detail in the 'Weapons' section*

NO LOS	no line of sight to the target
NO BORESIGHT	the target must be ahead of the helicopter for rockets and cannon pod
MIN RANGE	the target is too near
MAX RANGE	the target is too far
VALID LOCK	the lock is good

Pan

Pan the HMS left, right up and down. These keys should be used with Ctrl or Shift for panning the fixed cockpit views and used 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 off.

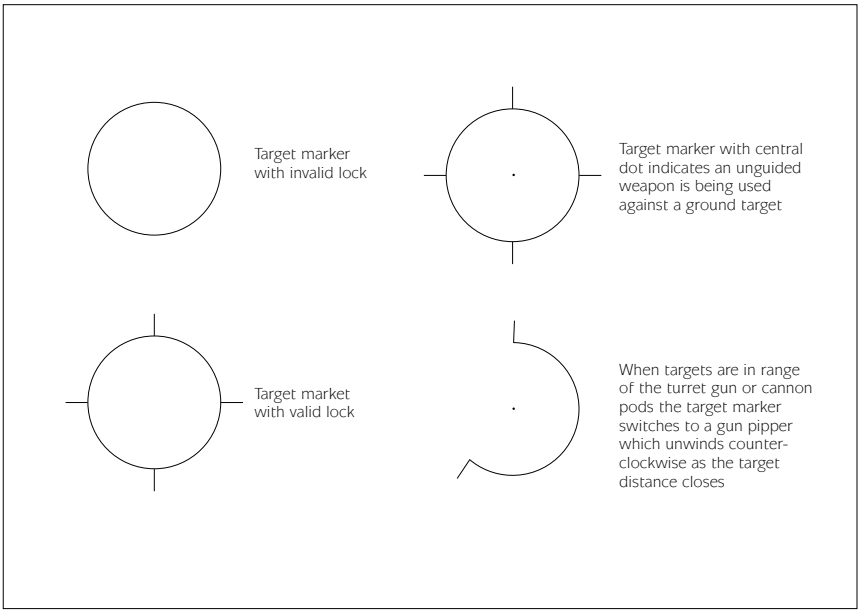


Diagram 6.14: *HMS display target marker*

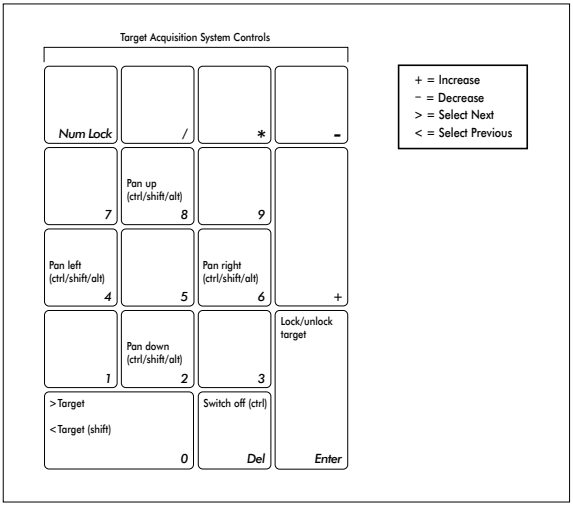


Diagram 6.15: *Helmet-mounted sight controls*

Weapons

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

The Havoc 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 helmet-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.
[Alt] + [←]	select turret gun.

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

Turret Gun

The Havoc has a powerful 30mm 2A42 cannon in the chin turret. The cannon is installed between two cartridge containers each holding 130 rounds. The gun is fed selectively from the containers allowing a choice of either high-explosive or armour-piercing ammunition.

The gun automatically tracks the selected target and can be rotated ±110° in azimuth (left or right) and from +13° to -40° 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 per round

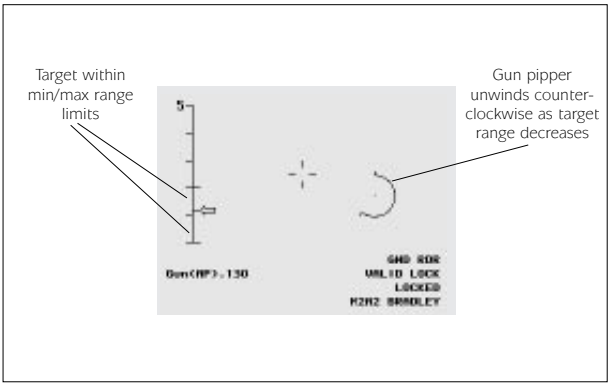


Diagram 6.16: *HMS display for turret gun showing valid ground target*

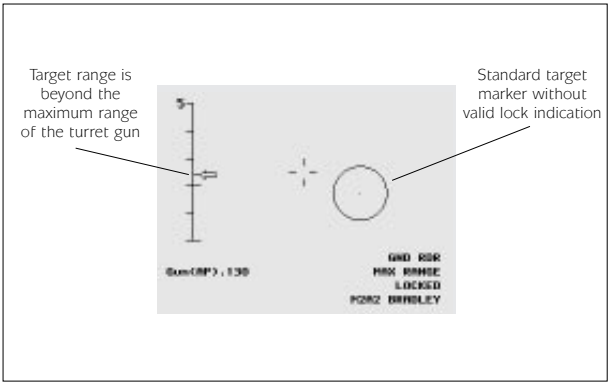


Diagram 6.17: *HMS display for turret gun showing out of range ground target*

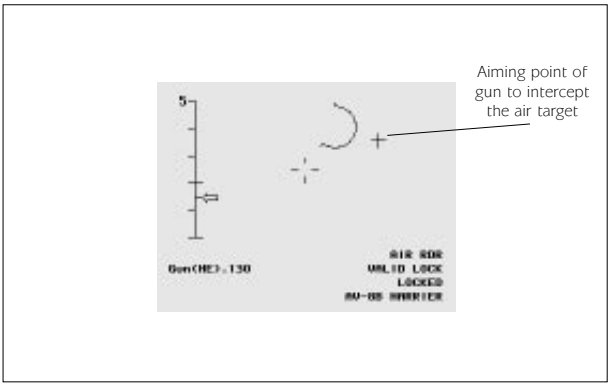


Diagram 6.18: *HMS display for turret gun showing valid air target*

Igla-V

The Havoc carries Igla-V short-range air-to-air guided missiles. They are mounted in racks of 4 so a maximum of 16 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°
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 therefore increase the kill probability.

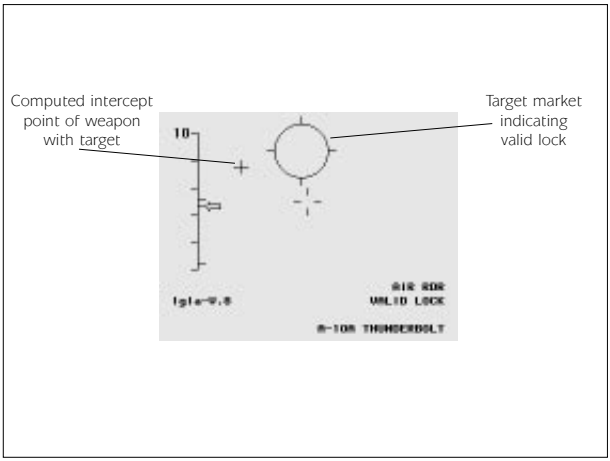


Diagram 6.19: *HMS display for Igla-V showing valid air target*

Ataka

The Havoc carries Ataka short-range anti-tank guided missiles. They are mounted in racks of 8 but can only be fitted to the outer hardpoints so a maximum of 16 missiles can carried.

The Ataka is radio-command guided via a transmitter in the Havoc's nose. 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 Ataka 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	radio-command
Maximum range	6,000 metres
Cruise speed	Mach 1.1
Seeker field of view	50°
Weight	42.5 Kg

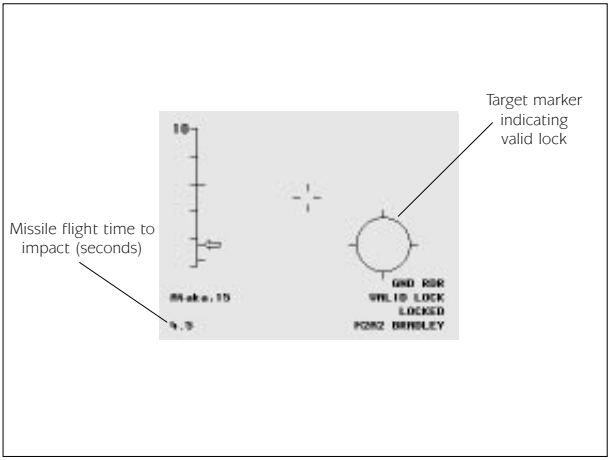


Diagram 6.20: *HMS display for Ataka showing valid ground target*

Unguided Rockets

The Havoc 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.

[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.

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

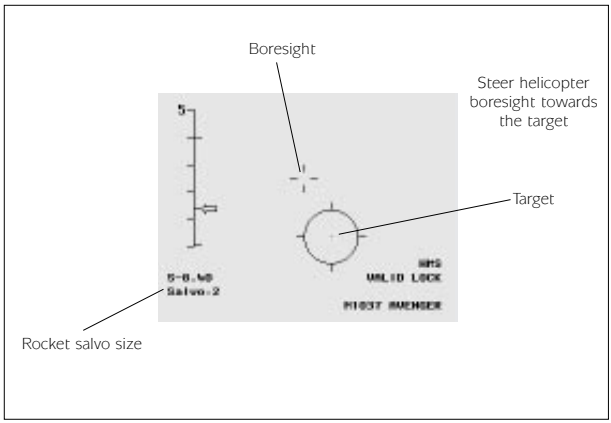


Diagram 6.21: *HMS display showing unguided rocket not lined up with ground target*

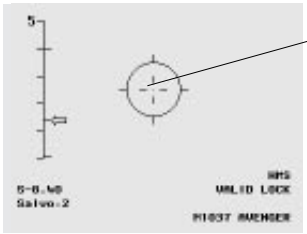


Diagram 6.22: *HMS display showing unguided rocket lined up with ground target*

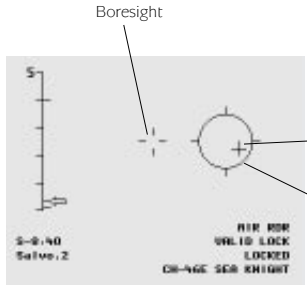


Diagram 6.23: *HMS display showing unguided rocket not lined up with air target*

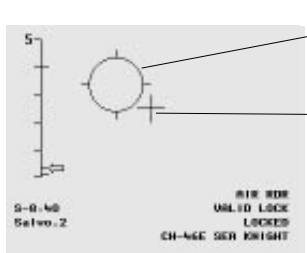


Diagram 6.24: *HMS display showing unguided rocket lined up with air target*

Cannon Pods

The Havoc 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 per round

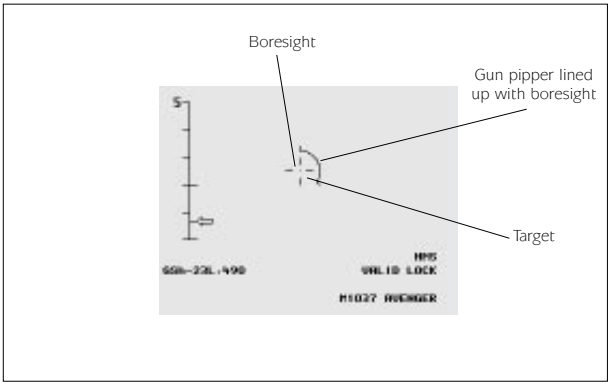


Diagram 6.25: *HMS display showing cannon pods lined up with ground target*

Countermeasures

When the threat warning display indicates a radar or infra-red threat then the following counter measures 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.

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 to the enemy. Use your jammers when required and do not forget to turn them off.

The disadvantage of chaff and flares is that they run out! The Havoc carries 30 of each.

Automatic Countermeasures

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

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

Ctrl + C automatic countermeasures on/off.

When automatic countermeasures are active the AC status light is illuminated.

Night Vision Goggles (NVG)

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

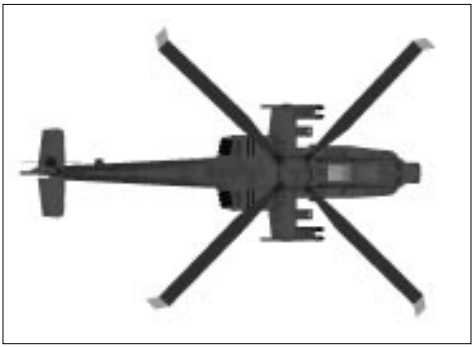
N NVG on/off.

7. RECOGNITION GUIDE

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: Reconnaissance/attack

RAH-66 Comanche

Recognition features:

- 5-bladed 'low-profile' main rotor and integral 'fenestron' tail rotor
- distinctive angular stealth fuselage design
- tandem cockpits with single flush-sided canopy
- angular engine nacelles/inlets
- nose mounted TADS/PNVS turret
- weapons pylons retractable into internal bays
- retractable undercarriage and tail wheel

Armament:

- 20mm cannon
- AIM-92 Stinger IR guided air-to-air missiles
- AGM-114L Longbow Hellfire radar guided anti-tank missiles

Decoys:

- chaff
- flares

Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**
- stealth features reduce radar signature

USA COMBAT HELICOPTERS

Type: Attack/assault

UH-60 Black Hawk

Recognition features:

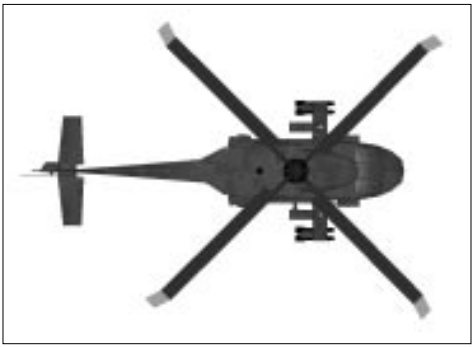
- 4-bladed main rotor and 4-bladed tail rotor
- twin seat side-by-side cockpit
- low and wide appearance to main fuselage section with flat underside and elongated nose
- sliding doors on either side of main cabin
- IR suppressors fitted to engine exhaust outlets
- external stores supports for weapon 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

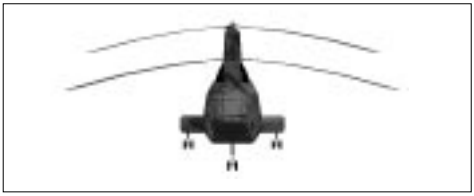
CH-46E Sea Knight

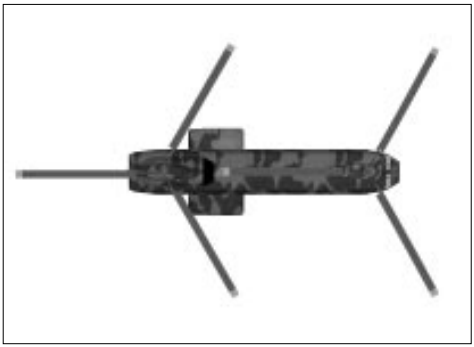
Recognition features:

- 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

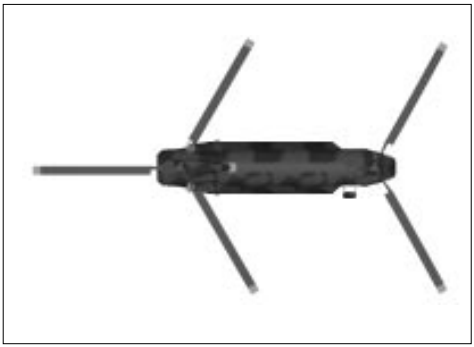
CH-47D Chinook

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 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:

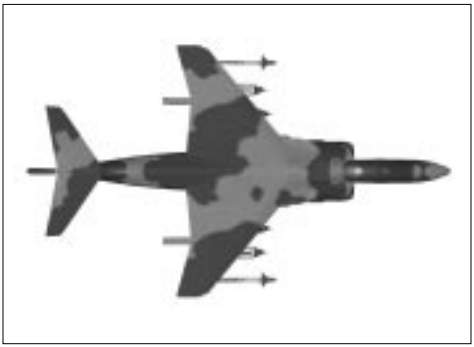
- high-wing, swept leading and trailing edges, sharp downward cant
- swept tail fin, downward canted all-moving tail plane
- compact bulbous fuselage with rounded main air intakes immediately aft of either side of cockpit
- short nose with 'up-front' cockpit arrangement
- thrust vectoring nozzles under 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 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: H
- 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: H
- 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: H
- 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: H
- 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

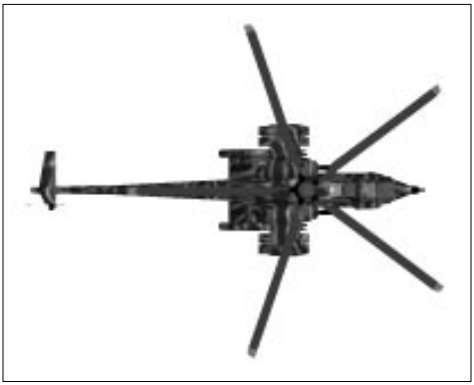
Game notes:

- 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

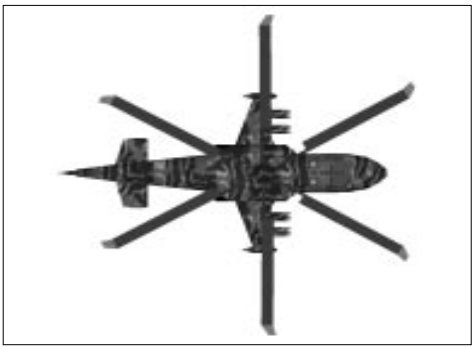
Game notes:

- radar symbol: ⋈
- ground radar priority: **medium**

RUSSIAN COMBAT HELICOPTERS

Type: Reconnaissance/attack

Ka-52 Hokum-B



Recognition features:

- twin 3-bladed co-axial main rotors (no tail rotor)
- twin seat side-by-side cockpit
- distinctive main tail fin and tail plane with endplate fins
- engine nacelles each side of fuselage
- nose-mounted FLIR turret, mast-mounted radome
- stub wings with weapons pylons and wing-tip 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

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:

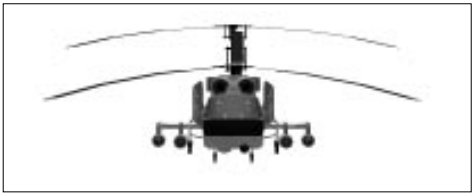
- twin 3-bladed co-axial main rotors (no tail rotor)
- twin seat side-by-side cockpit
- short rectangular section fuselage with distinctive flat nose and tail plane with endplate fins
- hinged loading doors on either side of main cabin
- weapon pylons supported on outboard racks
- fixed 4-wheeled undercarriage 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:

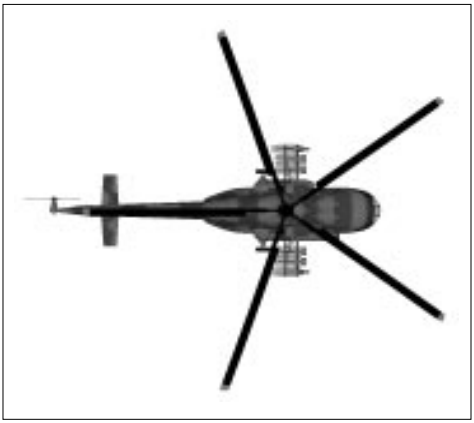
- 5-bladed main rotor and 3-bladed tail rotor
- twin seat side-by-side cockpit inside glazed nose
- long rounded main fuselage and slender tail boom
- rear fuselage has 'clam shell' cargo hold doors
- IR suppressor fitted to engine exhaust outlets
- weapon pylons supported on outboard racks
- fixed tricycle 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

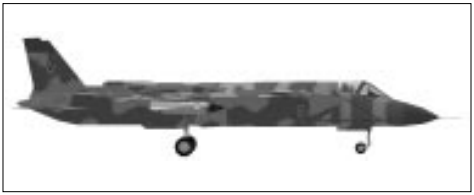
Game notes:

- 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

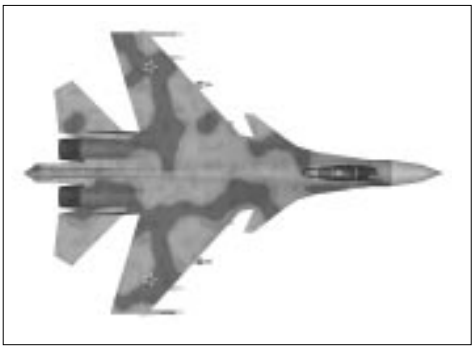
Game notes:

- 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 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:

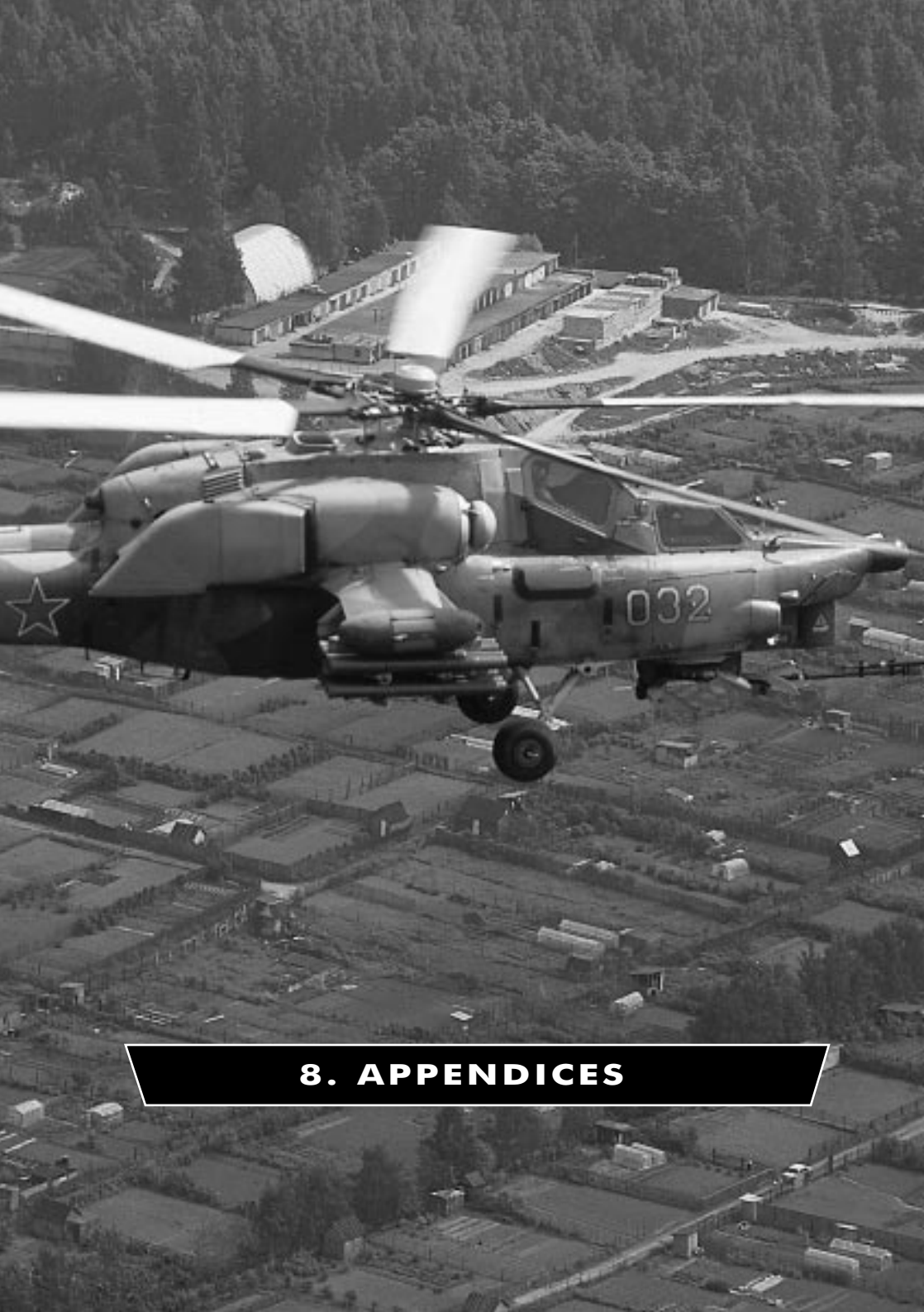
- long and wide high-sided hull with curved upper edge and rounded overhanging bow section over loading ramp below, high-sided all-round inflatable skirt with enlarged curved bulge under bow door
- twin forward-mounted gun turrets either side of bow
- low and wide forward bridge section with squat lattice 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



8. APPENDICES

Acronyms

AAA Anti-Aircraft Artillery ("Triple A")
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
CAP Combat Air Patrol
CAS Close Air Support
CP/G Co-Pilot/Gunner
DTV Daylight TV
DVO Direct View Optics
ECM Electronic Countermeasures
EO Electro-Optical
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
HMS Helmet Mounted Sight
HSI Horizontal Situation Indicator
HUD Head Up Display
IFV Infantry Fighting Vehicle
IHADSS Integrated Helmet And Display Sighting System
IR Infra-Red
LLLTV Low Light Level TV
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
MPSM Multi-Purpose Sub-Munitions
MRLS Multiple Rocket Launch System
NOE Nap Of the Earth
NVG Night Vision Goggles
PNVS Pilot Night Vision Sensor
RWR Radar Warning Receiver
SAM Surface to Air Missile
SEAD Suppression of Enemy Air Defences
TADS Target Acquisition and Designation System
TOW Tube-Launched, Optically-tracked, Wire-guided
TSD Tactical Situation Display
TWD Threat Warning Display
VSI Vertical Speed Indicator

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