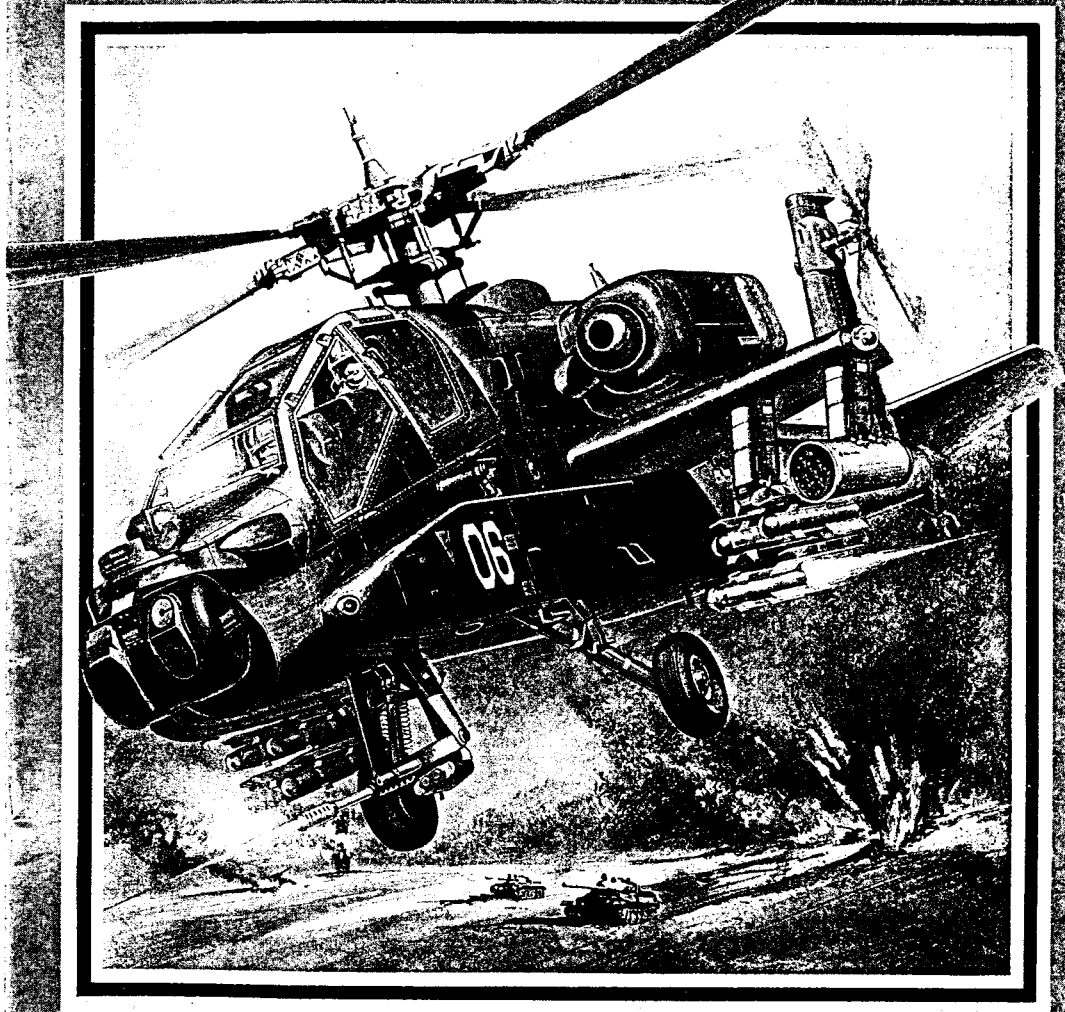


ONLY THE BEST BECOME A...  
**FIGHTER PILOT**  
**ATARI**  
 400/800/600 XL  
 800 XL/130 XE  
 WITH AT LEAST 48K.  
 BY D.K. MARSHALL  
 ADAPTED BY NIK SEN

**SUZUKI**  
**RACER**  
 "Unbelievably realistic"  
 Paul Lewis, Sports Illustrated  
 Great Suzuki/Casco  
 Competition  
 DIGITAL INTEGRATION **D**

# TOMAHAWK<sup>®</sup>

## HELICOPTER FLIGHT SIMULATION



**AMSTRAD**  
 PCW 8256/8512  
 BY D.K. MARSHALL  
 ADAPTED BY DARRELL D.

**DIGITAL INTEGRATION**  
**D**  
 JOYSTICK COMPATIBLE

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 ter. It may not be transmitted, copied,  
 itten permission of

### Loading Instructions

1. Switch on computer.
2. Hold disc by labelled end.
3. Insert disc into drive A (top drive). If already in CPM mode, press 'SHIFT', 'EXTRA', and 'EXIT' simultaneously.
4. Program will load automatically to display title page.
5. Select language by pressing E for English, D for Deutsch, or F for Français.
6. Select options from menu page.

### 3D real-world display:

Features include landing pads, buildings, trees, transmission pylons, mountains, enemy tanks, field guns and helicopters. Ground texture is visible when flying below 500 feet to enhance the sensation of speed. It is possible, with practice, to fly between trees and mountain peaks.

### MENU OPTIONS

**MISSION 1 - FLYING TRAINING** - Used for helicopter familiarisation and developing ground attack skills. Enemy ground forces will not return fire. Each sector contains 8 enemy targets, either field guns or tanks, giving a total of 1024 possible targets across the complete map. Proceed to an adjacent sector after destroying all targets in your present sector, either by flying directly or landing at a pad and using the joystick (method described later under 'MAP'). Refuel and reload with ammunition as necessary.

**MISSION 2 - COMBAT** - This is a short mission involving the invasion of four allied sectors by enemy ground forces. By selecting the map mode, you will see the sectors in question, flashing to indicate the presence of hostile forces. Your mission is to liberate the four sectors by destroying the ground targets, each sector taking typically 10 minutes to clear. After destroying all targets the mission is completed by landing at the nearest helicopter pad and closing the throttle.

**MISSION 3 - COMBAT** - Surrounded totally by enemy territory, your mission is to liberate the entire map from enemy occupation. Each hostile sector becomes allied as the ground targets are cleared, thus allowing you to land and reload with weapons etc.

**MISSION 4 - COMBAT** - A strategic battle for occupation of the entire map. Your task is to support allied ground forces in their battle along the front line. As each sector is cleared of enemy ground forces, the front line will progress to the right until you have cleared a complete row. Likewise, if the enemy succeeds in destroying your ground forces, the sector will become hostile territory and the front line will progress to the left. Once a row is completely liberated or occupied, it is out of the game.

n.b. in all COMBAT missions the enemy will fire back! The simplest approach is to use the laser-guided missiles to destroy the enemy as soon as possible, but points scored will be lower than using rockets or guns.

In the heat of the battle, care must be taken to avoid landing in enemy territory if you are damaged or need to reload or refuel. Check for enemy occupation before landing by inspecting the map.

**2 DAY OR NIGHT - Daytime:** horizon visible. Nighttime: no horizon, computer-enhanced infrared imaging. (Pilots' Night Vision System.)

**3 CLEAR OR CLOUDY** - option for overcast sky with selectable cloudbase for instrument flying.

**4 CLOUDBASE** - selectable from 50 ft to 5000 ft.

**5 CROSSWINDS & TURBULENCE** - for the experienced pilot! Variable crosswind & turbulence effects.

**6 PILOT RATING** - TRAINEE  
SQUADRON  
INSTRUCTOR  
ACE

The pilot rating is equivalent to difficulty level and varies potency of enemy. With each increase in pilot rating, the enemy's accuracy doubles!

**7. KEYBOARD or JOYSTICK**

### INSTRUMENTS:

#### TADS

Target Acquisition & Designation System - Used to identify and track tanks, field guns and helicopters, allied or enemy. Includes range readout in feet when target is less than 10,000 feet away.

**VDU** - Visual Display Unit

Speed, in knots, displayed in reverse video when flying backwards.

Altitude, feet

**VSI** - Vertical Speed, ft/sec (arrow UP = climb, arrow DOWN = descent)

**TIME** - Time to reach target, in hours and minutes (hashed if greater than 4 hrs, zero if less than 1 minute)

**RANGE** - autoranging navigation computer

Within 0.1 mls: resolution in feet

Within 4.9 mls: resolution in 0.1 mls

Over 5 mls: resolution 1 mile.

#### ARTIFICIAL HORIZON

Shows attitude of helicopter relative to the ground. For example, if the helicopter rolls right, then the artificial horizon will roll to the left and vice versa.

#### DOPPLER NAVIGATION/COMPASS

Headout of Heading, Bearing & Track. Heading: direction in which the helicopter is pointing.

Track: flight path direction.

Bearing: heading required to point at objective.

Note: a helicopter can be pointing in one direction (Heading) but moving in a different direction (Track) e.g. sideways! Match the heading to the target bearing to intercept target. The flashing dot indicates relative bearing of target.

Four modes:

B: Beacon navigation (8 beacons)

H: Landing Pad guidance (4 pads per sector)

T: Ground target tracking (8 targets per sector)

Lightning symbol: enemy helicopter interception

Flashing symbol warns of approaching enemy helicopter.

#### CONTROLS

**THROTTLE** - key W to open throttle

key S to close throttle

Controls engine/turbine rpm. Normally set to fully open unless practising engine-off landings. Assisted in flight by computerised autothrottle control.

**COLLECTIVE LEVER** - key Q increases lift  
key A decreases lift

This is basically a vertical lift control used for take-off to the hover, and forward thrust control in straight & level flight.

#### CYCLIC CONTROL

joystick forward (cursor key ↑) tilts nose down

joystick back (cursor key ↓) tilts nose up

joystick right (cursor key →) to roll right

joystick left (cursor key ←) to roll left

### MAP

Use key M to select map or to return to normal display. Your helicopter is shown by the flashing symbol with a tail. Enemy helicopters are shown without a tailplane. Beacons 0 to 7 are used for navigation purposes.

By selecting MAP mode when sitting on any allied pad, the helicopter may be moved to another allied sector by using cursor keys or joystick.

This feature eliminates the need for lengthy straight and level flight to visit each sector.

When training (Mission 1), all sectors are allied and any landing pad may be used for refuelling, rearming or repairs. All sectors contain enemy tanks and field guns for target practice.

In combat missions, territory is distinguished by black (Allied) sectors and green (hostile) sectors. A flashing black sector indicates the presence of enemy forces in allied territory. Likewise, a flashing green sector indicates the presence of allied forces in hostile territory. You will be captured by the enemy if you touchdown in hostile territory.

The destruction of all enemy forces in a hostile sector will result in the sector becoming allied. Likewise, if all allied forces in a sector are destroyed, the sector becomes hostile.

The map is designed to "wrap around" at the edges i.e. when flying off the map, the helicopter will reappear at the opposite edge.

### COMPLETION OF MISSION

A mission is completed when all enemy ground forces have been destroyed and you have returned safely to a landing pad. After touchdown, close the throttle to bring the turbine and rotor rpm to zero. A complimentary mission report will follow.

### PILOT'S NOTES

The controls in a real helicopter are "proportional", i.e. their effect is proportional to the displacement from centre. It is not possible to implement this feature on the joystick since it contains simple on/off microswitches. By making the effect of each control proportional to how long the joystick is held, a simple approximation to "real" controls has been achieved, i.e. momentary operation of the joystick for line control, and hold to build up a rapid rate. This does however mean that the joystick must be operated repeatedly for manoeuvres such as a steady turn or to hold a steady pitch angle.

Helicopters are naturally unstable and difficult to fly without auto-stabilisation. The Apache is fitted with Digital Automatic Stabilisation Equipment (DASE) making it far easier to fly than most modern helicopters.

### Take-off procedure:

- 1 Ensure that collective indicator is at minimum.
- 2 Select full throttle - key W - hold pressed until throttle indicator at maximum.
- 3 Wait for turbine rpm & rotor rpm to reach 100%.
- 4 Increase collective pitch by pressing key Q until lift-off occurs. VSI indicates vertical speed in ft/sec.
- 5 Reduce collective (key A) to achieve hover i.e. VSI = 0. The helicopter is now hovering above the helipad.
- 6 Turning on the spot is accomplished by applying left or right rudder (Z or X).

### Transition to forward flight from hover

- 1 Increase collective (key Q) to between 80% to 100% Torque. Reduce collective (key A) if overtorque warning sounds.
- 2 Tilt nose of helicopter downwards (key ↑ or joystick forward) to between 15 and 30 degrees.

**RUDDER** - key X to yaw right  
key Z to yaw left

### DOPPLER MODE

Key C selects between beacon mode (B), landing pad mode (H), ground attack mode (T) or air-to-air mode (lightning symbol) on DOPPLER/COMPASS instrument. Hold down key to cycle through modes.

key N selects "next objective" in each mode:

- 8 beacons (0 to 7)
- 4 landing pads per sector (0 to 3)
- 8 enemy targets per sector (0 to 7)
- 1 enemy helicopter

### WEAPON SYSTEMS & TARGET ATTACK

When in ground attack or air-to-air mode, the weapons systems are activated. The helicopter must be airborne to fire its weapons. Select between gun, rockets or missiles using key P. The gun & rockets are manual tracking, only i.e. the target must be in the sights when the weapon is launched or for the TADS to operate. The missile system locks on to any hostile target passing through the sights & lock-on is depicted by a Solid Square. Tracking is automatic if the target remains on screen.

**GUN** - vert/horz sights - range 2000 ft  
1200 rounds 30mm ammunition, 750 rounds/min.

**ROCKET** - diagonal sights - range 4000 ft  
38 unguided rockets (19 each side).

**MISSILES** - square sights - range 3.1 mls  
8 Hellfire missiles - laser guided, auto-tracking

**FIRE BUTTON** - SPACE BAR or fire button on joystick.

The time for a weapon to reach a target will depend on how far the target is away. It is possible to locate and destroy enemy targets in both map mode and in cloud.

During combat, enemy fire is indicated by flak. The screen will flash if the helicopter is hit. Damage to helicopter systems is indicated on the failure status panel, and structural damage is shown by the Doppler helicopter symbol.

A third structural hit is fatal! The chances of being hit by the enemy are decreased by swerving during the attack. You have a total of 3 helicopters per mission. Study the mission report for crash evaluation and performance report.

If an enemy helicopter is approaching, a warning symbol will be flashed on the Doppler instrument if you are not in air-to-air combat mode. You are advised to select air-to-air combat mode and destroy the enemy helicopter before he gets too close!

### Scoring Scheme

Weapon Used	Field gun	Tank	Helicopter	Target
Gun	20	20	100	10
Rockets	10	20	50	25
Missiles	5	10	25	Points Scored

It is not possible to destroy a tank with the chain gun. Destruction of allied forces will result in total loss of score. Although it is much easier to hit a target with a missile, fewer points will be scored. The enemy will begin to fire back at a range over 4000 and 5000 feet, making it much more dangerous to use guns (range 2000 ft) but the points scored will be higher.

3 Speed will be seen to increase. Autostabilisers will slowly raise the nose of the helicopter to a level attitude.

4 Reduce collective (key A) to adjust for VSI = 0 ft/sec i.e. not climbing or descending.

The helicopter will now be cruising at a steady forward speed. The Apache is a very agile helicopter. From a stable hover, it can reach 100 kts in approx. 6 seconds by pulling 100% torque and tilting the nose downwards to approx. 30 deg.

#### Straight & Level Flight

Forward speed is related primarily to the torque setting & hence the collective lever setting, assuming the helicopter is not autorotating (explained later). Typical speed/torque settings are as follows:

Torque	Speed
44%	60 kts
60%	119 kts
75%	147 kts
100%	159 kts

These values will vary slightly with altitude and changes in helicopter weight resulting from fuel consumption and weapon release. The Apache is fitted with a computer-controlled stabilator which enables the helicopter to cruise at any speed with the fuselage level.

#### Turning Flight

Providing that the forward speed is greater than 60 kts, turning is achieved by simply banking left or right. Some vertical lift will be lost when banking and the helicopter will begin to descend. This may be counteracted by increasing the collective setting. The helicopter will tend to slow down in a turn unless the pilot dives to sacrifice height to maintain speed.

At speeds under 60 kts, the helicopter will tend to "drift" into the turn, shown by the sideslip ball at the bottom of the artificial horizon. Turns may be assisted by applying the rudder, but this will reduce forward speed.

Fluctuations in rotor rpm occur during a turn because of g force effects. The autofrottle will adjust the turbine rpm accordingly to keep the rotor rpm at approximately 100%.

#### Slowing down & returning to the hover

1 Gently raise the nose of the helicopter by pulling back on the joystick (key J). The aircraft will begin to slow down and also climb. Maintain the nose-up attitude by repeatedly pulling back on joystick (gently).

2 Reduce the rate of climb by reducing collective (key A) to keep VSI to approximately zero. As the forward speed drops below 60 kts, increase collective (key C) to counteract sink rate. Allow nose of helicopter to return to level flight as speed approaches zero.

3 Adjust collective as required to achieve a VSI of zero. The helicopter should now be in a stable hover.

4 The helicopter will also slow down when turning, providing that it is not in a dive. Banking repeatedly left and right is another common method of slowing down.

5 Providing that the forward speed is less than 60 knots, the pilot may apply rudder to increase sideslip (sideways drift). The helicopter will slow down dramatically as a result of the large drag forces generated.

#### Landing

The helicopter may be landed from the hover (vertical descent) or at forward speeds of less than 60 kts.

(a) From hover: Lower the collective lever to maintain a steady rate of descent. Maximum VSI at touchdown = 12 ft/s. Ground cushion effect will be experienced below 30 ft, resulting in reduction of the descent rate.

(b) Rolling touchdown: With a forward speed of less than 60 kts, gently lower the collective lever to begin descent. Max VSI at touchdown = 12 ft/s. After touchdown, the helicopter will slow down and eventually stop. Steer on the ground by using rudder control.

#### Taxiing on ground

The helicopter may be taxied on the ground, up to a maximum speed of 60 kts, providing that the engine/rotor rpm are at 100%. Assuming that the helicopter is stationary, raise the collective lever to produce about 20% torque. Pushing forward on the joystick will accelerate the aircraft, and likewise pulling back will decelerate and eventually stop. Steer by using the rudder.

#### Refuelling/Rearming/Repairs

By landing or taxiing onto a helipad (not an enemy one!) the aircraft may refuel, reload with weapons, and be repaired. Once on the pad, close the throttle to bring turbine & rotor rpm to zero. The helicopter will be serviced and prepared for the next take-off immediately.

#### Backward & Sideways Flight

Starting from the hover, the helicopter may be flown backwards by raising the collective lever and raising the nose to approximately 10 deg. The speed readout will turn white to denote backward flight. Keep the nose of the helicopter pitched up to sustain speed. Likewise, the helicopter may be flown sideways by rolling left or right and raising the collective lever. The speed readout does not show sideways speed and the pilot must watch the sideslip indicator below the artificial horizon in order to monitor sideways drift.

#### Torque Turn

This manoeuvre allows the pilot to perform a 180 deg turn with a dramatic climb & simultaneous turn. With a forward speed of 100 kts or more, pull the nose of the aircraft up to approx 70 deg pitch. Hold this nose-up attitude until the speed drops to approx 60 kts. Release joystick & apply rudder until heading has changed by approx 160 deg. Release rudder, adjust roll to zero if necessary and accelerate with nose down attitude. During this manoeuvre, the helicopter will roll, pitch & yaw simultaneously, pulling out on a reciprocal heading.

#### Aerobatics

The Apache may be flown safely within the following limits: Pitch  $\pm$  90 deg  
Roll  $\pm$  110 deg

Control response may become unpredictable outside these limits i.e. loops & rolls are NOT recommended!

#### Autorotation

Autorotation is equivalent to the helicopter "gliding" through the air and is used when the pilot wishes to descend rapidly or after engine failure. During autorotation, the rotor blades are being driven by airflow through the rotor disc as the helicopter descends. This reduces the power required from the engines and the engine RPM is automatically reduced to maintain 100% rotor speed and the "split" between turbine rpm & rotor rpm can be seen on the bar scales. Autorotation is best performed at approximately 60 kts, and above 500 ft. Entry into autorotation is made by gently lowering the collective lever.

#### (a) Engines active

As the descent rate builds up, the automatic throttle control will be seen to reduce the turbine rpm. Any fluctuations in rotor rpm will be compensated automatically by the autofrottle. As the altitude falls to below 200 feet, the pilot should begin to pull the collective lever up to reduce the rate of descent, accompanied by raising the nose of the helicopter if he wishes to slow down. With practice, the pilot will co-ordinate increasing the collective and adjusting the pitch angle in order to slow down to the hover just a few feet above the ground.

#### (b) Engine-off landings

In the event of failure of both engines or if the pilot deliberately closes the throttle in flight, engine rpm will reduce to zero. The pilot must respond quickly by lowering the collective lever before the rotor blades slow down too much. Rotor rpm is controlled during the descent by careful adjustment of the collective lever. Keeping the helicopter level and the speed between 50 & 60 kts, raise the collective lever just before touchdown to bring the rate of descent to below 12 ft/sec.

#### Warnings - limits worth noting!

1. The maximum permissible speed of Apache is 197 kts, in a dive. If the speed should rise above this, the pilot will get an audible warning. If he continues to increase his speed, the helicopter will shed a rotor blade at 210 kts, resulting in catastrophic loss of control!
2. If the pilot demands too much power from the engines (overtorque), the engine temperature will rise and an audible warning will occur. If this warning is ignored, the engines will overheat and eventually fail. It is possible to hover and fly on one engine but flying time is limited if both engines have failed!

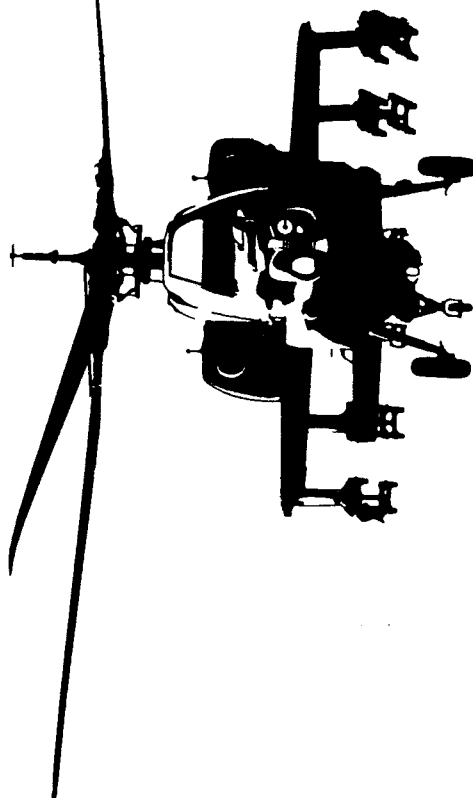
#### Features of TOMAHAWK:

- Spectacular 3D real world display
- Fully aerobic (within limitations of real helicopter)
- Ground attack & air-to-air interception
- Over 7000 ground features
- Day/night vision systems
- Cloudy conditions, crosswinds & turbulence
- Doppler navigation & target tracking system
- Laser guided missiles, plus rockets & 30mm chain gun
- Selection of training and combat missions
- Pilot ratings - Trainee to Ace

#### Acknowledgements

Digital Integration would like to thank McDonnell Douglas Helicopters for their technical assistance during the design of TOMAHAWK. We would also like to thank the many pilots who kindly assisted in the testing and evaluation of this product.

All information stated herein is accurate to the best of our knowledge. Although considerable effort has been given to achieving a realistic simulation, approximations have been made due to the limitations of the computer and certain technical data not being available to the public.





### SUMMARY OF CONTROLS

- ← Roll LEFT (joystick left)
- ↑ Pitch UP (joystick back)
- ↓ Pitch DOWN (joystick forward)
- Roll RIGHT (joystick right)
- Z LEFT rudder
- X RIGHT rudder
- C Change mode of Doppler

- N Next objective
- P Select weapon system
- Q Increase collective
- A Decrease collective
- W Open THROTTLE
- S Close THROTTLE
- M MAP
- H Pause
- SPACE FIRE button
- SHIFT STOP to Abort mission & return to menu.

### ÜBERSICHT/ANGABE DER STEUERGERÄTE

- Nach links rollen (Steuerknüppel nach links)
- Steigungssteuerung (Steuerknüppel zurück) erhöhen
- Steigungssteuerung (Steuerknüppel nach vorne) senken
- Nach rechts rollen (Steuerknüppel nach rechts)
- Z LINKES Steuerrohr
- X RECHTES Steuerrohr

- C Dopplermodus Wechsel
- N Nächstes Ziel
- P Waffensystem wählen
- Q Nichtperiodische Steigungssteuerung erhöhen
- A Nichtperiodische Steigungssteuerung senken
- W Vergaser öffnen
- S Vergaser schließen
- M Karte
- H Pause
- LEERTASTE Scheißdrucker
- SHIFT STOP um den Einsatz abzubrechen & und zu dem Menu zurückzukommen

### INSTRUMENT PANEL NOTATION

- 1 Collective lever
- 2 Torque % (a) Engine 1 (b) Engine 2
- 3 RPM % (a) Engine 1 (b) Rotor blades (c) Engine 2
- 4 Throttle indicator
- 5 TADS - Target Acquisition & Designation System
- 6 Fuel level
- 7 Engine temperature
- 8 Pilot's Visual Display Unit
- 9 Speed, in knots
- 10 Altitude, in feet
- 11 Time to objective, hours & mins
- 12 Vertical speed indicator, VSI, feet per sec

- 13 Distance from objective, in feet or miles
- 14 Artificial Horizon
- 15 30mm chain gun ammo supply
- 16 Rockets
- 17 Hellfire Missiles
- 18 Sideslip (drift) indicator
- 19 Doppler Navigation/Compass
- 20 Heading
- 21 Bearing
- 22 Track
- 23 Engines
- 24 Weapons
- 25 Nav computer
- 26 TADS
- 27 Score
- 28 Altitude units of 10 ft
- 29 Altitude units of 100 ft

### INSTRUMENTTAFEL DARSTELLUNG

- 1 Nichtperiodische Steigungssteuerung
- 2 Drehmoment % (a) Motor 1, (b) Motor 2
- 3 RPM %, (a) Motor 1, (b) Rotorblätter, (c) Motor 2
- 4 Vergaseranzeiger
- 5 TADS Zielerfassungs- und Bezeichnungssystem
- 6 Kraftstoffstand
- 7 Motortemperatur
- 8 VDU Bildsichtgerät des Piloten
- 9 Geschwindigkeit in Knoten
- 10 Höhenlage in Fuß
- 11 Zeit bis Ziel, Stunden & Minuten
- 12 VSI vertikaler Geschwindigkeitsanzeiger
- 13 Entfernung vom Ziel, in Fuß oder Meilen
- 14 Kunststlicher Horizont

- 15 30mm Kettengeschoss Munitionsversorgung
- 16 Raketen
- 17 Hellfire Lenkwaffen
- 18 Schiebefluganzeiger (Abtrieb)
- 19 Dopplernavigationskompass
- 20 Steuerkurs
- 21 Peilung
- 22 Kurs
- 23 Motore
- 24 Waffen
- 25 Nav Computer
- 26 TADS
- 27 Spielstand
- 28 Höheneinheiten von 10 Fuß, (3m)
- 29 Höheneinheiten von 100 Fuß, (30m)

### RECAPITULATION DES COMMANDES

- ← Roulis vers la gauche (manche vers la gauche)
- ↑ En cabre (manche vers l'arrière)
- En piqué (manche vers l'avant)
- ↑ Roulis vers la droite (manche vers la droite)
- Z Gouvernail de direction vers la GAUCHE
- X Gouvernail de direction vers la DROITE
- C Modifier mode de Doppler
- N Objectif suivant
- P Sélection système armement

- Q Augmente pas général
- A Diminue pas général
- W Ouvrir MANETTE
- S Fermer MANETTE
- M CARTE
- H Pause
- SPACE Bouton FEU
- SHIFT STOP Abandon de la mission et retour au menu

### NOMENCLATURE DU TABLEAU DE BORD

- 1 Levier de pas général (collectif)
- 2 Couple % (a) Moteur 1, (b) Moteur 2
- 3 Régime % (a) Moteur 1, (b) Pales de rotor, (c) Moteur 2
- 4 Position de la manette
- 5 SADC - Système d'Acquisition et de Désignation du Cible
- 6 Niveau carburant
- 7 Température moteur
- 8 Unité affichage pilote
- 9 Vitesse en nœuds
- 10 Altitude en pieds
- 11 Temps nécessaire pour atteindre objectif, heures/minutes
- 12 Variomètre (indicateur de vitesse verticale), pieds par seconde
- 13 Distance de l'objectif, en pieds ou milles.

- 14 Horizon artificiel
- 15 Alimentation munitions pour canon à chaîne 30 mm
- 16 Fusées
- 17 Missiles Hellfire
- 18 Indicateur de derapage (dérive latérale) (niveau Vinot)
- 19 Navigation Doppler/boussole
- 20 Cape
- 21 Gisement (azimut)
- 22 Cap (parcours)
- 23 Moteurs
- 24 Armes
- 25 Ordinateur navigation
- 26 SADC
- 27 Compte des points
- 28 Unites d'altitude de 10 pieds (3m)
- 29 Unites d'altitude de 100 pieds (30m)

Tableau état défauts



### SUMMARY OF CONTROLS

- ← Roll LEFT (joystick left)
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- ↑ Pitch DOWN (joystick forward)
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