DC DESIGNS AV-8B
HARRIER II

OPERATIONS MANUAL

Welcome to the *DC Designs* AV-8B Harrier II. This manual will guide you through the operation of the aircraft, and ensure that you enjoy flying the airplane.

It should be noted that although this rendition of the AV-8B Harrier II is not "*study-level*", it is sufficiently complex to require some training to master the airplane, and especially to master VTOL operations. To get the best out of the AV-8B Harrier II, it is required to read this manual in full.

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GENERAL PERFORMANCE TABLE

- **Crew:** 1 pilot
- **Length:** 46 ft 4 in (14.12 m)
- **Wingspan:** 30 ft 4 in (9.25 m)
- **Height:** 11 ft 8 in (3.55 m)
- **Wing area:** 243.4 sq ft (22.61 m^2)
- **Airfoil:** supercritical airfoil
- **Empty weight:** 13,968 lb (6,340 kg)
- **Gross weight:** 22,950 lb (10,410 kg)
- **Maximum takeoff weight:**
    - **Rolling takeoff:** 31,000 lb (14,100 kg)
    - **Vertical takeoff:** 20,755 lb (9,415 kg)
- **Powerplant:** 1 × Rolls-Royce Pegasus F402-RR-408 (Mk 107) vectored-thrust turbofan, 23,500 lbf (105 kN) thrust

Performance

- **Maximum speed:** 585 kn (673 mph, 1,083 km/h)
- **Maximum speed:** Mach 0.9
- **Range:** 1,200 nmi (1,400 mi, 2,200 km)
- **Combat range:** 300 nmi (350 mi, 556 km)
- **Ferry range:** 1,800 nmi (2,100 mi, 3,300 km)
- **Rate of climb:** 14,700 ft/min (75 m/s)
- **Wing loading:** 94.29 lb/sq ft (460.4 kg/m^2)
- **Thrust/weight:** 0.948

The AV-8B Harrier II has become one of the most famous aircraft in the world, developed from the original British Hawker Siddeley Harrier "jump-jet" to bring it up to date with the demands and requirements of the modern aerial battlefield. Equipped with an upgraded version of the legendary Rolls Royce *Pegasus* vectored-thrust engine, the Harrier is an icon to Anglo-American engineering ingenuity and remains one of the most versatile combat aircraft in the world.

Note: Weapons are only available on versions of this aircraft purchased *outside* of the Marketplace, i.e, from third-party stores. This is due to Microsoft Terms and Conditions for sale on the in-game Marketplace.

AIRCRAFT FAMILIARISATION

Harrier GR9 of 1 Squadron, Royal Air Force

The AV-8B Harrier II exists as three modern variants – the AV-8B, AV-8B Plus, and the GR9 variant of the Royal Air Force. Each variant differs slightly from each other externally due to the different requirements and demands of their respective operators. The AV-8B was the original upgraded variant, while the AV-8B Plus was enhanced with an internal radar. The British Harrier GR9 does not have the internal radar, but houses Looking Infra-Red sensors in the nose.

The original AV-8B Harrier in "Desert Storm" colours.

The AV-8B Plus Harrier II, with extending radar housing in the nose and FLIR sensor atop.

PANEL LAYOUT

The cockpit of the AV-8B Harrier II is dominated by two Multi-Function-Displays and a Heads-Up-Display, common to many modern aircraft.

The cockpit contains a full navigation suite and a full autopilot system, as well as a Heads-Up Display mounted directly in the pilot's line of sight, to relay vital flight information. Each of these displays is coded to appear as close as possible to those of the real aircraft, although there are limitations currently in MSFS that prevent a perfect rendition of the aircraft's systems, along of course with the classified nature of many modern fighter aircraft systems.

(**Note***: Although all of the buttons and switches in the AV-8B Harrier II's cockpit are operable, some do not have an active function assigned at this time, as the simulator does not support them in any way).*

MAIN PANELS

Left panel: Left Multi-Function Display, weapons switches below

Right panel: Nozzle and engine gauges, Right Multi-Function Display, fuel controls

Centre Upper Panel: Up Front Control Panel

Lower Panel: Airspeed indicator, Artificial Horizon, AoA indicator, VSI , Altimeter

PILOT'S LEFT FORWARD PANEL

Upper Section: H20 feed switch

Main Section: Emergency Gear Selector (INOP in MSFS), Flap indicator, Flap Switch, Landing / Taxi light switch, Landing Gear lever

PILOT'S RIGHT FORWARD PANEL

Centre Panel: Brake Pressure Gauges, Warning Panel Display, Cabin Pressure gauge

HUD

The Heads-Up Display contains basic flight information projected digitally onto a glass screen in front of the pilot. To the left of the HUD is the Angle of Attack indicator, Mach Indicator, G-Force indicator and Ground Speed Indicator.

The central display contains a pitch ladder at 5-degree increments, calibrated to the physical world outside the aircraft. The "Velocity Vector" is calibrated as closely as possible to represent the true path of the aircraft.

At top is the heading indicator, while at the bottom is the angle of bank marker.

The HUD displays well under most conditions, but can be tough to see against particularly bright skies or cloud in MSFS. Although there is a brightness control, it does little to alleviate the visibility when encountering these conditions, so revert to the right MFD for flight information, or the analogue flight instruments, when required.

PILOT'S LEFT SIDE PANEL

Front section; Trim indicators, RPS/Yaw controls, Autopilot switches

Centre section: Throttle, Nozzle-retention lever, nozzle-angle lever, rudder trim switch, Manual fuel switch. Fuel prop, pressure and pumps switches. Lights panel.

Aft section: H20 Dump switch, Oxygen switches, LIDS control, EFC switches

The throttle retention lever prevents the pilot from selecting the nozzles to angles that are too high for the Harrier to operate. When flying at weights too heavy to hover, this protects the aircraft from losing control. It is *VERY IMPORTANT* to remember that the Harrier can only take-off and land vertically at very low airframe weights, typically below 21,000lbs. At this weight, the engine has a 2,000lb thrust clearance over the aircraft's mass, allowing it to climb vertically.

When operating at weights above 21,000lbs, the pilot must select a nozzle-retention angle of 30 degrees, preventing accidental VTOL selection when in normal flight.

PILOT'S RIGHT-SIDE PANEL

Forward section: APU, Engine Starter, Generator, Battery switches.

Centre section: Radio panels, internal lighting panel, Equipment panel

FLYING THE AV-8B HARRIER II

The DC Designs AV-8B Harrier II is not designed to be "*study level*". However, it is intended to be as accurate in terms of aerodynamics as we can make them in MSFS. We also like to include the "*quirks*" of any aircraft we build, in order to try to give the user some idea of what it might be like to fly these aircraft in real life.

It is required that you learn the limitations and systems of this rendition of the aircraft in order to master it. While we have kept those essential systems and quirks to a minimum in order to preserve as much "fun" in the flying as we can, the aircraft would not be a Harrier without them. A handy tip for newcomers is that although the Harrier is famous for its ability to land and take-off vertically, this can only be achieved at low aircraft weights (21,000lbs and below) just like the real Harrier.

When above these weights, the Harrier must take-off and land conventionally just like any other aircraft.

If you're starting from cold-and-dark, on the apron, you will find that the aircraft will have its covers deployed. The Harrier is fitted with an Auxiliary Power Unit, so engine-start is a fairly straight-forward procedure with no ground-power option required.

Start by using the Interactive Checklist while inside the cockpit. This will guide you through the entire start-up procedure.

CHECKLISTS

The AV-8B Harrier II comes with a comprehensive Interactive Checklist inside the simulator, which you can use to ensure the proper start-up procedure. Just move your mouse up to the top of the screen and select the "Checklist" option. Be certain to check your fuel quantity to make sure you have enough for your flight.

Aircraft weight is something that is important to *all* aircraft. All aircraft have a *maximum take-off weight*, which if exceeded can cause the airplane to fly poorly or, at worst, not fly at all and crash. For this reason, it is advised that you select both fuel and ordnance individually and not using the menu's "payload" slider, as this can easily put the aircraft beyond its maximum take-off weight.

If you select a full load of ordnance on the AV-8B Harrier II, you must then sacrifice fuel-load to keep the weight below the maximum take-off weight. AV-8B Harrier II can take-off with external tanks, the required ordnance for the mission, and a low fuel-load before then going to join with a tanker to air-to-air refuel. Once airborne, the aircraft could then fill up with fuel. You can do the same after taking off and climbing out, by extending the refuel probe – doing so will add 25% to your total fuel load.

In the above image, the pilot has selected LIDS at 105lbs, has internal fuel of 6,641lbs and has also loaded AIM-9 missiles by typing in the relevant weights as listed in the stations on the right of the menu. Total weight is 20,494. At this weight, a vertical take-off is possible.

With your payload set, and fuel checked, you're ready to taxi. The AV-8B Harrier II's flaps can be set to cruise, auto or VSTOL. In auto mode, they will detect their required settings based on a variety of aerodynamic factors, automatically adjusting themselves to provide optimum lift.

The AV-8B Harrier II rotates at around 160 knots. Gear retraction should be brisk as the aircraft will accelerate rapidly. The aircraft's auto-trim system will engage above 240 knots to assist the pilot in precision control, while the flaps will retract automatically if set to auto mode.

Cruising airspeed for the AV-8B Harrier II is anywhere between 350 and 450 knots depending on mission profile.

AIR COMBAT MANOEUVRING

For the DC Designs AV-8B Harrier II, here are the basics of how to get the best out of your aircraft should you encounter a willing adversary in multiplayer;

Keep your energy up

Don't go into the fight at 900 knots with an eyeballs-out-G break into the enemy. Aim for 6-7Gs and maintain 'corner velocity' (400-420 knots). This will ensure the AV-8B Harrier II's tightest turn *radius*, against its best turn *rate*, as you try to out-turn your opponent and gain the advantage by sliding into his 6 o'clock position.

Although not an air-superiority platform, the AV-8B Harrier II has a high thrust-to-weight ratio, making it an energy fighter, and using the vertical can force an opponent to lose situational awareness. In addition, vectoring in forward-flight (VIFFing) can force an opponent to overshoot, putting you on their tail in an instant.

On that note, last but not least, try to keep your eyes on your opponent…

"LOSE SIGHT, LOSE THE FIGHT"

INTERNAL LIGHTING

The AV-8B Harrier II cockpit comes with full night-lighting options, which can be dimmed using the control knobs near the lighting switches on the pilot's right-side panel.

External lighting consists of navigation lights, strobe lights and formation lights, sometimes known as "slime lights", which allow formation flying at night.

LANDING THE AV-8B HARRIER II

CONVENTIONAL LANDINGS

A recovery to the airbase is conducted with the aircraft entering the overhead pattern on the active runway heading, at 1,000ft and 350 knots. At mid-field, the aircraft conducts a 4G break into the downwind, slowing to 150 knots while lowering gear. The pilot should check fuel and also calculate aircraft weight to ensure the AV-8B Harrier II is not too heavy to land, and trim the aircraft to be light on the stick at 170 knots.

A curved, descending finals approach is conducted, with the aircraft rolling out onto the final at the correct airspeed and angle-of-attack. Over the threshold the power is cut to idle, and the AV-8B Harrier II allowed to sink before touchdown at around 150 knots. Apply braking once all wheels are down.

The AV-8B Harrier II taxies best below 20 knots with slow turns.

VSTOL LANDINGS

Upon arrival over the airfield, slow the Harrier down to around 240 knots indicated airspeed. Ensure that the Harrier's weight is at 21,000lbs or below, and that the nozzle-retention lever is fully aft.

Rotate the nozzles to 45-degrees, pitch the nose up slightly and reduce power. The Harrier will slow down gradually. Maintain required pitch and elevator trim to maintain altitude. As the aircraft slows towards 140 knots, lower gear and select Flaps to VSTOL setting.

Increase power as the aircraft slows, and rotate the nozzles gradually to the 90-degree position as the speed drops below 110 knots. As the Harrier transitions to the hover, it will start to descend and will require the pilot to push the power to maximum. Watch the descent rate in the HUD, and control the aircraft's altitude with the throttle. Power is based on N2, so once the descent rate is arrested, the pilot can relinquish a small amount of power to maintain the hover. At 20,000lbs, an engine RPM of 993 will maintain the hover altitude.

Use rudder and aileron to gently manoeuvre the Harrier over its intended landing spot. Be aware that strong winds will "carry" the Harrier along with them, so you will need to counter any ambient weather with stick and throttle movements. Try to spot the airfield's windsock, to assist in maintaining the correct attitude, and therefore, position.

When ready, slightly reduce the power and allow the Harrier to sink slowly to her landing spot. Descent rates can be as high as 500fpm, but should be less upon touchdown. Remember that the engine's N2 power will lag behind the throttle position, so it is important to anticipate when to add and remove power to remain stable in the hover or to control a descent or ascent.

VSTOL TAKE OFF

To take off vertically, when the aircraft weighs less than 21,000lbs and when VSTOL Master Mode is engaged and flaps are set to VSTOL, rotate the nozzles to the 90-degree position and smoothly apply maximum throttle. The Harrier will lift off when N2 thrust exceeds aircraft mass. Once above 100ft altitude, retract the undercarriage and maintain the vertical climb to at least 500 feet.

Stabilise the aircraft's altitude, and then gradually begin to move the nozzles forward. *DO NOT PUSH THEM ALL THE WAY FORWARD AT ONCE.*

Pitch the nose up to 5-degrees while easing the nozzles to the 45-degree position and monitor airspeed. At around 110 knots the wings will catch with increasing lift and pitch the nose up. As you reach 150 knots, control the pitch angle with the stick while slowly rotating the nozzles to the 0-degrees position.

At 200 knots indicated and above, the Harrier will be flying conventionally and the flaps switch can be set to either AUTO or CRUISE for normal flying operations.

AV-8B + Harrier II demonstrates a rough-field VTOL landing – a unique capability for a fighter aircraft

Maintain a good look-out when hovering in the Harrier. The aircraft's large bubble canopy affords excellent all-round visibility, perfect when trying to judge where to land.

The high visibility from the cockpit, although the cockpit itself is very cramped, also allows pilots to operate at low-level in the Harrier, which was where most of its combat operations took place.

As with all of our products, if a user wishes their aircraft to fly correctly, they must learn to fly that aircraft correctly. The Harrier in real life is considered one of the hardest fighter aircraft in the world to fly, and only the best pilots are streamed onto it from their training. Not all, despite being fighter pilots, make the grade – it's *that* hard to fly.

This rendition of the Harrier seeks to replicate that difficulty, but without removing the unique enjoyment of flying this remarkable aircraft in Microsoft Flight Simulator. Therefore, some of the Harrier's more insidious traits, such as the tendency to flip onto its back and crash (inevitably killing the pilot in the process) when attempting to hover in certain conditions, have not been included.

Practice makes perfect. I recommend learning to hover, transition and return to conventional flight in light winds and with no stores initially, before attempting to do so in live weather conditions or closer to maximum VTOL weights. Likewise, landing on a moving vessel of any kind takes the difficulty level up a notch further and will challenge even the best simulator pilots.

If you can truly master the Harrier, in all conditions, you've genuinely achieved something great within flight simulation.

DEVELOPER NOTES

At the time of writing the manual for this aircraft's launch, Microsoft Flight Simulator is still in many ways a work-in-progress. Features that we expect to come to the flight simulator are not yet present, many variables are not yet active, and as developers we have not yet mastered all aspects of the simulator.

As time progresses, this and our other products will be continuously updated to match further advancements of MSFS. The new simulator has, we hope, many successful future years ahead of it, and as more features come on-line we will be keen to ensure that the Harrier remain at the cutting edge of what's possible for fighter aircraft. As with all launches by our sister company, DC Designs, expect this rendition of the AV-8B Harrier II to get ever better as Microsoft Flight Simulator becomes more established at the forefront of flight simulation software.

CREDITS

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SOFTWARE PIRACY

This software is copy protected.

Recently, two commercial flight simulation developers purchased a clean computer and used it to download their own products from well-known piracy sites, so that they could see what had been done to them. Unsurprisingly, all of the products were bloated with malware – Trojans, data-mining software and others, some quite advanced and well-hidden from anti-virus software. Everybody who has ever downloaded pirated software from such sites now has those infections on their home computers. Anybody who thinks

otherwise, that piracy site owners create and pay for these sites out of the kindness of their hearts, is incredibly gullible.

A pirate, otherwise known as a thief, makes a profit from the sale of other people's hard work. In some cases he makes more profit than the publishers and developers make from the sale of an original title. Piracy is not just the domain of the casual domestic user in his or her back room, but is also a multi-million-pound business conducted by criminals often associated with the illegal drugs trade. Buying or downloading pirated copies of programs directly support these illegal operations.

Don't be fooled by a load of old tosh about file 'sharing'. The sites that host these 'shared' files cover their backsides with the excuse that they are simply a 'gateway' to the files. In fact, they actively encourage piracy and are often funded by advertising. Most of them are illegal money-laundering operations by another name.

The people who really suffer from game piracy are the artists, programmers and other committed game development staff. Piracy and theft directly affects people and their families. Loss of revenue to the games industry through piracy means many are losing their jobs due to cut-backs that have to be made to ensure developers and publishers survive. The logical outcome of this is that eventually the supply of flight simulation programs will dry up because developers think it is not worth the hassle.

It's not just copying software that is against the law. Owning copied software also constitutes a criminal offence, so anyone buying or downloading from these people is also at risk of arrest and prosecution.