- *Introduction*

The BAE Systems Hawk is an agile aircraft which offers supreme handling, clean responsiveness to controls, and is by all accounts great fun to fly. It is capable of transonic speeds in a dive, and has long range and endurance. It is economical to operate and has an excellent safety record.

DSB Design brings you this excellent rendition of the Boeing/BAE Systems T-45C Goshawk airframe.

The fourth in a line of Hawk Products from DSB Design, the T-45C Goshawk package offers users of Microsoft Flight Simulator 2002 & 2004 a chance to accurately fly one of BAE Systems most popular export training aircraft.

The Hawk has been designed with assistance from the aircraft manufacturer, BAE Systems, allowing for a visual model which is unsurpassed and a flight model which is modeled closely on real world specifications.

We at DSB Design hope you enjoy this aircraft and have many enjoyable hours flying it….I know we did!

If you have any requests or questions regarding the DSB Design Hawk, or other products available from DSB Design, please drop us an e-mail at support@dsbdesign.com

David Brice
Product Manager
IRIS
http://iris.dsbdesign.com

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- *Credits*

Project Manager _____ David Brice
Visual Models _____ David Brice
Aircraft Textures _____ David Brice
Aircraft Panel _____ Han Tilroe
Gauges Programming _____ David Brice
Specialist XML Gauges _____ Rob Barendregt, Doug Dawson
Flight Dynamics _____ David Brice, David Friswell
Sounds _____ Dyl Roberts, David Brice, Peter Saveraux
Alpha Testing _____ Bryan Mulheran, Jon Watkins, Steve Dobson
Beta Testing _____ Dyl Roberts, Adam Preece, Del Payne,
Manual _____ David Brice

Special Thanks to the members of RAF Virtual (http://www.rafvirtual.org) for the multiplayer compatibility testing and their unerring support over the last eight months since the Hawk product's commencement.
(By far the BEST RAF Virtual Air Force on the net!)

Further thanks go to Greg Goebel (http://www.vectorsite.net) who kindly allowed the use of his material on the Hawk for this manual.

- *BAE Systems Hawk History*

Origins

* In the early 1960s, the British Royal Air Force (RAF) was operating two jet trainer aircraft: the Hawker "Hunter T.7" two seat side-by-side trainer, and the Folland "Gnat T.1".

The Hunter trainer was well liked, but it was also expensive to operate; had limited endurance; and its side-by-side seating arrangement was increasingly seen as outdated. Side-by-side seating is well suited for primary training, since it gives the instructor a close view of what the student pilot is doing, but is poorly suited to advanced training, as it creates a cockpit environment that is dissimilar to that of the single-seat aircraft the student is presumably being trained to fly.

Although the Gnat T.1 was appreciated for its agility and good handling and achieved recognition as the mount for the RAF Red Arrows aerobatic display team, it suffered from high maintenance overhead; a cramped cockpit that could not accommodate tall pilots, and left the flight instructor straining to see forward through the back of the student's head; and no weapons training capability.

In 1964, the RAF released a draft requirement for a trainer to replace both the Hunter trainers and the Gnat T.1, with the designation "Air Staff Target (AST) 362". Transition to the new trainer was to begin in the mid-1970s. In step with the spirit of the times, the new trainer was to have a top speed of Mach 1.5. It hadn't been realized yet that the benefits of a supersonic trainer did not really outweigh the drawbacks of higher purchase and operation costs.

Then international politics intervened. The French were also interested in a new trainer to replace their Lockheed T-33 "T-birds" and Dassault Mystere IVs, and a round of typically complicated Anglo-French negotiations followed. These discussions led off in one direction to the Anglo-French SEPECAT Jaguar, which was originally conceived as a trainer and light strike aircraft. Ultimately, the Jaguar became very much a competent strike fighter, but was simply too much aircraft for flight instruction. Tandem seat Jaguars were built, but they were used for operational conversion, not flight instruction.

Another offshoot of this round of discussions was a series of proposals made to the RAF in 1968 by Hawker Siddeley Aircraft (HSA) for a jet trainer. By this time, the RAF's focus had shifted somewhat towards a replacement for the Huntington Jet Provost T.5 trainer, and HSA was also looking very seriously at the broader international market to replace aging trainers such as the Jet Provost, T-33, and Macchi MB.326. The estimated market for new jet trainers was estimated at thousands of aircraft, excluding the US, which rarely "bought foreign", and the Eastern Bloc, where political barriers ruled out the sale of Western aircraft.

HSA gave their studies the designation "HS.1182". The new trainer was to have armament capability so that it could be used for weapons training, as well as for light combat duties. Early concepts envisioned a single-engine, tandem-seat aircraft with straight, low-mounted wings, with some resemblance to the Macchi MB.326 trainer.

In 1969, the British Ministry of Defense gave the ball another push by issuing requirement "AST.397" for a tandem seat, single engine, subsonic jet trainer with weapons capability and an unprecedented 6,000 hour fatigue life. This specification was open to international competition and was by no means written around the HS.1182 specification, but gradually the competitors, in the form of aircraft such as the Dassault-Dornier Alpha Jet and proposals by British Aircraft Corporation (BAC), fell out, and in October 1971 the HSA proposal was accepted. This led to a production contract early the next year for 176 trainers, with the first to be delivered in late 1976.

With the beginning of full scale development, HSA assigned Gordon Hudson as chief designer, and confusingly assigned Gordon Hodson as the assistant chief designer. Both men were ex-Folland personnel. The design was given the name "Hawk", although traditionally trainers had, logically but a bit stuffily, been named after educational establishments. However, "Hawk" was a simple name, and easy to put in flight logbooks; the RAF Staff College emblem featured the Egyptian hawk god Horus; and apparently there were officials who thought that naming aircraft after universities was a bit stuffy, too, or at least wouldn't have much appeal for export sales.

The design that was finalized during development modified earlier concepts by providing a slightly swept wing, with the engine intakes mounted above the wing roots. Shoulder-mounted intakes had been considered earlier, but wind tunnel tests indicated some stability problems with that configuration. In any case, the design team had good reason to feel pleased with the machine, as it had clean and elegant lines.

The first "Hawk T.1", painted in snappy red and white colors, flew on 21 August 1974, with test pilot Duncan Simpson at the controls. A number of defects were discovered in flight test and corrected, but these were ordinary development and teething problems, as the Hawk's design was fundamentally sound.

T-45 Goshawk

The Hawk had never really been designed for carrier operations, and the T-45 Goshawk, as the USN trainer was designated, was by no means just another tweaky variant of the Hawk. Carrier operation meant more robust and wider landing gear with catapult attachment; arresting hook; good low-speed flight characteristics; and other substantial changes. The changes were so extensive that the first Goshawk prototype did not fly until 1988, the same year a production contract was awarded. USN evaluation of the initial prototype resulted in a long list of deficiencies that had to be corrected. Most of the items were nitpicky, but there was a small set of critical difficulties, which became known as "the Big Five".

Further delays were introduced by a decision to move production from the Douglas plant in California to the McDonnell plant in Saint Louis, Missouri. Carrier trials did not take place until 1991. Even then, the aircraft's troubles were not over, with one being lost in 1992 in a very wild landing caused by a landing gear defect, the pilot ejecting safely. All Goshawk prototypes were grounded until the problem was properly reviewed. Flight instruction with the Goshawk did not begin until 1994.

The Goshawk is still clearly a Hawk, but it is a considerably modified Hawk with clearly distinctive features. In the final production form, the changes include:

- A strengthened airframe and wing; larger tail surfaces; and squared-off wingtips and horizontal tailplane tips. Leading-edge slats were fitted on the wing for low-speed flying and other, smaller changes were made in flight control systems and surfaces. Apparently the wing redesign was a source of dispute between MDD and BAe, with some sources claiming that MDD's bumbling on the wing redesign contributed to the development program's difficulties.

- A new cockpit layout that conformed to USN practice and included a "mini-HUD" for simulated weapons training. The Hawk Martin-Baker 10B ejector seats were replace by "Navy Aircrew Common Ejector Seats (NACES)", which are basically Martin-Baker 14 seats manufactured in the US under license.

- Two-wheel nosegear that featured tow and catapult connections, and a "stinger" type arresting hook similar to that used on the F/A-18 Hornet.

- Twin airbrakes mounted in front of the horizontal tailplane, reminiscent of those used on the F-86 Sabre, replacing the single belly airbrake of the conventional Hawk.

- A single ventral fin, instead of the more conventional pair of ventral fins. Small control surfaces were fitted ahead of the all-moving horizontal tailplane, with the odd name of "smurfs", an acronym standing for the torturous phrase "side mounted unit root fins". The smurfs create vortex turbulence over the horizontal tailplane when the aircraft is at high angles of attack, ensuring that the control surfaces remain effective.

- An Americanized Rolls-Royce "Adour F405-RR-401" engine with 26.24 kN (2,675 kgp / 5,900 lbf) thrust, which is an Adour 871 with minor modifications.

Engine fit for the Goshawk turned out to be a complicated issue. Lower-thrust versions of the Adour were considered at first to provide longer engine life, but unsurprisingly the changes made to the Hawk to produce the Goshawk substantially increased weight, and so the USN opted for a more powerful engine

In 1991, very late in the Hawk's development, the US Congress attempted to push the Navy to adopt the Garrett F124-GA100 turbofan engine, in order to steer more business to American industry. On paper, the F124 was a much more modern engine than the Adour, offering a higher thrust to weight ratio, longer life, and other advantages -- but the phrase "on paper" was critical, since no aircraft had been fitted with the new Garrett engine.

Navy Goshawk program officials were appalled at the prospect of having to take another "zig" in a development program that had already had its fair share of "zags". After intense debate, the Secretary of the Navy ruled that the Goshawk would keep the Adour.

Interestingly, some sources say the Goshawk is *not* intended for weapons training and is never fitted with a gun pack or stores pylons. This is borne out by pictures of the aircraft, none of which seem to show such kit, but other sources say the Goshawk was qualified for stores carriage and release during development. The two facts may not be inconsistent, since it is logical that even if the USN didn't want to use the T-45 for weapons training, the service may still have wanted the capability.

* In flight, the Goshawk looks much like any other Hawk trainer, but on carrier approach, with everything "down and dirty", the Goshawk looks very much a carrier aircraft, with its wide undercarriage spread open, leading-edge slats out, twin airbrakes extended, and arresting hook hanging down.

The Goshawk is built with MDD as the prime contractor, BAe serving as the airframe subcontractor, and Rolls-Royce serving as the engine subcontractor. MDD provides a "complete package" for Goshawk operations in the form of the "T-45 Training System", which includes maintenance, service, and a Hughes simulation system. Despite the delays and problems, the USN is very pleased with the end product. The very severity of the evaluation ensured that the Goshawk thoroughly satisfied their requirements.

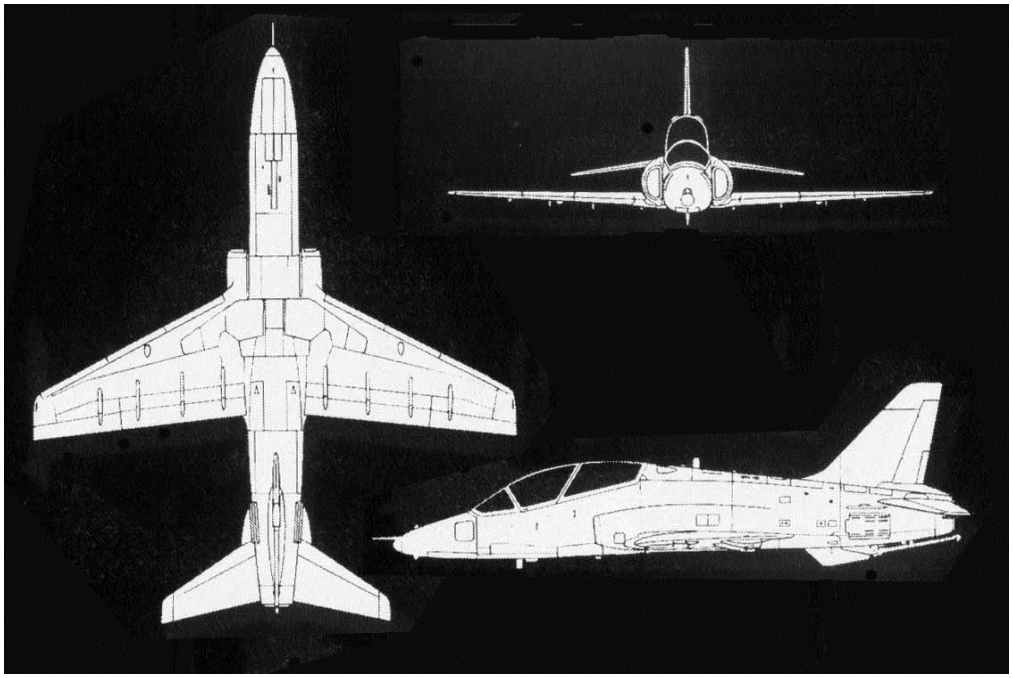
The USN originally expected to acquire 302 Goshawks, but given the end of the Cold War the total is currently scheduled to be no more than 187, and possibly no more than 170. Deliveries have been running at about a dozen aircraft a year.

The first 83 production Goshawks were T-45As, which were followed in 1997 by the "T-45C" with a digital glass cockpit layout featuring twin multifunction displays (MFDs); a head-up display (HUD); a Global Positioning System (GPS) satellite navigation receiver; and a MIL-STD 1553B digital data bus. The Goshawk was originally to have been fitted with a glass cockpit, but the USN had to drop that plan due to cost constraints. Later, the glass cockpit requirement was revived and implemented as a "Cockpit 21" effort in 1994, leading to the T-45C. Existing T-45As are expected to be upgraded to the T-45C standard.

The reason why the variant designation jumped from T-45A to T-45C was because the USN had considered purchase of a proposed "T-45B" variant for a time, which would have been basically a conventional Hawk with a USN cockpit and no carrier capability. The USN had wanted the T-45B to get an earlier training capability, but abandoned the idea in 1984.

* By the way, the reason the T-45 was given the name "Goshawk" instead of retaining the name "Hawk" was not out of any nationalistic desire to differ with the British. After all, the US adopted the Harrier from the British without a name change. The T-45 was named "Goshawk" to avoid confusion with the Hawk surface to air missile, another item in the US military inventory. Anybody who's ever been in any military organization knows that if a paperwork screwup is possible it will happen, and taking measures to avoid such difficulties is prudent. The possible scenarios for screwups between Hawk aircraft and Hawk missiles makes for some amusing speculation.

Aircraft Specifications



Crew: Two; Pilot & Instructor

Dimensions: Length 39 feet 3 inches; Height 14 feet; Wing Span 30 ft 10 in; Wing Area 179.60 sq ft

Engines: A Rolls-Royce "Adour F405-RR-401" engine with 5,900 lb thrust

Weights: Empty Equipped 8,040 lb (3647 kg); Normal Take-off 11,100 lb (5035 kg); Maximum Take-off 15,624 lb

Armament: Loads may comprise of BDU-33 Practice Bombs loaded under mid-wing pylons.

Performance: Maximum level speed 540 kt (620 mph) at 11,000 ft (3355 m); Maximum rate of climb at sea level 9,300 ft/min (2835 m/min); Service ceiling 42,250 ft (12875 m); Standard range 1000 nm (1150 miles, 1850 km)

System Specifications

- **Pentium II 500**
- **128 Mb RAM**
- **140 Mb of free available hard disk space**
- **Sound Card**
- **Microsoft Flight Simulator 2002 (Professional or Standard Version)**

OR

- **Microsoft Flight Simulator 2004**
- **Microsoft Windows 98(SE), Windows ME, Windows 2000 or Windows XP**
- **Adobe Acrobat Reader to view and print this manual***
- **Video Card with at least 32mb on board RAM**

***Adobe Acrobat Reader is available for free from**
http://www.adobe.com/products/acrobat/readstep2.html

Further Additions

The T-45C is optimized for Carrier Operations. The DSB Design T-45C Goshawk has been designed for use with Rob Barendregt's and Doug Dawson's Carrier Operation Package for FS2004 Military Jets.

If you have the above product installed on your system, you will find the T-45C comes complete with the catapult/arrester capability already built in. Those who have not got the Carrier Operations Package can find it at a number of reputable flightsim websites such as www.flightsim.com.

The file name required is RCBco-11.zip

Installation instructions and details on it's use can be found within the comprehensive readme file located with the zip file.

T-45C PFD and RMI

The DSB Design T-45C comes with a custom made PFD and RMI which is expandable for easier reading in flight. These systems link effectively with the Up Front Controller (UFC) which controls lighting, avionics and autopilot functions.