de Havilland Tiger Moth 47” Wing Span Plan

The **de Havilland DH 82 Tiger Moth** is a 1930s biplane designed by Geoffrey de Havilland and was operated by the Royal Air Force (RAF) and others as a primary trainer. The Tiger Moth remained in service with the RAF until replaced by the de Havilland Chipmunk in 1952, when many of the surplus aircraft entered civil operation. Many other nations used the Tiger Moth in both military and civil applications, and it remains in widespread use as a recreational aircraft in many countries. It is still occasionally used as a primary training aircraft, particularly for those pilots wanting to gain experience before moving on to other tailwheel aircraft, although most Tiger Moths have a skid. Many are now employed by various companies offering trial lesson experiences. Those in private hands generally fly far fewer hours and tend to be kept in concours condition. The de Havilland Moth club founded 1975 is now a highly organized owners' association offering technical support and focus for Moth enthusiasts.

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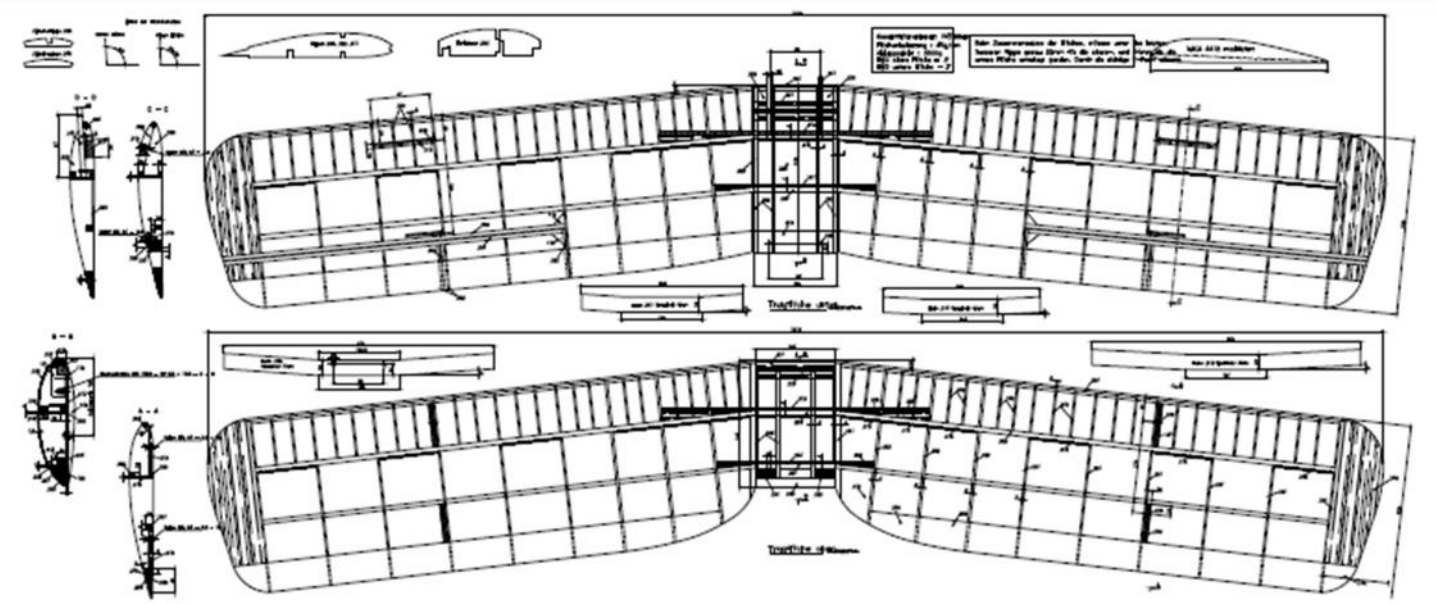

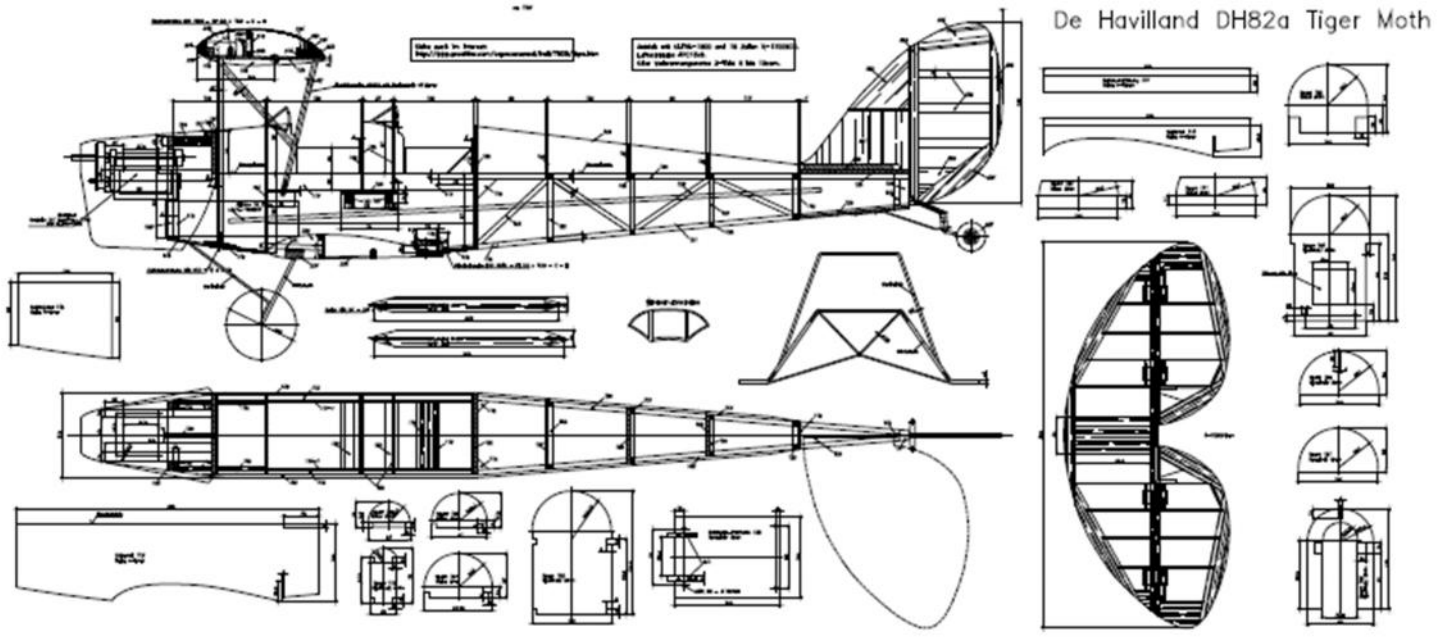

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Design and development

The Tiger Moth trainer prototype was derived from the **DH 60** de Havilland Gipsy Moth in response to Air Ministry specification 13/31 for an *ab-initio* training aircraft. The main change to the DH Moth series was necessitated by a desire to improve access to the front cockpit since the training requirement specified that the front seat occupant had to be able to escape easily, especially when wearing a parachute.[2] Access to the front cockpit of the Moth predecessors was restricted by the proximity of the aircraft's fuel tank directly above the front cockpit and the rear cabane struts for the upper wing. The solution adopted was to shift the upper wing forward but sweep the wings back to maintain the centre of lift.[3] Other changes included a strengthened structure, fold-down doors on both sides of the cockpit and a revised exhaust system.[2] It was powered by a de Havilland Gipsy III 120 hp engine and first flew on 26 October 1931 with de Havilland Chief Test Pilot Hubert Broad at the controls.[4]

One distinctive characteristic of the Tiger Moth design is its differential aileron control setup. The ailerons (on the lower wing only) on a Tiger Moth are operated by an externally mounted circular bellcrank, which lies flush with the lower wing's fabric undersurface covering. This circular bellcrank is rotated by metal cables and chains from the cockpit's control columns, and has the externally mounted aileron pushrod attached at a point 45° outboard and forward of the bellcrank's centre, when the ailerons are both at their neutral position. This results in an aileron control system operating, with barely any travel down at all on the wing on the outside of the turn, while the aileron on the inside travels a large amount upwards to counter-act adverse yaw.

From the outset, the Tiger Moth proved to be an ideal trainer, simple and cheap to own and maintain, although control movements required a positive and sure hand as there was a slowness to control inputs. Some instructors preferred these flight characteristics because of the effect of "weeding" out the inept student pilot.[5]

Canadian DH.82C Tiger Moth showing characteristic canopy

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Operational history

The RAF ordered 35 dual-control **Tiger Moth I**s which had the company designation **DH 82**.[6] A subsequent order was placed for 50 aircraft powered by the de Havilland Gipsy Major I engine (130 hp) which was the **DH 82A** or to the RAF **Tiger Moth II**. The Tiger Moth entered service at the RAF Central Flying School in February 1932. By the start of the Second World War, the RAF had 500 of the aircraft in service and large numbers of civilian Tiger Moths were impressed to meet the demand for trainers.

During a British production run of over 7,000 Tiger Moths, a total of 4,005 Tiger Moth IIs were built during the war specifically for the RAF, nearly half being built by Morris Motors LImited at Cowley, Oxford.

Royal New Zealand Air Force Tiger Moth aircraft with blind flying hoods for instrument training, early in the war.

The Tiger Moth became the foremost primary trainer throughout the Commonwealth and elsewhere. It was the principal type used in the British Commonwealth Air Training Plan where thousands of military pilots got their first taste of flight in this robust little machine. The RAF found the Tiger Moth's handling ideal for training future fighter pilots. Whilst generally docile and forgiving in the normal flight phases encountered during initial training, when used for aerobatic and formation training the Tiger Moth required definite skill and concentration to perform well — a botched manoeuvre could easily cause the aircraft to stall or spin.

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DH-82 Queen Bee, 2008. Built 1944.

A radio-controlled gunnery target version of Tiger Moth appeared in 1935 called the **DH.82 Queen Bee**; it used a wooden fuselage based on that of the DH.60 Gipsy Moth (with appropriate structural changes related to cabane strut placement) with the wings of the Tiger Moth II.[7] There were nearly 300 in service at the start of the Second World War. It is believed the name "Drone" derived from "Queen Bee". These aircraft retained a normal front cockpit for test-flying or ferry flights, but had a radio-control system in the rear cockpit that operated the controls using pneumaticically driven servos. Four-hundred were built by de Havilland at Hatfield, and a further 70 by Scottish Aviation.[8]

de Havilland Canada in Downsview manufactured 1,548 of all versions including the **DH.82C** and Menasco-engined variants known as the **Menasco Moth**. The de Havilland Canada operation also built 200 Tiger Moths to USAAF Lend-Lease orders, which were designated for paperwork purposes as the **PT-24** before being delivered to the Royal Canadian Air Force. de Havilland Australia assembled 20 aircraft from parts sent from the United Kingdom before embarking on a major production campaign of their own of the DH.82A, which resulted in a further 1,070 being built locally. Additionally, 23 were built in Sweden as the **Sk.11** by AB Svenska Järnvägsverkstädernas Aeroplanavdelning, 91 were built in Portugal by OGMA, 38 in Norway by Kjeller Flyfabrikk (some sources say 37 so the first may have been assembled from a kit) and 133 were built in New Zealand by de Havilland New Zealand in addition to a large number of aircraft assembled from kits shipped from the UK.[9]

In the aftermath of Britain's disastrous campaign in France, in August 1940, three proposals for beach defence systems were put forward. 350 Tiger Moths were fitted with bomb racks to serve as light bombers as a part of Operation Banquet. A more radical conversion involved the "paraslasher," a scythe-like blade fitted to a Tiger Moth and intended to cut parachutists' canopies as they descended to earth. Flight tests proved the idea, but it was not officially adopted. The Tiger Moth was also tested as a dispenser of Paris Green rat poison for use against ground troops, with powder dispensers located under the wings.[10]

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Postwar

Tiger Moth Coupe with spatted undercarriage at Coventry Airport in 1955

Dutch Tiger Moth with the extended fin area required by the local authorities

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Early aerial topdressing conversion of the Tiger Moth exhibited in Te Papa Museum

In postwar use, large numbers of surplus Tiger Moths were made available for sale to flying clubs and individuals. They proved to be inexpensive to operate and found enthusiastic reception in the civil market, taking on new roles including aerial advertising, aerial ambulance, aerobatic performer, crop duster and glider tug.[*citation needed*]

The Tiger Moth was often compared[*according to whom?*] with the Belgian-designed Stampe SV.4 aerobatic aircraft which had a very similar design layout. Several Tiger Moths were converted during the 1950s to *Coupe* standard with a sliding canopy over both crew positions.[*citation needed*] Many ex-RAF examples imported to the Netherlands post war were required by the Dutch civil aviation authorities to be fitted with additional fin area, incorporating an extended forward fillet to the fin.[*citation needed*]

After the development of aerial topdressing in New Zealand, large numbers of ex-Royal New Zealand Air Force Tiger Moths built in that country and in the United Kingdom were converted into agricultural aircraft. The front seat was replaced with a hopper to hold superphosphate for aerial topdressing. From the mid 1950s, these topdressers were replaced by more modern types such as the PAC Fletcher, and a large number of New Zealand Tiger Moths in good flying condition were then passed to pilot owner enthusiasts.[*citation needed*] It has been claimed that more people have flown themselves in Tiger Moths than in any other plane.[*citation needed*]

Royal Navy Tiger Moths utilised as target tugs and "air experience" machines became the last military examples when that service purchased a batch of refurbished ex civil examples in 1956.[11] One became the last biplane to land on an aircraft carrier (HMS *Eagle*) in the English Channel during the Summer of 1967. On take-off the wind over the deck meant she took off but was slower than the carrier, which turned hard to starboard to avoid a possible collision.[*citation needed*] These planes remained in service until the early 1970s.[*citation needed*]

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Tiger Moths were often modified to stand in for rarer aircraft in films. Notably, Tiger Moth biplanes were used in the crash scenes in *The Great Waldo Pepper*, standing in for the Curtiss JN-1.[*citation needed*] Due to the popularity of the design and the rising cost of flyable examples, a number of replicas (scale and full size) have been designed for the homebuilder, including the Fisher R-80 Tiger Moth and the RagWing RW22 Tiger Moth.[*citation needed*]

DH.82A Tiger Moth, 2005

Flying the Tiger Moth

The Tiger Moth responds well to control input, and is fairly easy to fly for a tail dragger. Its big "parachute" wings are very forgiving, and it stalls at a speed as slow as 25 knots with power. Its stall and spin characteristics are benign. It has some adverse yaw, and therefore requires rudder input during turns.[12]

Because the Tiger Moth has no electrical system, it must be started by hand. This needs to be done with care to prevent being struck by the propeller, which would result in serious injury. Being a tail-dragging biplane, taxiing also requires care. The pilot cannot see directly ahead, so the lower wing can hit obstructions, and it is susceptible to gusts of wind on its inclined, large, upper wing.[12]

The take off is then uneventful, and it has a reasonable rate of climb. However, full power should not be maintained for more than a minute or so to avoid damaging the engine.[12]

The Tiger Moth's biplane design makes it strong, and it is fully aerobatic. But it only has ailerons on its bottom wing, which makes its rate of roll relatively slow for a biplane. Most manoeuvres are started at about 90 to 110 knots, and it has a Velocity Never Exceeded (VNE) of 140 knots. It is important to lock the automatic slats (leading edge flaps) during aerobatic manoeuvres.[12]

"Wheel" landings are straight forward, as the plane is pushed on to the runway at a moderate speed with just the front wheels on the ground, and then the tail is held up until the speed reduces. The open cockpit allows pilots

to stick their heads over the side to see the runway. As the aircraft is a tail dragger, it is essential to land it straight with no sideways movement to avoid ground loops.[12]