# Heinkel He 176

Le **Heinkel He 176** était un avion-fusée d'expérimentations allemand, conçu juste avant le début de la Seconde Guerre mondiale par le constructeur Heinkel. Il fut le premier aéronef au monde à être propulsé uniquement par un moteur-fusée à ergols liquides, effectuant son premier vol propulsé le 20 juin 1939, piloté par Erich Warsitz. L'appareil fut développé sur une initiative privée de la part de la compagnie Heinkel, en accord avec la volonté du directeur Ernst Heinkel de développer des technologies pour le vol à haute vitesse. Dans les faits, les performances du He 176 n'étaient pas spectaculaires, mais l'avion servit de démonstrateur pour la propulsion par moteur-fusée. Tous les documents concernant de près ou de loin le He 176 furent détruits pendant la guerre. Les données de performances fréquemment citées, comme la vitesse maximale de 750 km/h, ainsi que certains dessins, ne reposent pas sur des documents clairs ou officiels. Il ne reste en fait que deux images réelles du He 176 qui aient survécu, probablement prises en 1938 à Peenemünde pendant les essais de roulage.

**Conception et développement**

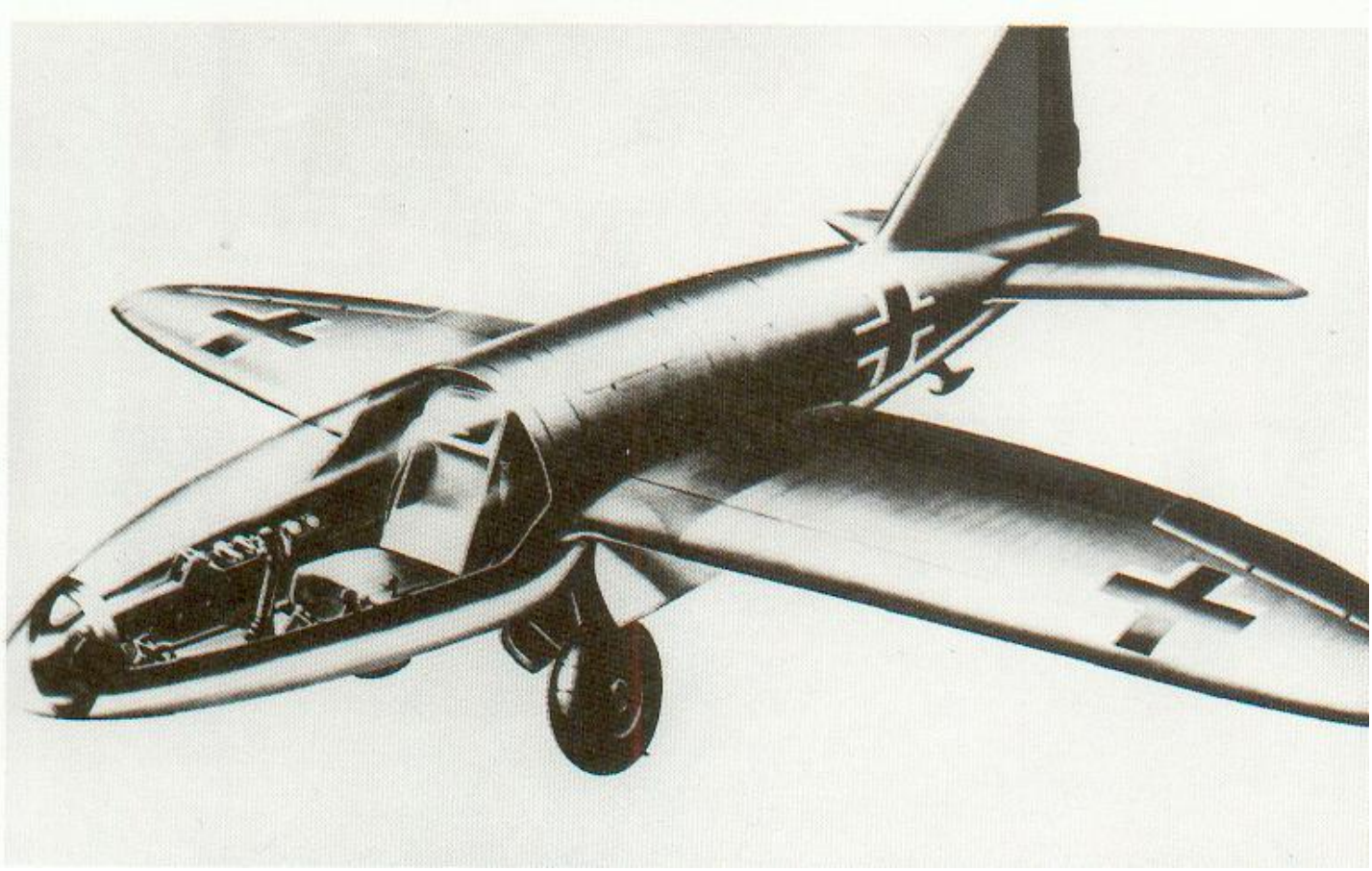
Au cours des années 1920, des cascadeurs allemands avaient effectué de nombreuses expériences employant des moteurs-fusées à propergol solide pour propulser des voitures, des motos, des chariots sur rails, des luges et, en 1929, des avions, tels que l'*Ente*, d'Alexander Lippisch, et le Opel-Sander RAK.1 de Fritz von Opel. Cependant, les moteurs-fusées à propergol solide possédaient de gros inconvénients pour la propulsion aéronautique, car leur poussée ne pouvait être modifiée en vol et les moteurs ne pouvaient pas être éteints une fois allumés. À la fin des années 1930, l'équipe de scientifiques fuséologues de Wernher von Braun travaillant à Peenemünde étudia l'installation de moteurs employant des ergols liquides dans un avion. Heinkel apporta avec enthousiasme son soutien à leurs efforts, leur fournissant un Heinkel He 72 puis plus tard deux Heinkel He 112 pour effectuer des expérimentations. Début 1937, l'un de ces deux derniers appareils effectua un vol avec son moteur à pistons coupé pendant le vol, se retrouvant alors propulsé seulement par la poussée de son moteur-fusée. Au même moment, les expériences menées par Hellmuth Walter dans les moteurs-fusées de type monergol, utilisant du peroxyde d'hydrogène, allaient mener à la création de moteurs simples et légers, qui apparaissaient bien adaptés pour une installation dans un aéronef.

Le He 176 fut construit pour utiliser l'un des nouveaux moteurs Walter **(en)**, le R1-203, pouvant produire une poussée de 500 kgp pendant environ 60 secondes. L'appareil devait être le premier avion dans l'histoire à utiliser des ergols liquides dans son moteur-fusée. Une proposition fut avancée pour la première fois à Berlin en mai 1935 par le major Wolfram von Richthofen pour le développement d'un intercepteur à moteur-fusée pour l'attaque de bombardiers à haute altitude. Cette proposition mena à la fabrication du prototype He 176, puis plus tard du célèbre Me 163 *Komet*, premier avion de combat au monde à utiliser ce mode de propulsion.

Les travaux de conception débutèrent à la fin de l'année 1936, les dessins détaillés étant finis vers juillet 1937. La construction du prototype démarra au même moment. L'appareil était petit, simple, et presque entièrement fait de bois, mais possédait un cockpit totalement fermé vraiment avancé pour son époque, avec un nez vitré transparent sans structure fait d'une seule pièce, à travers lequel les palonniers du pilote étaient visibles, et un vitrage de cockpit supérieur lisse qui était démontable pour entrer dans l'appareil, rendant le cockpit totalement conforme aux contours avant en forme d'obus du fuselage[5]. Le train d'atterrissage était une combinaison de trains classiques et tricycle, avec les supports du train principal devant se rétracter vers l'arrière à l'intérieur du fuselage, une roue avant fixe disposant d'un carénage, et une roulette de queue rétractable. Une caractéristique unique du He 176 était son système d'évacuation d'urgence. L'appareil était en effet doté d'un nez largable, qui était séparé du reste du fuselage par un système à air comprimé, un parachute aidant également en diminuant la force nécessaire pour la séparation. Après que le parachute soit déployé la verrière supérieure était larguée et une évacuation classique du pilote était effectuée (celui-ci descendant sous son propre parachute). Tous les travaux de conception furent menés dans le *Sonderentwicklung I*, un département qui était tenu à l'écart du reste de l'usine Heinkel à Rostock-Marienehe.

Les hommes qui conçurent l'avion étaient:

- Walter Künzel : Chef de projet/installation du moteur ;
- Walter Günter **(en)** : Aérodynamique (victime d'un accident fatal le 21 septembre 1937) ;
- Adolf Jensen : Aérodynamique/mécanique du vol ;
- H. Bosch : Analyse des charges et contraintes ;
- H. Regner : Conception détaillée ;
- Jacob : Train d'atterrissage.

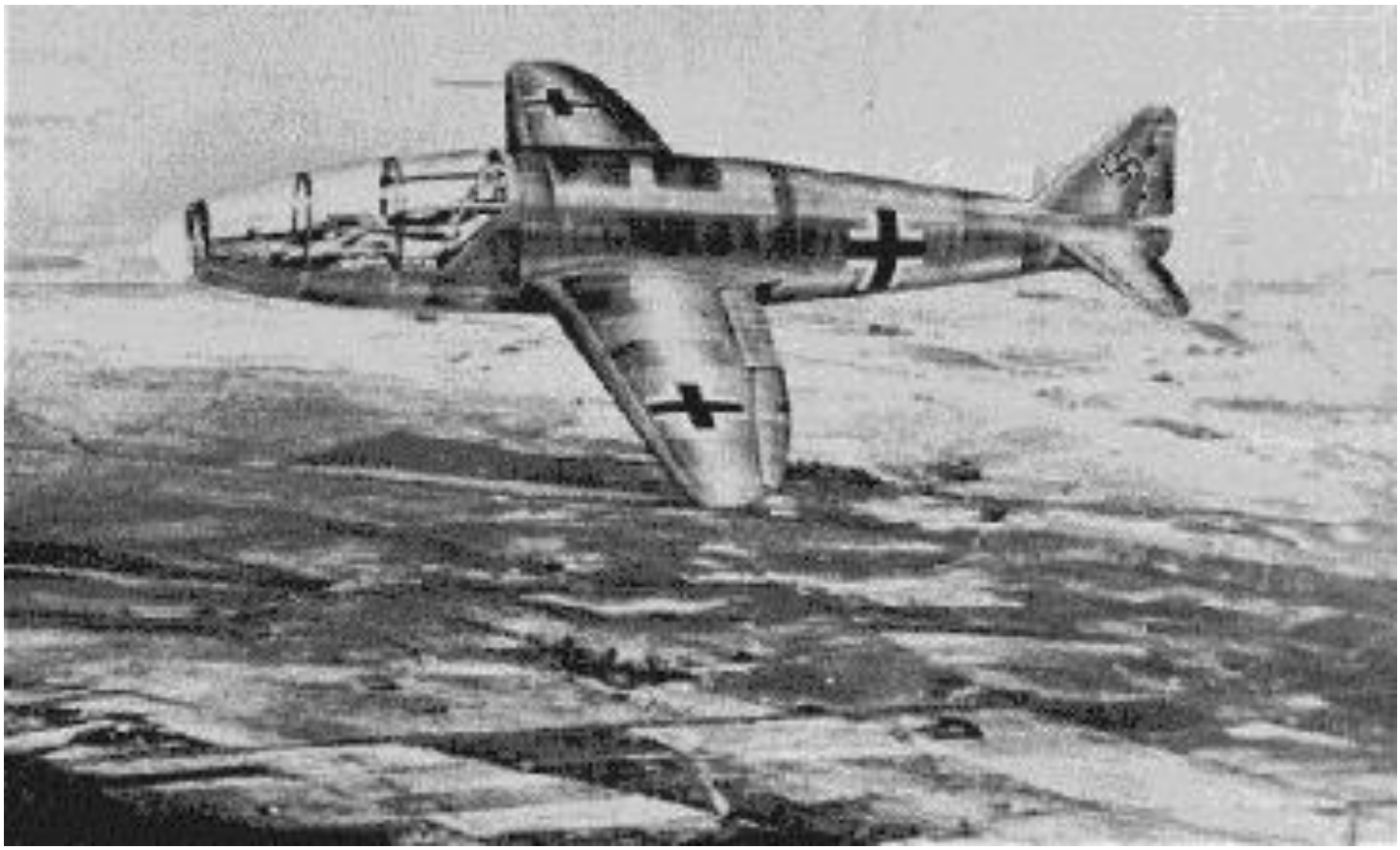


**Essais et fin du programme**

Entre le 9 et le 13 juillet 1938, le He 176 fut testé dans un grand tunnel aérodynamique à Göttingen. Bien que le programme ait commencé à l'usine Heinkel de Rostock-Marienehe, le prototype complet fut rapidement déplacé à Peenemünde, où le secret l'entourant serait mieux assuré[4]. Des essais furent menés avec une maquette de cockpit en bois larguée depuis un Heinkel He 111 depuis une altitude comprise entre 6 000 et 7 000 mètres. Afin d'obtenir des données précises, un mannequin à taille réelle fut conçu avec des articulations assez réalistes, et largué avec la maquette de cabine. Sur la plage près de Peenemünde, le prototype de l'avion fut ensuite tracté derrière une Mercedes 7,6 litres pour les essais de roulage, atteignant des vitesses au sol de 155 km/h. Les premiers sauts de courte longueur furent effectués en mars 1939, à l'aide du moteur-fusée mais en n'emportant que de très faibles quantités de carburant dans les réservoirs. Le premier vol officiel fut effectué le 20 juin 1939 avec le pilote d'essai Erich Warsitz aux commandes. Le jour suivant, l'avion fut présenté à quelques-uns des dirigeants du Ministère de l'Aviation du Reich (Ernst Udet, Erhard Milch), mais ceux-ci ne furent pas impressionnés par la performance de l'appareil. Udel interdit même la poursuite des essais en raison du danger représenté par l'emploi du moteur-fusée. Cette interdiction fut levée et réitérée deux fois jusqu'au 3 juillet 1939, lorsqu'une autre présentation fut arrangée à Roggentin pour Adolf Hitler et une grande partie des dirigeants du Troisième Reich.

Un ordre officiel fut émis le 12 septembre 1939, mettant fin à tous travaux ultérieurs sur le projet He 176. Cette issue mena à l'abandon du programme de propulsion par fusée de la compagnie. Les tests du He 176 se terminèrent alors qu'un seul exemplaire avait été construit. Il fut ensuite mis en exposition au musée de l'Air de Berlin, mais un bombardement allié en 1943 le détruisit totalement.

Avant l'annulation du programme, des plans avaient été dessinés pour un avion-fusée plus sophistiqué, toujours désigné He 176, mais désigné de nos jours **He 176 V2**. Il ne fut jamais construit, mais la désignation commune à celle de la première version (qui vola vraiment) fait que de nombreux ouvrages et sites internet publient par erreur des images de cette version pour décrire l'appareil. L'Allemagne fit finalement voler un avion-fusée de combat opérationnel, le *Komet* dessiné par Alexander Lippisch, mais cet avion fut construit par la compagnie concurrente Messerschmitt, et utilisait un moteur qui était une évolution de celui employé dans le He 176, le HWK 109-509.

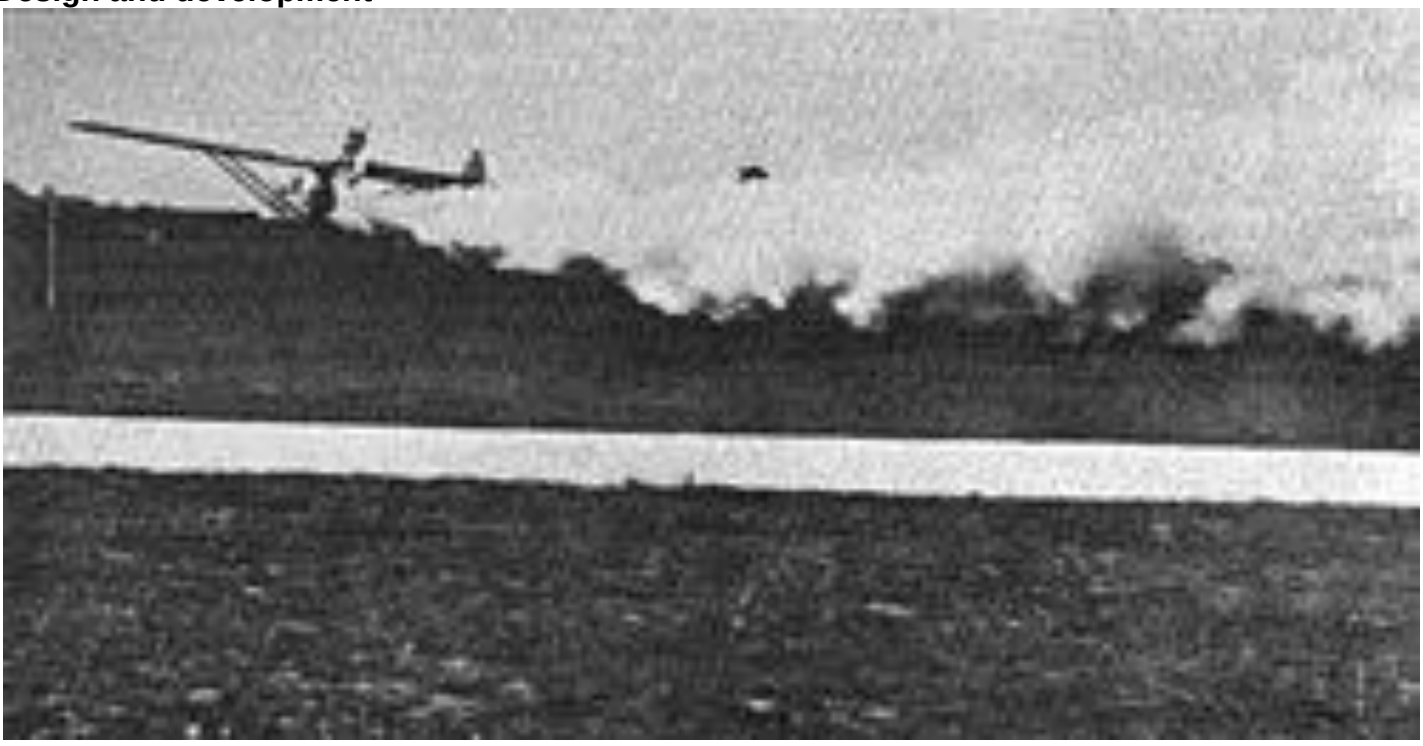


Source : https://fr.wikipedia.org/wiki/Heinkel_He_176

Version anglaise wikipédia

The **Heinkel He 176** was a German experimental rocket-powered aircraft. It was the world's first aircraft to be propelled solely by a liquid-fueled rocket, making its first powered flight on 20 June 1939 with Erich Warsitz at the controls. The He 176 was developed as a private venture by the Heinkel company in accordance with director Ernst Heinkel's emphasis on developing technology for high-speed flight. Work on the project began in 1936 after testing with a modified He 72 and a pair of He 112s had shown rocket propulsion to have some viability. The He 176 was purpose-built to harness this propulsion, rather than a modification of existing piston engined-types. The resulting aircraft was relatively compact, was largely composed of wood, and in some respects relatively simplistic. It also incorporated some novel concepts, such as an unconventional reclined seating position for the pilot along with a unique jettisonable nose escape system for emergencies. In December 1937, the He 176 designation was officially assigned to the aircraft. On 12 September 1939, the He 176 project was ordered to be cancelled, allegedly due to its unimpressive size and performance. However, the aircraft did provide "proof of concept" for rocket propulsion and high speed flight in general; lessons and designs cues were incorporated into subsequent aircraft such as the Heinkel He 280 prototype jet fighter and the Messerschmitt Me 163 rocket interceptor. The prototype itself along with most documentation related to the He 176 were destroyed by the end of the war. Warsitz stated his belief that some material may have entered the Soviet/Russian archives. The often quoted performance data of the aircraft, such as its speed reaching 750 km/h, or 800 km/h, is drawn from Warsitz's account, and are usually not based on sound documents. Only two true pictures of the He 176 have survived which were probably taken in Peenemünde while undergoing testing.[1]

**Design and development**



Opel RAK.1, world's first public flight of a rocket-powered aircraft on September 30, 1929, piloted by Fritz von Opel

During the 1920s, German daredevils and inventors had experimented with the use of solid-fuel rockets to propel various vehicles, such as cars, motorcycles, railway carriages, snow sleds, and, by 1929, aircraft such as Alexander Lippisch's *Ente* and Fritz von Opel's RAK.1.[2] Solid-fuel rockets, however, have major disadvantages when used for aircraft propulsion, as their thrust cannot be throttled, and the engines cannot be shut down until the fuel is exhausted.

In the mid 1930s, the aerospace engineer Wernher von Braun and his rocketry team working at Peenemünde investigated the use of liquid-fuelled rockets for powering aircraft. The German aircraft designer Ernst Heinkel became an enthusiastic supporter of their efforts, initially supplying a He 72 and later a pair of He 112s to support these experiments. During early 1937, one of these aircraft was flown with its piston engine shut down during flight, thus being propelled by rocket power alone.[3][4] At the same time, Hellmuth Walter's experiments into Hydrogen peroxide monopropellant-based rockets were leading towards light and simple rockets that appeared well-suited for aircraft installation, although at the price of considerable danger and limited duration.[5][6] The experimental flights of the He 112 had been subject to the close attention of the *Reichsluftfahrtministerium (RLM)* (the German Reich Aviation Ministry), which had become interested in the potential for a rocket-propelled interceptor aircraft.[7] Heinkel decided to establish a secret department at its Rostock facility to pursue such endeavours; work commenced as early as 1936.[8] Unlike the preceding He 112, the design team wanted to produce an aircraft that would be purpose-built to harness this new form of propulsion, and thus achieve superior performance from it; it would be from this effort that the He 176 would emerge.[9]

**Design**[edit]

The basic design of the He 176 was sketched out during the Neuhardenberg rocket motor and booster tests. In 1936, the RLM awarded Heinkel the contract to build the world's first rocket aircraft. It was decided to tailor-built the aircraft to specifically fit the test pilot Erich Warsitz, to minimise the size of the cockpit, along with the rest of the aircraft, to make the aircraft as lightweight as humanly possible.[10] The resulting cockpit was so cramped that the pilot could not even flex his elbows while some controls were often placed in inconvenient positions. Due to the high speed range that the He 176 was designed to encounter, the sensitivity of these controls would have to be adjusted multiple times throughout the flight for the pilot to maintain sufficient control.[11] The cockpit also featured an unconventional reclined seating position was adopted to help the pilot cope with the aircraft's high rate of acceleration, it also helped reduce the frontal area and thereby had performance benefits.[11] A crude plexiglas glazed section was removable so that the pilot could enter the aircraft.[10] The aircraft itself was relatively compact and in some respects fairly simplistic, being composed almost entirely out of wood, but did possess an advanced and entirely enclosed cockpit with a frameless single-piece clear nose.[12] The undercarriage was a combination of conventional and tricycle gear designs, for which the main gear's struts were intended to retract rearwards into the fuselage while the aerodynamically faired nose wheel and strut were fixed.[13] The greatest diameter of the fuselage was only 700 millimetres (28 in). The overall surface area, including the fuselage, was 5 square metres (54 sq ft), with a 5 metres (16 ft) wingspan, a fuselage length of 5.5 metres (18 ft), a height with the undercarriage deployed at 1.44 metres (4.7 ft), and a wheelbase of 700 millimetres (28 in).[14] The aircraft's rudder proved to be relatively ineffective at slow speeds; during takeoff runs, it proved to be a more practical means of steering the aircraft via differential use of the wheel brakes.[12]

The He 176 featured an elliptical wing that had a wing sweep of 40% and a thickness of 9% at 90 millimetres (3.5 in).[14] The wing had a slight positive dihedral so that sufficient stability would be maintained.[10] The fuel tanks were also integrated into the interior of wings; a new welding technique has to be developed to manufacture these. Significant attention was paid to the reduction of aerodynamic drag.[10] During ground test runs, it was discovered that that wings would often make contact with the ground; to prevent damage from being incurred, the wingtips were outfitted with metal bumpers.[12] The design team recognised that the conventional means of escaping the aircraft in an emergency situation by bailing out would be extremely difficult at high speed and possibly impossible without fatal injuries being sustained by the pilot.[12] Accordingly, the He 176 was equipped with a unique jettisonable nose escape system. Compressed air was used to separate the nose from the aircraft, then a drogue chute was used to reduce the opening force required. After the drogue was deployed, the flush-fitting cockpit canopy was released and a conventional pilot/parachute bailout occurred.[13] Unmanned scale mockups of the nose section were flight tested from a Heinkel He 111 bomber with positive results.[12] The original model of the He 176 was designed to be powered by one of the new Walter engines. This engine was similar to that of the He 112, the primary difference being the doubling of its thrust output to 6,000 Newtons, which was largely achieved via the addition of a pump to draw in propellant instead of using compressed air to push the fuel into the engine.[10][15]

The fuel used was 82% hydrogen peroxide.[10] To provide more effective directional controls while flying at slow speeds, a rudder was to be installed within the engine nozzle itself.[12] Detailed design work on the aircraft was completed by July 1937, after which construction of the prototype commenced almost immediately.[8] In December 1947, the He 176 designation was officially assigned to the aircraft.[16]

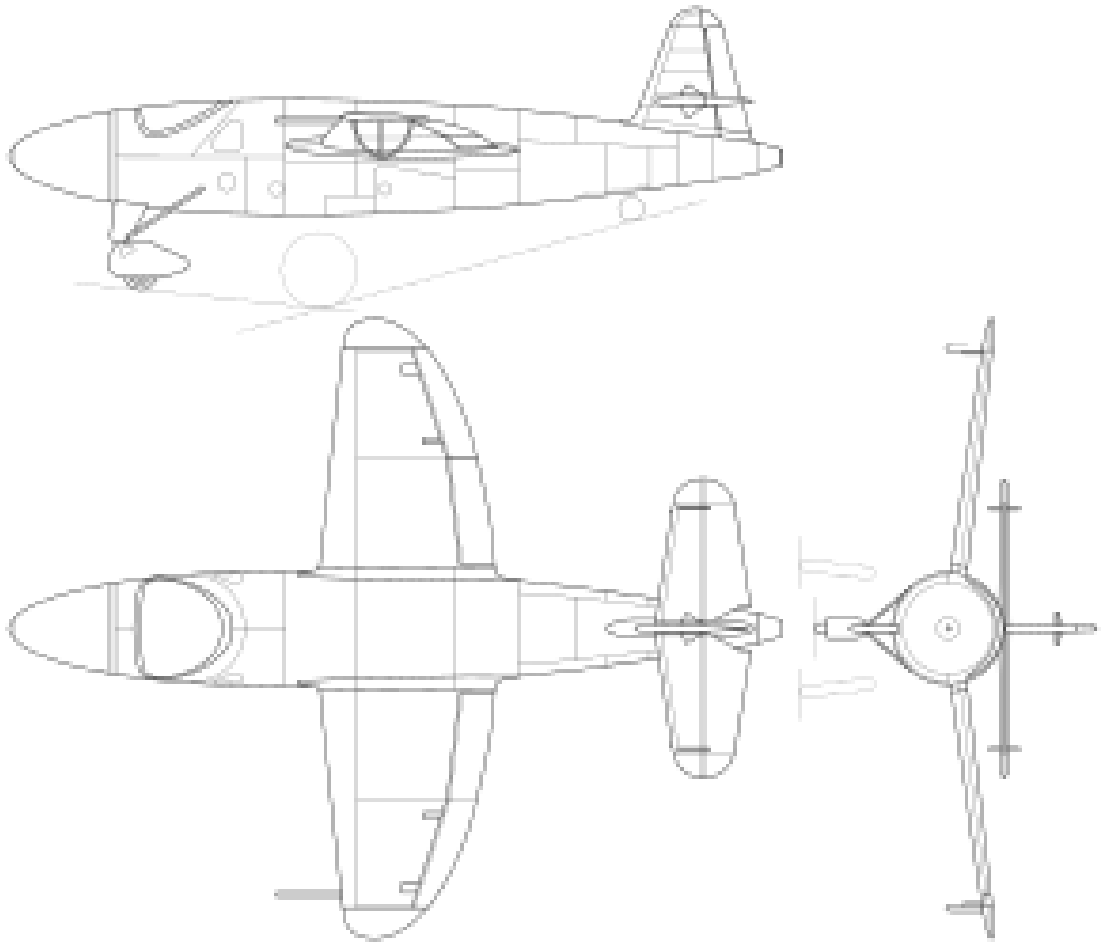
**Flight testing and cancellation**

On 20 June 1939, the He 176 performed its maiden flight piloted by Warsitz, the occasion being the first manned rocket flight in the world.[8][17] Warsitz later described the flight: "On quite another heading from that originally intended she leapt into the air and flew with a yaw and a wobble. I kept her close to the ground while gaining speed, then pulled back gently on the control stick for rapid ascent. I was at 750 kms/hr and without any loss in speed the machine shot skywards at an angle somewhere between vertical and 45°. She was enormously sensitive to the controls...Everything turned out wonderfully, however, and it was a relief to fly round the northern tip of Usedom Island without a sound at 800 kms/hr. I banked sharp left again to straighten up for the airstrip, losing such speed and altitude as I could, and during this steep turn the rocket died as the tanks dried up. The abrupt loss of speed hurled me forward in my restraint straps. I pressed the stick forward, hissed rapidly over the Penne and came in at 500 kms/hr. I crossed the airfield boundary and after several prescribed little bounces the machine came to a stop."[18] Following the initial test flight, the aircraft received alterations; allegedly the fixed nose wheel was removed at this point as the design team intended for regular landings to use only the two main wheels and the tail.[10] Following an initial round of flight testing, Heinkel demonstrated the He 176 to the RLM, however, the organisation displayed a lack of official interest in the aircraft. According to Warsitz, speaking of Von Braun's cooperation during the tests at Pennemunde: "Although not technically part of the He 176-V1 project with the Walter rocket engine, naturally everything affecting it was of interest to himself and his colleagues because the He 176-V2 was to have the von Braun engine..."[14] The RLM's unfavourable attitude towards the aircraft was a major contributor to Heinkel's decision to reduce his involvement in rocket propulsion efforts. On 12 September 1939, the discontinuation of the He 176 test programme was officially ordered, allegedly due to dissatisfaction with its performance and size.[19][20] Only the one aircraft was ever completed prior to the termination of flight testing. After its retirement, the sole He 176 prototype was put on static display at the Berlin Air Museum, it was destroyed by an Allied bombing raid during 1943.[13]

**Impact**

Prior to the cancellation of the programme, Heinkel had been in the process of designing a more sophisticated rocket powered aircraft, sometimes referred to the *He 176 V2*, which was allegedly intended for operational use.[10] For this model, a more powerful von Braun engine would have been used, which would have allegedly allowed the He 176 V2 to reach speeds of up to 1,000 kph or 620 mph.[10] No such aircraft were ever constructed, but because it bore the same designation as the aircraft that was actually flown, many books and websites mistakenly publish pictures of this aircraft when intending to illustrate its earlier namesake. Some of the technical knowledge gained through the He 176 was incorporated into future projects undertaken by Heinkel, such as the He 280 prototype jet fighter.[17] Germany did eventually fly an operational rocket-propelled fighter, the Alexander Lippisch-designed Me 163 *Komet*, but this was produced by the competing Messerschmitt firm. By the time that orders to terminate work on the He 176 had been received, early work on the Me 163 project had already commenced.[21] It was powered by a similar rocket engine that was actually a further development of the unit that had powered the He 176.

**Specifications (He 176 V1)**



Heinkel He 176 V1 with main gear retracted

**General characteristics**

- **Crew:** 1
- **Length:** 5.21 m (17 ft 1 in)
- **Wingspan:** 5.00 m (16 ft 5 in)
- **Height:** 1.435 m (4 ft 8.5 in)
- **Wing area:** 5.4 $m^2$ (58 sq ft)
- **Empty weight:** 900 kg (1,985 lb)
- **Gross weight:** 1,620 kg (3,572 lb)
- **Powerplant:** 1 × Walter HWK R1-203 liquid-fuelled rocket engine, 5.88 kN (1,323 lbf) thrust , 50 s burn time

**Performance**

- **Maximum speed:** 750 km/h (466 mph, 405 kn) estimated
- **Cruise speed:** 710 km/h (441 mph, 383 kn) estimated
- **Range:** 109 km (68 mi, 59 nmi)
- **Service ceiling:** 9,000 m (29,500 ft)
- **Rate of climb:** 60.6 m/s (11,930 ft/min)
- **Time to altitude:** 2.5 minutes to 8,000 m (26,250 ft)

Source : https://en.wikipedia.org/wiki/Heinkel_He_176