# Bachem Ba 349 Natter

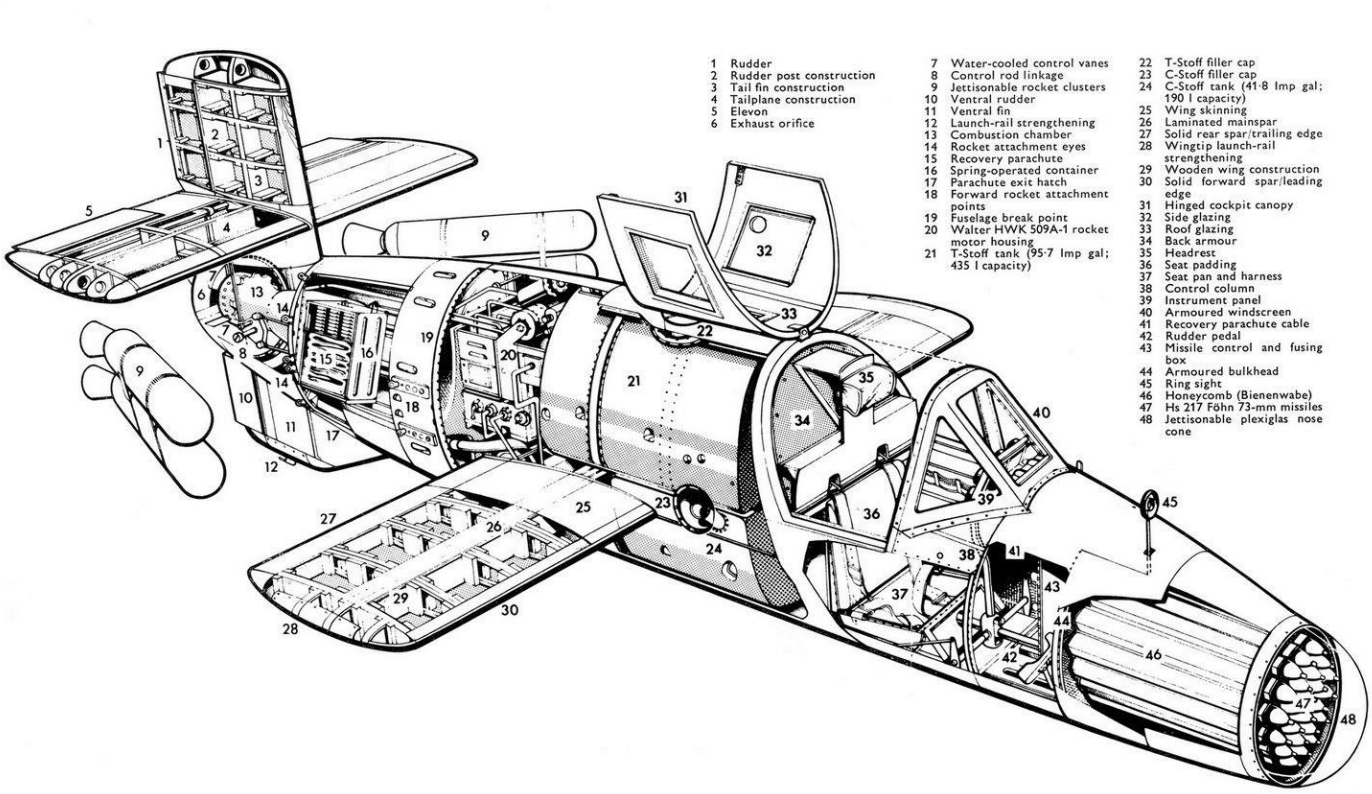
Conçu en 1944 en vue d'assurer la protection des industries et des voies de communication allemandes contre les raids des bombardiers américains, le Natter (vipère) se présentait comme un intercepteur à réaction très performant et d'un coût réduit, sa cellule pouvant être produite en série par de petits ateliers. En effet le Natter, dont la construction n'exigeait que 500 heures de travail, était dépourvu de roues, construit en bois et assemblé à la colle.

Arme de la dernière chance au même titre que le Ohka japonais, le Bachem ne servit néanmoins jamais en opération. Une fois lancé à partir d'une rampe verticale, le pilote rejoignait sa cible grâce au pilote automatique à 11.000 m/mn, propulsé grâce à quatre boosters pendant 10 secondes. Puis pendant 70 secondes à pleine puissance par un moteur fusée, il effectuait une approche pour se placer dans le dos de l'ennemi, fonçait sur lui à 800 km/h. Ensuite, il attaquait les bombardiers avec ses roquettes transportées dans son nez. Enfin, sa mission effectuée, le poste de pilotage se séparait du fuselage. Ce dernier et le moteur fusée était récupérés séparément pour être réutilisés.

Le Bachem Ba 349 Natter (vipère) est un intercepteur monoplace de la Luftwaffe, qui fut développé à la fin de la Seconde Guerre mondiale par l'ingénieur Erich Bachem, ancien employé de Fieseler, constructeur du V1. En 1944, suite aux bombardements alliés de jour sur l'Allemagne, la Luftwaffe choisit le projet d'Erich Bachem pour construire un intercepteur piloté, doté d'une très grande puissance de feu et pouvant atteindre les bombardiers lourds très rapidement.

Au repos, l'appareil est installé sur un chariot. Pour un lancement imminent, il est alors placé sur une rampe de lancement d'une inclinaison d'environ 87°. Des moteurs-fusées "Schmiddling" à combustible solide sont utilisés pour le décollage. Au moment où les appareils ennemis survolent la zone de lancement, l'intercepteur est lancé grâce aux moteurs-fusées puis poursuit son ascension grâce à une fusée interne. Le pilote active son armement consistant en une batterie de 24 missiles HS 217 "Föhn" (tempête) lorsqu'il se trouve à proximité des bombardiers ennemis.

Grâce à l'énergie cinétique emmagasinée, le Natter grimpe encore plus haut, et pique ensuite en vue d'effectuer une passe de tir de ses roquettes. L'appareil ne pouvant se poser, le pilote s'éjectait en activant un système désolidarisant la partie avant de la partie arrière comportant le moteur. La partie arrière retombait en parachute.




Aucun autre système d'éjection ne put être mis en œuvre. La construction du Natter était simple: entièrement en bois excepté le cockpit blindé en métal.

Des essais sans pilote furent effectués depuis la rampe de lancement, et quelques vols furent réalisé en vol plané à partir d'un Heinkel He 111 à 6000m environ. Le premier tir avec pilote se déroula le 28 février 1945. Cinq secondes après l'allumage, la verrière se détacha l'Oberleutnant Lothar Siebert fut tué. Le Natter s'écrasa. En avril 1945, 36 appareils volaient dont 7 avec pilote, lorsque les troupes alliées s'emparèrent de l'usine et de la base de lancement.

Les premiers essais commencèrent en octobre 1944, et des lancements sans pilote à bord furent conduits à partir du mois de décembre de la même année. Le seul vol avec pilote s’étant achevé de façon dramatique, le programme fut arrêté alors que 20 exemplaires de série Ba 349A avaient déjà été réalisés. Seulement 36 Ba 349 Natter furent produits sur la commande de 200 et 10 furent mis en batterie dans les derniers jours de la Guerre sur la base de Kirchheim mais l’approche des tanks américains entraîna leur destruction par les allemands eux-mêmes sans qu’aucun de ces missiles pilotés ne puissent servir opérationnellement.

La version suivante, le Ba 349B, rebaptisé Umbau (reconstruit) était dotée d'une dimension supérieure avec une capacité de carburant accrue et un armement supérieur. Seuls trois exemplaires furent achevés. Enfin, une série C encore plus grande était prévue. Aucune mission de combat ne fut jamais effectuée.


Source : http://www.avionslegendaires.net
http://milguerres.unblog.fr/bachem-ba-349-natter/

version anglaise

The **Bachem Ba 349 Natter** (English: Colubrid, grass-snake) was a World War II German point-defence rocket-powered interceptor, which was to be used in a very similar way to a manned surface-to-air missile. After a vertical take-off, which eliminated the need for airfields, most of the flight to the Allied bombers was to be controlled by an autopilot. The primary role of the relatively untrained pilot was to aim the aircraft at its target bomber and fire its armament of rockets. The pilot and the fuselage containing the rocket motor would then land using separate parachutes, while the nose section was disposable. The first and only manned vertical take-off flight, on 1 March 1945, ended in the death of the test pilot, Lothar Sieber.

**Background**

In 1943, *Luftwaffe* air superiority was being challenged by the Allies over the *Reich* and radical innovations were required to overcome the crisis. Surface-to-air missiles appeared to be a promising approach to counter the Allied strategic bombing offensive; a variety of projects were started, but invariably problems with the guidance and homing systems prevented any of these from attaining operational status. Providing the missile with a pilot, who could operate a weapon during the brief terminal approach phase, offered a solution. Submissions for a simple target defence interceptor were requested by the *Luftwaffe* in early 1944 under the umbrella of the *Jägernotprogramm*, literally "Fighter Emergency Program". A number of simple designs were proposed, including the Heinkel P.1077 *Julia*, in which the pilot lay prone (on his stomach), to reduce the frontal area. The *Julia* was the front-runner for the contract. The initial plan was to launch the aircraft vertically, but this concept was later changed to a conventional horizontal take-off from a tricycle-wheeled trolley, similar to that used by the first eight prototypes of the Arado Ar 234 jet reconnaissance bomber.

**Bachem's proposal**

Erich Bachem's BP-20 ("Natter") was a development from a design he had worked on at Fieseler, the Fi 166 concept, but considerably more radical than the other submissions. It was built using glued and nailed wooden parts with an armour-plated bulkhead and bulletproof glass windshield at the front of the cockpit. The initial plan was to power the machine with a Walter HWK 109-509A-2 rocket motor; however, only the 109-509A-1, as used in the Me 163, was available. It had a sea level thrust variable between 100 kg (220 lb) at "idle" to 1,600 kg (3,500 lb) at full power, with the *Natter's* intended quartet of rear flank-mount Schmidding SG34 solid fuel rocket boosters used in its vertical launch to provide an additional 4,800 kg (10,600 lb) thrust for 10 seconds before they burned out and were jettisoned. The experimental prototypes slid up a 20 m (66 ft)-tall vertical steel launch tower for a maximum sliding length of 17 m (56 ft) in three guideways, one for each wing tip and one for the lower tip of the ventral tail fin. By the time the aircraft left the tower it was hoped that it would have achieved sufficient speed to allow its aerodynamic surfaces to provide stable flight.

Under operational conditions, once the Natter had left the launcher, it would be guided to the proximity of the Allied bombers by an autopilot with the possibility of an added beam guidance similar to that used in some V-2 rocket launches. Only then would the pilot take control, aim and fire the armament, which was originally proposed to be a salvo of nineteen 55mm R4M rockets. Later, 28 R4Ms or a number of the larger, 73mm Henschel Hs 297 *Föhn* rockets were suggested, with either variety of unguided rocket fired from the Natter's nose-mounted cellular launch tubes. The Natter was intended to fly up and over the bombers, by which time its Walter motor would probably be out of propellant. Following its one-time attack with its rockets, the pilot would dive his Natter, now effectively a glider, to an altitude of around 3,000 m (9,800 ft), flatten out, release the nose of the aircraft and a small braking parachute from the rear fuselage. The fuselage would decelerate and the pilot would be ejected forwards by his own inertia and land by means of a personal parachute.

In an early proposal in August 1944, the Natter design had a concrete nose; it was suggested that the machine might ram a bomber, but this proposal was subsequently withdrawn in later Project Natter outlines. Bachem stated clearly in the initial proposal that the Natter was not a suicide weapon and much effort went into designing safety features for the pilot. However, owing to the potential dangers for the pilot inherent in the operation of this precarious aircraft, the Natter is sometimes listed as a suicide craft. The design had one decisive advantage over its competitors – it eliminated the necessity to land an unpowered gliding machine at an airbase, which, as the history of the Me 163 rocket aircraft had clearly demonstrated, made an aircraft extremely vulnerable to attack by Allied fighters.

**Modifications**

Heinrich Himmler became interested in Bachem's design. The *Reichsführer-SS* granted Bachem an interview and fully supported the project. In the middle of September 1944, the Technical Office of the *Waffen-SS* made an order for Bachem to develop and manufacture the Natter at his Waldsee factory. During December 1944, the project came largely under the control of the SS and Hans Kammler. This decision is said to have been the only time the SS significantly interfered with aircraft design and air fighting strategy. Early-on in the project, the *Reichsluftfahrtministerium* (*RLM*) undertook an engineering assessment of the Natter, which it reported on 28 October 1944.

The Natter was designed to be built by unskilled labor with poor-quality tools and inexpensive material. Various stringent economies were imposed on an already frugal design. The Natter had no landing gear, which saved weight, expense and construction time. Consequently, one of the most unusual features of the machine was the escape of the pilot and recovery of the machine.

The proposed sequence of these events was as follows: After the attack, the Natter might dive to a lower altitude and flatten out into level flight. The pilot would then proceed with a well-practised escape sequence. He would open the cockpit canopy latch, which would allow the canopy to flick backwards on its hinge in the airstream. Next, the pilot would undo his seat belt and remove his feet from the rudder pedal stirrups. By squeezing a lever mounted on the control column, he would release a lock at the base of the column, which would allow him to tilt the column forwards where it could engage in and undo a safety latch for the nose release mechanism. He would then lean a little further forward and pull a lever hinged near the floor at the front of the cockpit, freeing the nose section, which self-jettisoned as a result of the reduced aerodynamic pressure at the front of the fuselage.

As the nose section separated, it was intended to briefly pull on two cables that released a small ribbon parachute stored on the starboard side of the rear fuselage. The parachute subsequently opened and decelerated the Natter. The pilot would be ejected from the cockpit by his own inertia and as soon as he was clear of the fuselage, he would open his personal parachute and descend to the ground. A parachute was to eject the valuable Walter rocket motor from the rear, which would decelerate the aircraft and eject the pilot with inertia, however, associated problems with this mechanism were still not fully resolved prior to the conflict's end.

Wind tunnel testing on a wooden model, scaled to 40% of full size, was performed at the *Deutsche Versuchsanstalt für Luftfahrt* (DVL), the Institute for Aerodynamics at Berlin-Adlershof in September 1944 at speeds up to 504 km/h. Results from these tests were reported in January 1945 to the Bachem-Werk. Further model tests were carried out at the *Luftfahrtforschungsanstalt Hermann Göring* (LFA) facility in Völkenrode-Braunschweig, at speeds close to Mach 1. In March the Bachem-Werk simply received a statement that satisfactory flying qualities should be expected with speeds up to 1,100 km/h.

**Flight testing**

Construction of the first experimental prototype *Natter, Versuchsmuster 1*, was completed on 4 October 1944. V1 was subsequently referred to as *Baumuster1* (*BM1*) and later still the "B" was dropped and the machine became known as the M1. Most subsequent prototypes were known by 'M' codes, as the later prototypes of the Heinkel He 162 were. Manned glider flights began on 3 November 1944. The first glider M1 was towed to around 3,000 m by a Heinkel He 111 bomber with a cable (*Tragschlepp* mode) at Neuburg an der Donau. The pilot was Erich Klöckner, who made all four documented *Tragschlepp* ("towed") flights.

After carrying out the test programme of the M1, he bailed out and the machine crashed into the ground. It was found that the towing cable, and in the case of the M3, the undercarriage interfered with the flight characteristics of the gliders and consequently the results were difficult to interpret.[7] To clear any lingering doubts about the Natter in the glider mode, Hans Zübert made a daring free flight in the M8 on 14 February, and showed that the Natter was indeed a very good flying machine.[23]

The vertical take-off trials were conducted on high ground called the Ochsenkopf at the *Truppenübungsplatz* (military training area) Heuberg near Stetten am kalten Markt, Württemberg. The first successful unmanned vertical take-off from the experimental launch tower occurred on 22 December 1944. The test machine, the M16, was powered only by the Schmidding solid boosters, as were all the early vertical launch trials. Up to and including 1 March 1945, 16 prototypes had been used, eight in glider trials and eight in VTO trials.

**Manned test flight**

By January 1945, Bachem was under pressure from the authorities in Berlin to carry out a manned flight by the end of February. On 25 February, M22 was in the experimental launch tower. It was as complete an operational machine as possible with the Walter HWK 109-509 A1 motor installed for the first time. A dummy pilot was in the cockpit. Lift-off from the tower was perfect. The engineers and ground crew watched as the M22 ascended under the combined power of the four Schmidding boosters and the Walter motor, an estimated total thrust of 6,500 kg (14,300 lb). The nose separated as programmed and the dummy pilot descended safely under its personal parachute. The remainder of the fuselage came down under its two large salvage parachutes, but when it hit the ground the Walter liquid-propellant rocket motor's residual hypergolic propellants (*T-Stoff* oxidizer and *C-Stoff* fuel) exploded and the machine was destroyed.

Despite Bachem's concerns that the test programme had been significantly cut short, a young volunteer *Luftwaffe* test pilot, Lothar Sieber, climbed into the cockpit of the fully fuelled M23 on 1 March. The aircraft was equipped with an FM transmitter for the purpose of transmitting flight data from various monitoring sensors in the machine. A hard wire intercom appears to have been provided between Sieber and the engineers in the launch bunker using a system similar to that used in the manned glider flights. Around 1100 am, the M23 was ready for take-off. Low stratus clouds lay over the Ochsenkopf. The Walter liquid-fueled rocket motor built up to full thrust and Sieber pushed the button to ignite the four solid boosters.

Initially, the Natter rose vertically but, at an altitude of about 100 to 150 m (330 to 490 ft), it suddenly pitched up into an inverted curve at about 30° to the vertical. At about 500 m (1,600 ft) the cockpit canopy was seen to fly off. The Natter continued to climb at high speed at an angle of 15° from the horizontal and disappeared into the clouds. The Walter motor stalled about 15 seconds after take-off. It is estimated the Natter reached 1,500 m (4,900 ft), at which point it nose-dived and hit the ground with great force about 32 seconds later, some kilometres from the launch site. Unknown at the time, one of the Schmidding boosters failed to jettison and its remains were dug up at the crash site in 1998.

The pilot was likely unconscious long before the crash. Bachem surmised Sieber had involuntarily pulled back on the control column under the effect of the 3 G acceleration. Examination of the canopy, which fell near the launch site, showed the tip of the latch was bent, suggesting it may not have been in the fully closed position at launch. The pilot's headrest had been attached to the underside of the canopy and as the canopy flew off the pilot's head would have snapped back suddenly about 25 cm (9.8 in), hitting the solid wooden rear upper cockpit bulkhead, and either knocking Sieber unconscious or breaking his neck.

The accident reinforced Bachem's long held belief that the take-off and flight in the vicinity of the target bombers should be fully automated. The canopy latch was strengthened and the headrest was attached to the backboard of the cockpit. Before the introduction of the autopilot in the test programme, the control column would have a temporary locking device on it, which would allow the machine to ascend vertically to at least 1,000 m (3,300 ft) and then be removed by the pilot. The Walter motor probably ceased operation because the Natter was virtually upside-down and air may have entered the intake pipes in the propellant tanks, starving the motor. Sieber had become the first man to take off vertically from the ground under pure rocket power, 16 years before Yuri Gagarin's *Vostok 1* pioneering, peacetime orbital flight. Following Sieber's death, all of the eight subsequent Natter flights were unmanned.

**Production**

The SS ordered 150 Natters, and the *Luftwaffe* ordered 50, but none were delivered by the end of the war. Much debate has surrounded the number of Natters built at the Bachem-Werk and their disposition. According to Bachem, 36 *Natters* were produced at the Bachem-Werk in Waldsee by the end of the war. Up to April 1945, 17 aircraft had been used in unmanned trials comprising five gliders, all slung under an He 111 in the *Mistelschlepp* configuration prior to launch, and 12 VTO examples. Five aircraft were prepared for manned trials, four gliders and one VTO version. The M3 was flown twice, and then rebuilt at which time it was given the new code BM3a but was never flown. The total number of launches to early April 1945 was 22, as was the total number of Natters constructed up to that time. Bachem reported further that there were 14 more finished or almost finished aircraft in April 1945. Four of these were prototype A1 operational Natters built for test launching from a wooden pole launcher, which had been designed for field deployment. This new launcher was also constructed on the Heuberg, not far from the experimental steel tower. There is documentary evidence for two pole launches in April but not three as claimed by Bachem in his post-war presentation.[1] The documentation for this third flight may have been destroyed by the SS at war's end. Ten A1 operational Natters, called *K-Maschinen*, were constructed for the *Krokus-Einsatz* ("Operation Crocus").

The fate of these 14 A1 Natters was as follows: Three were fired from the vertical launch tower according to Bachem, four were burnt at Waldsee, two were burnt at *Lager* Schlatt, Oetztal, Austria, four were captured by US troops at Sankt Leonhard im Pitztal, Austria, and one, which had been sent as a sample model to a new factory in Thuringia, was captured by the Red Army. Consequently, the total of 36 test and operational aircraft constructed at the Bachem-Werk can be accounted for. However, Natter carcasses were used for a variety of ground-based purposes; for example, as a static booster rocket, armament and strength testing and pilot seat position tests. Some fuselages were reused after flight testing; for example, the M5, 6 and 7.

Of the four Natters captured at Sankt Leonhard im Pitztal, two went to the United States. Only one original Natter built in Germany in the Second World War survives in storage at the Paul E. Garber Preservation, Restoration, and Storage Facility in Suitland, Maryland, under the auspices of the Smithsonian Institution. The fate of the other Natter brought to the US is unknown. There is no documentary evidence that a Natter was ever flown from Muroc Field. The tail section of one of the Natters at Sankt Leonhard im Pitztal was broken off while it still rested on its trailer.

**Stability**

In early February 1945, the positions of the centre of gravity for the A1 operational machine during its flight profile were giving the RLM and the SS cause for concern. They wanted these figures to be decided upon for the upcoming construction of the A1 aircraft for *Krokus-Einsatz* (Operation Crocus), the field deployment of the Natter. The position of the centre of gravity is expressed as a percentage of the chord (distance between the leading and trailing edges) of the main wing. Thus 0% is the leading edge and 100% is the trailing edge. In the manned glider trials the centre of gravity had been varied between 20 and 34%.

At a meeting of engineers held on 8 February, the variations in the centre of gravity expected in the A1 *Krokus* machine were discussed. At take-off with the weight of the four solid boosters, the centre of gravity would be brought back to 65%, but after releasing these rockets it would move forwards to 22%. The free flight by Zübert on 14 February had showed unequivocally that the little Natter had excellent flying characteristics as a glider. The centre of gravity problem was solved initially by the addition of one-metre-square auxiliary tailfins that were released simultaneously with the jettisoning of the boosters. The *Krokus* aircraft had vanes that would direct the Walter rocket exhaust gases so as to assist vehicle stabilisation at low speed similar to those used in the V-2 rocket.

**Legacy**

A captured Ba 349 A1 Natter on display for Open Days at Freeman Field, Indiana September 1945. The swastikas are neither authentic nor positioned according to German military specifications.

By 25 April 1945, French forces had captured Waldsee and presumably took control of the Bachem-Werk. Shortly before the French troops arrived, a group of Bachem-Werk personnel set out for Austria with five A1 Natters on trailers. At Bad Wörishofen, the group waited for another squad retreating from Nabern unter Teck with one completed Natter. Both groups then set out for the Austrian Alps. One group with two Natters ended up at the junction of the river Inn and one of its tributaries, the Ötztaler Ache, at Camp Schlatt. The other group went to St. Leonhard im Pitztal with four aircraft. US troops captured the first group at Camp Schlatt around 4 May and the second group on the following day.

At some time during the project, the Bachem-Werk was ordered to give complete details of the BP-20 Natter to the Japanese, but there was doubt over whether they had received them. They were, however, known to have a general knowledge of the Natter and showed considerable interest in the project.

*Operation Krokus* launch pads at Hasenholz wood

An operational launch site for the first Ba 349A-1 operational Natters under the code name *Operation Krokus* was being established in a small wooded area called Hasenholz, south of the Stuttgart to Munich autobahn and to the east of Nabern unter Teck. Around the end of February and the beginning of March the Organisation Todt was in action, constructing each set of the trios of concrete foundations (or "footings") for the launch towers. These three launch pads and their towers were arranged at the corners of an equilateral triangle, 120 m per side.

The specific locations are said to be 48°37′42.017″N 9°29′53.607″E, 48°37′42.043″N 9°29′57.860″E and 48°37′38.629″N 9°29′55.140″E. In the centre of each of the three concrete footings is a square hole approximately 50 centimeters deep, which once served as the foundation for the launch tower. Beside each hole is a pipe, cut off at ground level, which was probably once a cable pit. These three concrete pads were noticed by a surveyor in the autumn of 1945, but not rediscovered until 1999.

On 27 January, eight pilots volunteered for the first operational flights and started familiarizing themselves with the Natter at Bachem's factory on 5 February. This training continued until the beginning of April. The pilots were expecting to fly three combat-ready Natters on 20 April, which was Hitler's birthday, but were unaware that the launch pads were still incomplete. But on that day the US 10th Armored Division drove its tanks into Kirchheim unter Teck to the northwest of Hasenholz wood. The next day it crossed the autobahn and headed straight for the Natter operational area. The Natter group subsequently retreated to Waldsee.

Last preserved Bachem Ba 349 Natter launch pad in the Hasenholz.

Ruins of the two Bachem Ba 349 Natter launch pads in the Hasenholz.

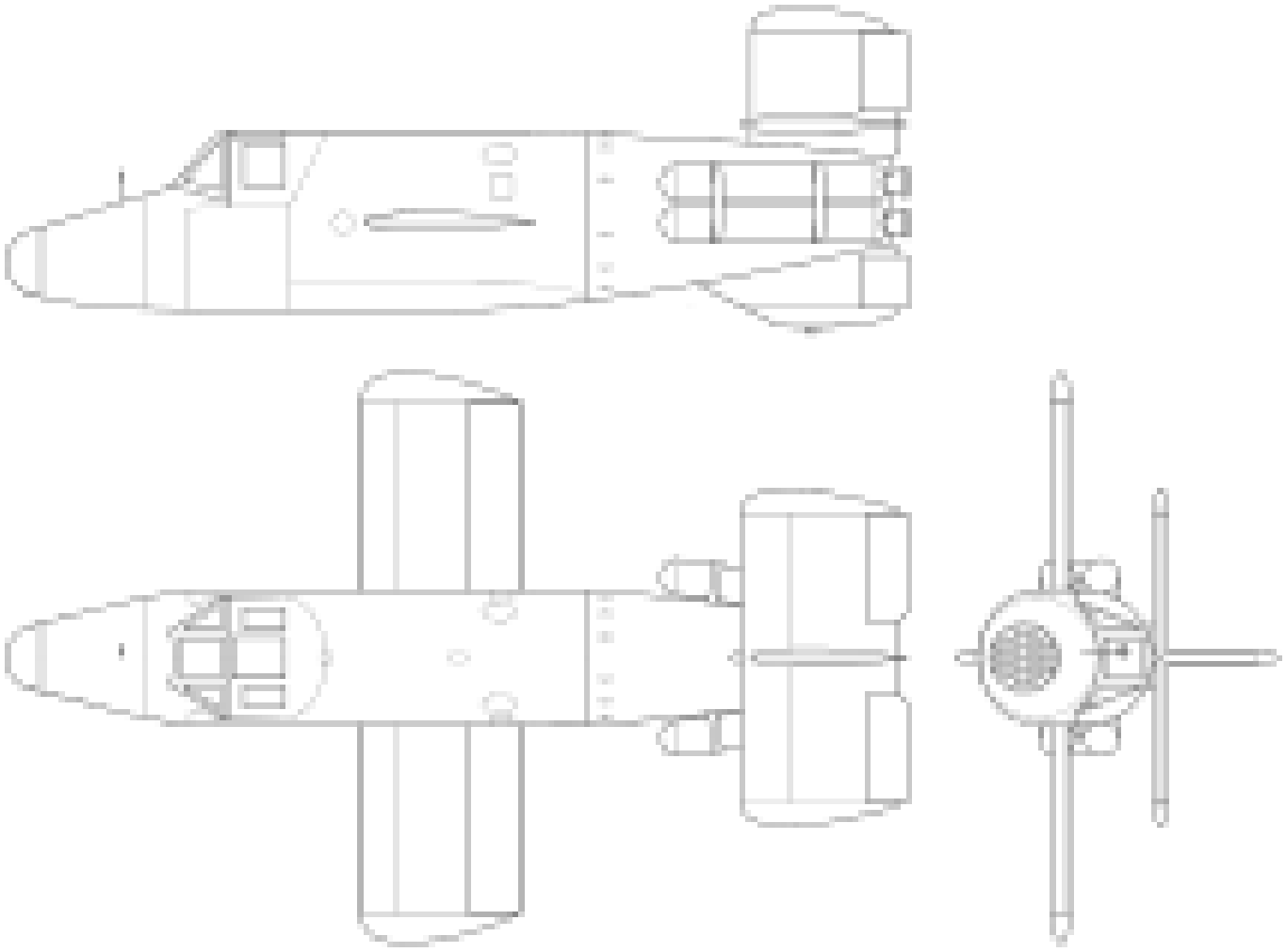
Surviving aircraft and replicas

The surviving Bachem Ba 349A-1 at the Smithsonian Institution's Paul E. Garber Preservation, Restoration, and Storage Facility in Suitland, Maryland

Only one original A1 Natter survives; it is stored in the Paul E. Garber Preservation, Restoration and Storage Facility in Suitland, Maryland, US. It is in a poor state of repair and is no longer accessible to the general public. The evidence supports the proposition that this machine was captured by US troops at St. Leonhard im Pitztal, Austria in May 1945.

The Natter displayed at the Deutsches Museum is said to have been reconstructed partly from sub-assemblies that survived the end of the war. This machine is of the experimental type as launched from the steel tower and is painted to look like an M17. There are several static reproductions of Natters around the world, for example at the Planes of Fame Air Museum, Chino, California and Fantasy of Flight, Polk City, Florida, US

**Specifications (Ba 349B-1)**



Ba 349

**General characteristics**

- **Crew:** 1
- **Length:** 6 m (19 ft 8 in)
- **Wingspan:** 4 m (13 ft 1 in)
- **Height:** 2.25 m (7 ft 5 in) (without fins)
- **Wing area:** 4.7 $m^2$ (51 sq ft)
- **Empty weight:** 880 kg (1,940 lb) fuel expended
- **Gross weight:** 2,232 kg (4,921 lb)
- **Gross weight boosters jettisoned:** 1,769 kg (3,900 lb)
- **Fuel capacity:** 650 kg
- **Powerplant:** 1 × Walter HWK 109-509C-1 bi-fuel rocket motor, 11.2 kN (2,500 lbf) thrust *Hauptofen* main chamber

  2.9 kN (652 lbf) *Marschofen* auxiliary chamber
- **Powerplant:** 4 × Schmidding SG 34 solid fuel booster rockets, 4.9 kN (1,100 lbf) thrust each

or 2 x 9.8 kN (2,203 lbf) solid fuel booster rockets

**Performance**

- **Maximum speed:** 1,000 km/h (620 mph, 540 kn) at 5,000 m (16,404 ft)
- **Cruise speed:** 800 km/h (500 mph, 430 kn)
- **Range:** 60 km (37 mi, 32 nmi) after climb at 3,000 m (9,843 ft)

  55 km (34 mi)after climb at 6,000 m (19,685 ft)

  42 km (26 mi)after climb at 9,000 m (29,528 ft)

  40 km (25 mi)after climb at 10,000 m (32,808 ft)
- **Endurance:** 4.36 minutes at 6,000 m (19,685 ft)

  3.15 minutes at 9,000 m (29,528 ft)
- **Service ceiling:** 12,000 m (39,000 ft)
- **Rate of climb:** 190 m/s (37,000 ft/min)
- **Time to altitude:** 62 seconds to 12 km (7.5 mi)

**Armament**

- 24 × 73 mm (2.874 in) Henschel Hs 297 Föhn rocket shells
- or 33 × 55 mm (2.165 in) R4M rocket shells
- or 2 × 30 mm (1.181 in) MK 108 cannon with 30 rpg (proposed)

source : https://en.wikipedia.org/wiki/Bachem_Ba_349_Natter