

Nakajima Ki-84 Hayate 'Franck'



Répondant à un programme de 1941 en vue de succéder aux Ki.43 et Ki.44, le Nakajima Ki.84 Hayate (« Rafale de vent ») vola pour la première fois au cours de l'été 1943. Les appareils de pré-série, livrés aussitôt après, permirent la mise en service dès le mois de mai 1944 de celui qui devint sans délai le chasseur standard de l'armée sous la désignation de Ki.84-I.

C'était un monoplane ailes basses, au train d'atterrissage escamotable, entièrement métallique à structure renforcée et il disposait d'un imposant blindage et de réservoirs auto-obturants. Avec un puissant moteur et un bon armement, le Hayate (« Frank » pour les alliés) devint en quelques semaines le meilleur monoplace de chasse de l'Armée Impériale.

Engagé au combat en Chine, l'appareil fut un adversaire particulièrement meurtrier des « Tigres Volants » de Chennault : plus rapide et mieux armé que ses prédécesseurs, il encaissait aussi bien que les chasseurs américains, mais avec une maniabilité nettement supérieure. Les principaux défauts du Ki.84-I étaient la fragilité du moteur, souvent trop poussé, et la mauvaise qualité de certaines pièces en acier, dont les jambes du train d'atterrissage.

Le Nakajima KI-84 Hayate (Tempête), connu sous le nom de « Frank » par les alliés, s'avéra un adversaire redoutable pour les meilleurs chasseurs américains, cependant, il parut trop tard et en trop petit nombre pour permettre au Japon de reprendre la maîtrise du ciel.

La genèse du Ki-84 commence au tout début du conflit. L'Armée fait une demande à Nakajima en vue de développer un successeur au Ki-43 Hayabusa, mais qui soit plus polyvalent que le Ki-44 qui est un intercepteur pur. L'avion doit avoir un profil quasiment idéal : long rayon d'action, polyvalence, maniabilité, vitesse maximale : de 640 à 680 km/h, autonomie d'1h30 à la puissance de combat et à 400 km de la base. Le moteur prévu pour le Ki-84 doit être le nouveau Nakajima Ha-45 à 18 cylindres en double étoile compact, refroidi par air développant de 1800 à 2000 chevaux, connu sous le nom de "Homare" dans la Marine).

L'armement, quant à lui, doit être composé de 2 canons de 20 mm Ho-5 et deux mitrailleuses de 12,7 mm Ho-103. De plus, le chasseur doit être équipé de blindages et de réservoirs auto-obturant.

Le moteur Ha-45-11 de 1800 chevaux est accouplé à une grande hélice quadri-pales à vitesse constante. Le prototype vole en avril 1943.

Le développement se poursuit sans problèmes majeurs. L'avion est une réussite, bien que les performances soient légèrement en retrait par rapport aux exigences du cahier des charges avec 624km/h au lieu des 640 demandés, restant quand même les meilleures performances pour un appareil japonais de cette époque.

Cependant, il est déjà trop tard pour les Japonais et les Ki84 furent décimés car utilisés sur la défensive contre des ennemis bien plus nombreux. De plus, les appareils souffraient de problèmes récurrents de train d'atterrissage, d'hydraulique et surtout de moteur.

Après-guerre, les Américains firent des essais avec des Ki-84 capturés. Ils furent très surpris car, "dopé" par le carburant américain de nettement meilleure qualité que le carburant japonais de 1945, le Ki-84 atteignait des vitesses comparables voire meilleures que celles des plus rapides North American P-51 Mustang et P-47N.



Pourtant, les seules modifications sérieuses qui furent apportées concernaient l'armement (Types Ib, à 4 canons de 20 mm et Ic à 2 canons de 30 mm et 2 canons de 20 mm) . Les autres changements furent surtout dictés par la pénurie de matériaux, dont l'aluminium : ainsi fut produit, au printemps 1945, le Ki.84-II ou KAI, construit partiellement en bois (Extrémités des ailes et arrière du fuselage) ; un Hayate fut même construit à trois exemplaires tout en bois par Tachikawa : désigné Ki.106, ce fut un échec. Plusieurs versions furent envisagées, en bois et acier ou avec différents moteurs (Ki.113, Ki.116, Ki.117), mais aucune n'aboutit.

Le Nakajima Ki.84-I Hayate fut produit à 3469 exemplaires. Deux appareils capturés en février 1945 permirent aux ingénieurs américains du Technical Air Intelligence Unit de découvrir, bien avant la capitulation, sa structure étonnamment robuste en dépit de la simplicité et de la rusticité de sa conception. La plus grande surprise fut cependant réservée à l'USAAF quand elle compara après-guerre le Ki.84 à ses avions les plus performants. Dopé par le carburant américain, le moteur Ha-45/21 parvint à développer près de 2000 ch et, dans toutes les figures de combat aérien, « Frank » surclassa largement les P-47 Thunderbolt et P-51 Mustang !

Modèle : Nakajima Ki-84-la Hayate 'Franck'

Envergure : 11.23 m

Longueur : 9.92 m

Hauteur : 3.38 m

Motorisation : 1 moteur Nakajima Ha-45

Puissance totale : 1 x 1900 ch.

Armement : 2 canons de 20mm

2 mitrailleuses de 12.7mm

2 bombes de 250 Kg (facultatif)

Charge utile : -

Poids en charge : 3900 kg

Vitesse max. : 631 km/h à 6120 m

Plafond pratique : 11100 m

Distance max. : 2170 Km

Equipage : 1



source : <http://www.avionslegendaires.net/avion-militaire/nakajima-ki-84-hayate-franck/>
<http://milguerres.unblog.fr/nakajima-ki-84-hayate-franck/>

version anglaise

The **Nakajima Ki-84 Hayate** (キ84 疾風, lit. "Gale") is a single-seat [fighter](#) flown by the [Imperial Japanese Army Air Service](#) in the last two years of [World War II](#). The [Allied reporting name](#) was "**Frank**"; the Japanese Army designation was **Army Type 4 Fighter** (四式戦闘機, *yon-shiki-sentō-ki*). The Ki-84 is generally considered the best Japanese fighter to operate in large numbers during the conflict. The aircraft boasted high speed and excellent maneuverability with an armament (up to two 30 mm and two 20 mm cannon) that gave it formidable firepower. The Ki-84's performance matched that of any single-engine Allied fighter it faced, and its operational ceiling enabled it to intercept high-flying [B-29 Superfortress](#) bombers. Pilots and crews in the field learned to take care with the plane's high-maintenance [Nakajima Homare](#) engine and a landing gear prone to buckling. The difficulties of [Japan's](#) situation late in the war took a toll on the aircraft's field performance as manufacturing defects multiplied, good quality fuel proved difficult to procure, and experienced pilots grew scarce. Nevertheless, a well-maintained Ki-84 was Japan's fastest fighter. A total of 3,514 aircraft were built.

Design and development



Prototype Nakajima Ki-84 with unique exhaust stack, similar to a Ki-43's

Design of the Ki-84 commenced in early 1942 to meet an [Imperial Japanese Army Air Service](#) requirement for a replacement to Nakajima's own, earlier [Ki-43](#) fighter, then just entering service. The specification recognized the need to combine the maneuverability of the Ki-43 with performance to match the best western fighters, and heavy firepower. The Ki-84 first flew in March 1943 and deliveries from Nakajima's Ota factory commenced the following month. Although the design was itself solid, growing difficulties in securing skilled pilots, proper fuel and construction materials, and adequate manufacture often prevented the aircraft from reaching its full potential in the field.

The design of the Ki-84 addressed the most common complaints about the popular and highly maneuverable Ki-43: insufficient firepower, poor defensive [armor](#), and lack of climbing speed. The Ki-84 was a cantilever low-wing monoplane of all-metal construction, except for the fabric-covered control surfaces, with [conventional landing gear](#).

Armament comprised two fuselage-mounted, synchronized 12.7 mm (.50 in) [machine guns](#) — these proved challenging to synchronize properly with the *Hayate's* four-blade propeller — and two wing-mounted 20 mm cannon, a considerable improvement over the two 12.7 mm (.50 in) [machine guns](#) used in the Ki-43 *Hayabusa*. Defensive [armor](#) offered *Hayate* pilots better protection than the [unsealed](#) wing tanks and light-alloy airframe of the Ki-43. In addition, the Ki-84 used a 65 mm (2.56 in) armor-glass [canopy](#), 13 mm (.51 in) of head and back armor, and multiple bulkheads in the [fuselage](#), which protected both the [methanol](#)-water tank (used to increase the effectiveness of the [supercharger](#)) and the centrally located [fuel tank](#).

It was the Nakajima firm's own-designed 35.8-litre (2,180 cu in) displacement, [Ha-45 Homare](#) ("Praise" or "Honor") air-cooled eighteen-cylinder radial engine, first accepted for military use in 1941, that gave the *Hayate* its high speed and prowess in combat. Derived from the Nakajima Homare engines common to many Japanese aircraft, the *Hayate* used several versions of the Homare engine, including the [carbureted](#) model 21 and the [fuel-injected](#) model 23 versions of the engine. Most Homare engines used [water injection](#) to aid the supercharger in giving the Ki-84 a rated 1,491 kW (2,000 hp) at takeoff. This combination theoretically gave it a climb rate and top speed roughly competitive with the top Allied fighters. Initial *Hayate* testing at Tachikawa in early summer 1943 saw test pilot [Lieutenant](#) Funabashi reach a maximum level airspeed of 624 km/h (387 mph) in the second prototype. In 1946, US Technical Intelligence bench-tested a Homare 45, Model 21 engine and verified the engine's maximum horsepower output using 96 octane AvGas, plus methanol injection.^[9]

The complicated Ha-45-21 carbureted engine was a compact design (only 3 cm (1.18 in) larger in diameter than the [Ki-43's](#) 27.9 litres (1,700 cu in) 14-cylinder [Nakajima Sakae](#) radial) that required a great deal of care in construction and maintenance and it became increasingly difficult to maintain the type's designed performance as the Allies advanced toward the Japanese homeland. To compound reliability problems, the Allied submarine blockade prevented delivery of crucial components, such as the [landing gear](#). Many landing gear units were compromised by the poor-quality heat treatment of late-war Japanese steel. As a result, many *Hayates* suffered strut collapses on landing. Further damage was caused by inadequately trained late war pilots, who sometimes found it difficult to transition to the relatively "hot" Ki-84 from the comparatively docile Ki-43, which had a significantly lower landing speed.

Operational service

The first major operational involvement was during the [battle of Leyte](#) at the end of 1944, and from that moment until the end of the Pacific war the Ki-84 was deployed wherever the action was intense. The 22nd Sentai re-equipped with production *Hayates*. Though it lacked sufficient high-[altitude](#) performance, it performed well at medium and low levels. Seeing action against the [USAAF](#) 14th Air Force, it quickly gained a reputation as a combat aircraft to be reckoned with. [Fighter-bomber](#) models also entered service. On April 15, 1945, 11 *Hayates* attacked US airfields on Okinawa, destroying many aircraft on the ground.

In the final year of the war the Ki-84, the [Ki-100](#) (essentially a radial-engined version of the inline-powered [Kawasaki Ki-61](#)) and Kawanishi's [N1K2-J](#) were the three Japanese fighters best suited to combat the newer [Allied](#) fighters.

Variants



The Tachikawa Ki-106, a derivative of the Ki-84

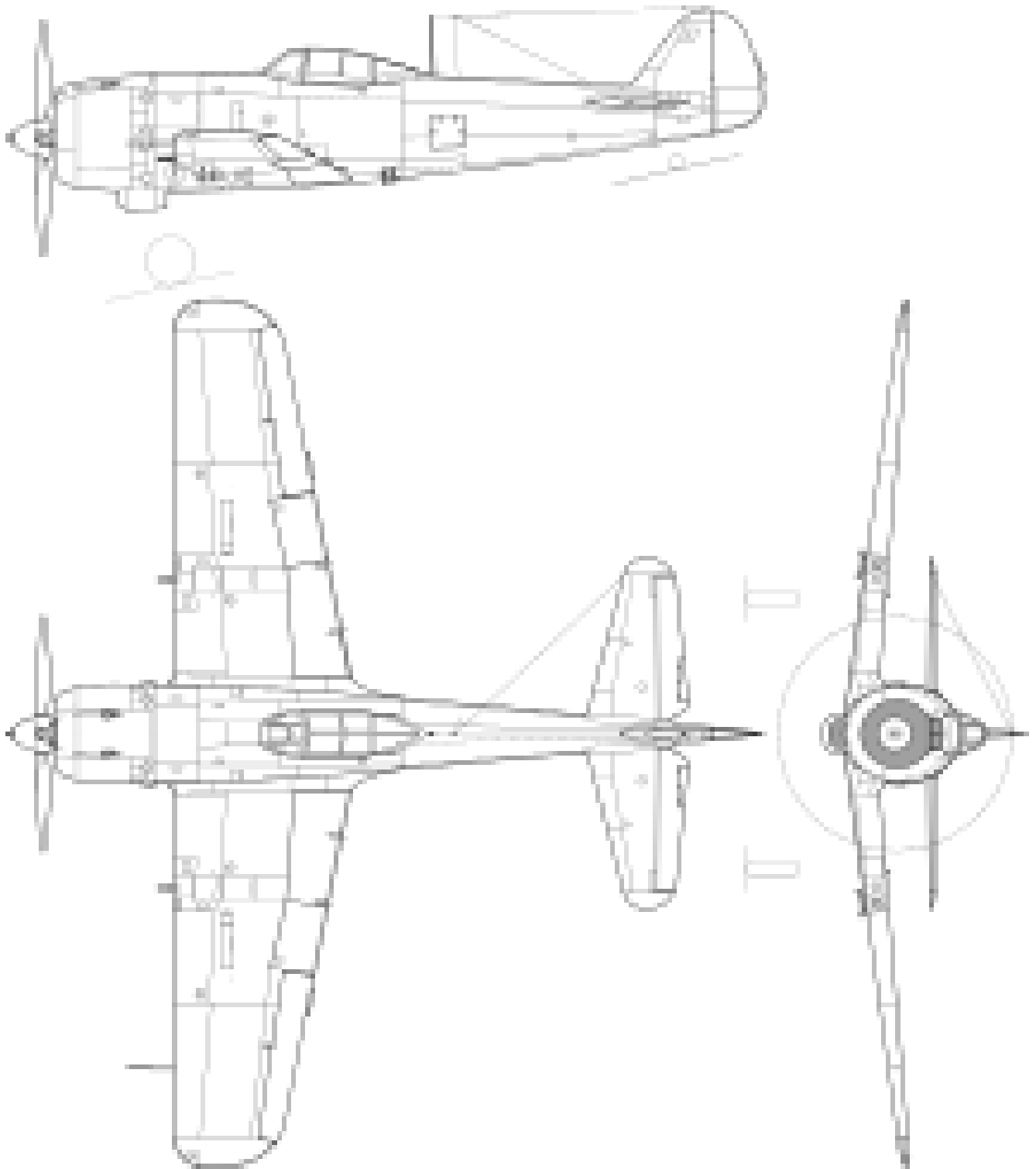
- **Ki-84-a:** Prototype.
- **Ki-84-b:** Evaluation model.
- **Ki-84-c:** Pre-production model.
- **Ki-84-I Ko:** Armed with 2 × 12.7 mm [Ho-103 machine guns](#) and 2 × 20mm [Ho-5 cannons](#) in wings (most widely produced version).
- **Ki-84-I Otsu:** Armed with 4 × 20 mm [Ho-5 cannon](#). (Limited production run, may not have equipped a full Sentai)
- **Ki-84-I Hei:** Armed with 2 × 20 mm Ho-5 cannon and 2 × 30 mm [Ho-155 cannon](#) in wings.
- **Ki-84-I Tei:** Night fighter variant of Ki-84 Otsu. Equipped with an additional Ho-5 20mm cannon (300 shells) placed at 45 degree angle behind the cockpit in [Schräge Musik](#) configuration. Rare variant, 2 built.
- **Ki-84-I Ko - Manshu Type:** Manufactured in [Manchukuo](#) for [Manshūkoku Hikōki Seizo KK](#) by Nakajima License.
- **Ki-84-II:** Sometimes known as the 'Hayate-Kai', the Ki-84-II had certain duralumin components replaced with ones made of wood and plywood, mainly concerning the rear fuselage, tail unit elements, wing tips, push-pull rods and other, minor components. This model was produced with the designations Ko, Otsu and Hei depending on the armament.
- **Ki-84-III:** A planned conversion of the Ki-84 into a high-altitude interceptor after development of the [Ki-87](#) prototype was delayed. Replaced the Homare engine with a 2450 hp [Nakajima Ha-44 12 Ru](#) air cooled radial engine with a [turbo-supercharger](#) mounted under the fuselage. The airframe remained unchanged, aside from the engine mountings to support the larger diameter engine. The airplane did not progress beyond the design stage.
- **Ki-84 Sa Go:** Oxygen injection system replacing the traditional water-methanol injection system to improve high altitude performance. No prototypes were built.

- **Ki-84-N:** 1st high-altitude interceptor variant of the Ki-84, with a 2500 hp [Nakajima Ha-219](#) air cooled radial engine and with wing area increased to 249.19 square feet. The Ki-84-N production model was assigned to the *Kitai* 'Ki-117'. Neither aircraft left the design stage before the war's end.
- **Ki-84-P:** 2nd high-altitude interceptor variant of the Ki-84, with a 2500 hp Nakajima Ha-219 air cooled radial engine and with wing area increased to 263.4 square feet. Cancelled in favor of further development of the Ki-84-R, which was proving to be a less ambitious project.
- **Ki-84-R:** 3rd high-altitude interceptor variant of the Ki-84, with a 2000 hp [Nakajima Ha-45-44](#) with a mechanically driven two-stage three-speed supercharger. The prototype was 80% completed at war's end.
- **Ki-106:** Prototype, constructed mainly out of wood. 3 Built.
- **Ki-113:** Based on the Ki-84 Otsu, with certain steel components on different areas of the aircraft. The project was an attempt to sustain light alloys, which were becoming very scarce later in the war. It employed steel sheet skinning and the cockpit section, ribs, and bulkheads were made of carbon steel.
- **Ki-116:** Evaluation model, equipped with a Mitsubishi Ha-112-II (Ha-33-62), 1,120 kW (1,500 hp). 1 Built.
- **Ki-117:** Production designation of the Ki-84N.

After the war a number of aircraft were tested by the allied forces, two at the [Allied Technical Air Intelligence Unit - South-West Pacific Area](#) (ATAIU-SWPA) as S10 and S17 and a further two in the United States as FE-301 and FE-302 (Later T2-301 and T2-302).

One example captured at Clark Field during 1945, serial number 1446, was transported aboard the [USS Long Island aircraft carrier](#) to the United States. In 1952 it was sold off as surplus to Edward Maloney, owner of the Ontario Air Museum ([Planes of Fame Air Museum](#)) and restored to flying condition before being returned to Japan for display at the Arashiyama Museum in Kyoto in 1973. With unsupervised access allowed to the aircraft, parts were stolen from the Ki-84, and coupled with the years of neglect it could no longer fly. Following the museum's closure in 1991, the aircraft was transferred to the [Tokko Heiwa Kinen-kan Museum](#), Kagoshima Prefecture, where it still is displayed to this day. It is the only surviving Ki-84.

Specifications (Ki-84-Ia)



3-view drawing of Nakajima ki-84

General characteristics

- **Crew:** One
- **Length:** 9.92 m (32 ft 7 in)
- **Wingspan:** 11.238 m (36 ft 10 in)
- **Height:** 3.385 m (11 ft 1 in)
- **Wing area:** 21 m² (230 sq ft)
- **Airfoil:** root: NN-21(16.5%); tip: NN-21(8%)
- **Empty weight:** 2,660 kg (5,864 lb)
- **Gross weight:** 3,601.5 kg (7,940 lb)
- **Max takeoff weight:** 4,170 kg (9,193 lb)
- **Powerplant:** 1 × [Nakajima Homare](#) Model Ha-45-21 (or Models 11, 12, 21, 23 or 25) 18-cylinder air-cooled radial piston engine, 1,522 kW (2,041 hp) at sea level and 1,360 kW (1,820 hp) at 5,500 m (17,900 ft)
- **Propellers:** 4-bladed constant-speed metal propeller

Performance

- **Maximum speed:** 687 km/h (427 mph, 371 kn) at 7,000 m (23,000 ft)
- **Range:** 2,168 km (1,347 mi, 1,171 nmi)
- **Service ceiling:** 11,826 m (38,799 ft)
- **Rate of climb:** 21.84 m/s (4,299 ft/min) at sea level
18.29 m/s (3,600 ft/min) at 3,050 m (10,007 ft)
- **Wing loading:** 171.47 kg/m² (35.12 lb/sq ft)
- **Power/mass:** 0.41 kW/kg (0.25 hp/lb)

Armament

- 2 × 12.7 mm (0.5 in) [Ho-103 machine guns](#) in nose, 350 rounds/gun
- 2 × 20 mm (0.787 in) [Ho-5 cannon](#) in wings, 150 shells/cannon
- 2 × 250 kg (550 lb) bombs
- 2× 200 L (53 US gal) [drop tanks](#)

