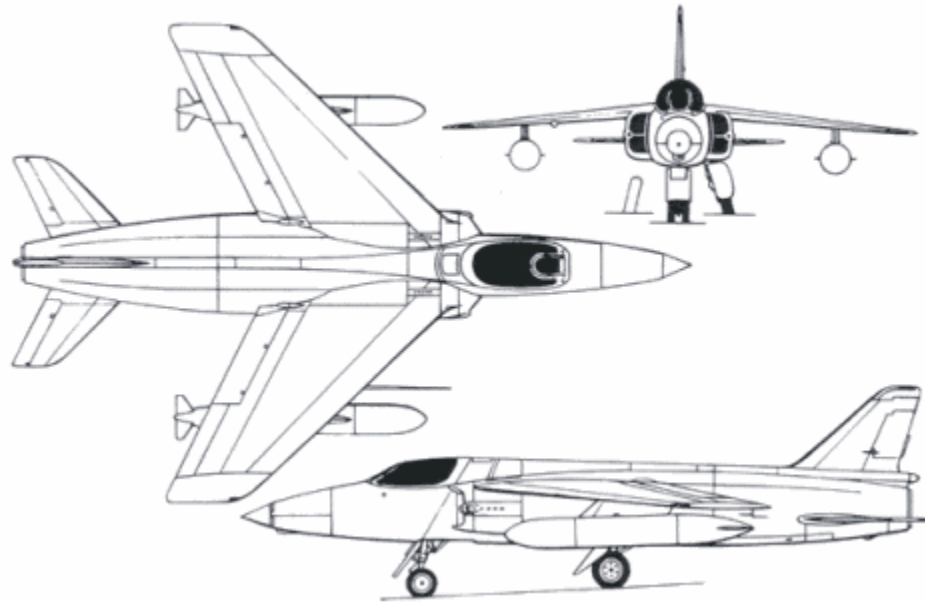


# **FOLLAND/HAL GNAT F.Mk.1 – THE GREATEST LITTLE FIGHTER EVER BUILT**



## **General characteristics**

**Crew:** 1

**Length:** 28 ft 8 in (8.74 m)

**Wingspan:** 22 ft 1 in (6.73 m)

**Height:** 8 ft 1 in (2.46 m)

**Wing area:** 136.6 ft<sup>2</sup> (12.69 m<sup>2</sup>)

**Empty weight:** 4,800 lb (2,175 kg)

**Max takeoff weight:** 9,040 lb (4,100 kg)

**Powerplant:** 1× Bristol-Siddeley Orpheus 701-01 turbojet, 4,705 lbf (20.9 kN)

### **Fuel:**

- Internal tanks – 795.5 Litres
- External tanks – 2 X 300 Litres

**Maximum speed:** 695 mph at 20,000 ft (1,120 km/h at 6,100 m)

**Range:** 500 mi (805 km)

**Service ceiling:** 48,000 ft (14,630 m)

**Rate of climb:** 20,000 ft/min (101.6 m/s)

### **Armament**

2x 30mm ADEN cannons

2x 500 lb (227 kg) bombs or 18x 3 in (76 mm) rockets

The Gnat was the creation of William Edward Willoughby "Teddy" Petter, a British aircraft designer who had gained wide recognition for his design of the English Electric Canberra bomber and other aircraft. Petter had grown suspicious of the trend towards bigger and more expensive combat aircraft, and he felt that a small, simple fighter would offer the advantages of low purchase and operational costs.

The Gnat was armed with two 30 millimeter Aden revolver-type cannon, firing from the outer edge of the air intakes. While this arrangement might have suggested that the Gnat would be prone to engine flameouts from muzzle gas ingestion, that did not prove to be the case, suggesting that the muzzle system had been carefully designed to deflect the gases out to the sides. The Gnat also had two stores pylons for drop tanks, 225 kilogram (500 pound) bombs, or unguided rocket pods.

The evaluation Gnats were powered by the production-spec Bristol Orpheus 701 turbojet with 20.1 kN (2,042 kgp / 4,502 lbf) thrust. Most of the test flights were conducted in the UK, though ground-attack trials were performed in Aden (now Yemen). The report from the RAF evaluation generally praised the Gnat's performance, but there were criticisms of its flight-control systems, and there was no consensus that the Gnat was what the RAF needed. Midge had a number of advanced features, such as hydraulically powered "flaperons", main gear that could be used as airbrakes, and a one-piece canopy that hinged over an inner armored windscreen. Despite the underpowered engine, the little jet could break Mach 1 in a dive and was very agile.

The good press given the Gnat opened the way for export sales. Gnat F.Mk.1s were sold to India, Finland and Yugoslavia.



India was also interested in a naval version of the Gnat but in an ironic turn of events it was found that the aircraft was too light - the catapult gear on the INS Vikrant, the Indian Navy's aircraft carrier, needed a 10,000lb weight minimum!

## Gnat F.Mk.1 Users

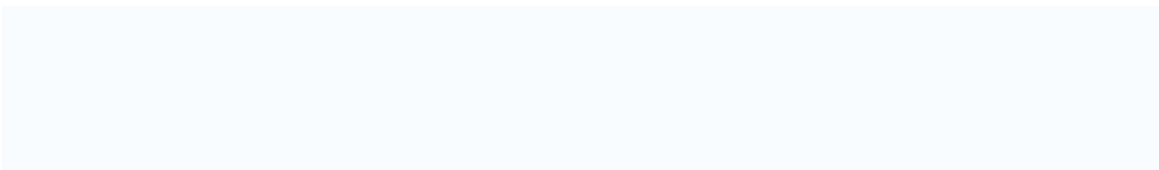


Yugoslavia



Two Gnat F.1s, serial numbers 11601 & 11602, were sold to Yugoslavia for evaluation and possible license production in Yugoslavia. The two examples were delivered in June and July of 1958. Yugoslav pilots were impressed with the Gnat's maneuverability and handling but its short range and inability to carry substantial armament made the Yugoslavs to opt for the Sabre instead. One Gnat was written off in a belly landing after hydraulic failure and Yugoslavia went on to buy second-hand F-86 Sabres instead of proceeding with more Gnats. Yugoslavia also bought F-86D-45s too. The Sabres remained in service till in Air to Air role until Mig-21Fs arrived in Yugoslavia.

Our good friend, starfighter2's uncle was a pilot in the Yugoslav Air Force. He flew T-33s, F-84Gs, F-86Es and 3 types of MiG-21(F, PFM, R). He also test flew the Gnats and his experience of flying the Gnat was very helpful in designing an accurate FM.





## Finland



The Finnish Air Force acquired 13 Folland Gnat F.1 aircraft in 1958-1960. They were coded GN-101 to GN-113. Two of the aircraft, GN-112 and GN-113, were photographic versions ('FR.1') equipped for reconnaissance. The Gnats of the Finnish Air force were used from 1958 to 1974.

The first two aircraft arrived on 30th July 1958 for the Fighter Squadron 21 (HävLv 21). The next day Major Lauri Pekuri exceeded the speed of sound as the first Finn in the Finnish airspace.

One of the Gnats (GN-102) was destroyed due to a technical fault on 26th August 1958. The Gnats were grounded, and only in January 1959 did they fly again, after thorough investigations and rectifications. A public debate that had begun in the press even before the aircraft's arrival was fuelled by the accident and contributed to the fact that no more Gnats were purchased and license production that had first been planned was not started in Finland. Finnish pilots liked the Gnat but the longitudinal instabilities did give rise to some concern and it had to be carefully handled.

Many snags and deficiencies emerged in Gnats in the early stages of their service, and continuous modification work was necessary to ensure flying safety. In 1961 HävLv 21 that flew the Gnats was renamed HävLv 11 (Fighter Squadron 11). In 1967 the Gnats were replaced by MiG-21F aircraft. The Gnats were used as trainers but they were still fully operational and armed. They were finally retired in 1974.



India



Indian interest in the Gnat was accidental. In October 1954, Indian test pilots Air Commodore P.C.Lal (Later Air Chief 1971 war), Group Captain H. Moolgavkar and Wing Commander Roshan Suri were sent to Europe to evaluate various European fighters on offer. These were Dassault Mystere IVA, Supermarine Swift and Saab Lansen. The Swift was, on paper, considered best suited for IAF requirements. P.C. Lal test flew the Swift at Chilbolton, had an engine flameout and after great difficulty landed safely. The test flight was disappointing. However, while flying the Swift, he noticed a tiny aircraft doing maneuvers near Chilbolton. On landing, Lal enquired about the aircraft and was told that it was the Folland Midge, a prototype of the Gnat but on a slightly smaller scale, designed by Teddy Petter. Lal was impressed and wanted to meet Mr. Petter and see if the aircraft was for sale to India. Lal met Petter and was told that the aircraft was not for sale to India. Later during a meeting between the directors of the aircraft company and the Indian test pilots, there was a conversation between the directors and Air Commodore Lal. Mr. Petter overheard a conversation and later called Lal to enquire whether he would like to test fly the Gnat. The Indian test pilots test flew the Gnat and were impressed with its handling characteristics, the Indian team recommended to the Government of India that the aircraft be considered for the air defense component of the IAF.

A contract was signed in 1956 and an agreement to manufacture the aircraft in India, the start of a long affair between the IAF and the tiny Gnat. The initial order was for 40 Gnats - 25 to be built at Hamble and 15 to be delivered as kits for assembly by HAL. HAL would also license produce the Gnat from scratch.

Squadron Leader Suranjan Das, arguably India's foremost test pilot of the time, was sent to Folland to assist in developing the Gnat. He was an exceptional pilot and he and Sqdn Ldr E A Tennant (Folland test pilot) put on the Gnat air displays at Farnborough, Legend has it that Tennant once remarked that he had learnt a quite a few things about display flying the Gnat from Suranjan Das. In late 1957 the first Gnat (IE-1059) was airlifted to India in the cargo bay of an IAF C-119G Packet (the Gnat's small size meaning that only the wings had to be removed for this flight).

Later when Petter visited HAL to see the indigenous Production of Gnat at HAL, he confessed to P C Lal that he was under the impression that India was a communist country and did not want to sell his aircraft to Communists. But later when he heard that cricket was being played in India and that India was a democracy, he agreed to sell the aircraft to India.

No. 23 Sqdn "Panthers" became the first squadron to equip with the Gnat. HAL started delivering Gnats built from indigenous raw materials from 1962 onwards. By 1965, three Squadrons - No. 23 "Panthers", No. 2 "Winged Arrows" and No. 9 "Wolfpack", were operational with the Gnat, while the fourth sqdn, No. 18 "Flying Bullets" was undergoing conversion to Gnat when the 1965 war broke out.

The Gnats performed well in the 1965 war. Its exploits in the 1965 war earned it the nickname "Sabre Slayer" as it downed eight PAF F-86s during the 1965 war. Squadron Leader Trevor Keelor of No. 23 "Panthers" Squadron opened IAF's account in the 1965 war when he shot down a PAF F-86 on 3rd September 1965 over Chamb. Trevor Keelor's brother, Sqdn Ldr Denzil Keelor too was flying Gnats with No. 9 "Wolfpack" Sqdn. He too shot down a PAF F-86 on 19th September. Thereby making it a unique achievement of brothers flying the same type of aircraft, albeit with different squadrons, shooting down the same type of enemy aircraft. In the 1965 war, Eight F-86s were shot down by IAF Gnats earning it the nickname "Sabre Slayer". In return two Gnats were downed by PAF fighters. During the initial days of the 1965 War an IAF Gnat, piloted by Squadron Leader Brij Pal Singh Sikand, landed at an abandoned Pakistani airstrip at Pasrur and was captured by the PAF. Pakistan initially claimed that the Gnat surrendered to two Pakistani F-104 Starfighters after straying from its main formation, while India claimed that the pilot lost his way, was low on fuel and landed by mistake. Later, a retired PAF historian, Air Commodore Kaiser Tufail, mentioned that the Gnat actually landed before the F-104 arrived on the scene, giving credibility to the Indian version. This particular captured Gnat (IE-1083) is displayed as a war trophy in the Pakistan Air Force Museum, Karachi. Sadly one of Gnat's teething problems, Gun Stoppage, occurred many times in combat against F-86s, denying many Gnat pilots kills. Had the problem not occurred, IAF Gnats would certainly have notched up few more kills.



### IAF Gnat kills 1965 war

Date	Aircraft	Name of the Pilot	Sqn	Remarks
03 Sept 65	F-86F Sabre	Sqn Ldr Trevor J Keelor	23	Over Chamb .
04 Sept 65	F-86F Sabre	Flt Lt Virendra Singh Pathania	23	Over Chamb
14 Sept 65	F-86F Sabre	Wg Cdr Bharat Singh	2	Air combat over Halwara
18 Sept 65	F-86F Sabre	Sqn Ldr Amarjit Singh Sandhu	23	Lahore
19 Sept 65	F-86F Sabre	Sqn Ldr Denzil J Keelor	9	Kasur
19 Sept 65	F-86F Sabre	Flt Lt Vinay Kapila	9	Kasur
20 Sept 65	F-86F Sabre	Flt Lt AK Mazumdar	2	Lahore
16 Dec 65	Cessna O-1	Sqn Ldr Trevor J Keelor	23	Shot down near Boparai Village.

In the 1971 war, Gnats were operational with Eight IAF Sqdns (Nos. 2 “Winged Arrows”, 9 “Wolpack”, 15 “Flying Lances”, 18 “Flying Bullets”, 21 “Ankush”, 22 “Swifts”, 23 “Panthers” & 24 “Hawks”). Gnats drew first blood when Gnats of No.22 "Swifts" Sqdn engaged PAF Canadair Sabre Mk.6s after they violated and strafed Indian positions near Boyra in the eastern theater of operations. Two Sabres were shot down and its pilots captured, while the third escaped back to East Pakistan(now Bangladesh) and its pilot ejected. The most memorable of engagements by Gnats in the west, was that by Flying Officer Nirmaljit Singh Sekhon of No.18 "Flying Bullets" Squadron. Flying from Srinagar on December 14th, Sekhon took off while still the runway was being bombed and he single handedly took on six PAF F-86 Sabres. Although eventually overwhelmed and killed, he managed to take score hits on two of them. Eventhough he was advised to get out of the combat area, his heroic efforts, above and beyond the call of duty, saved Srinagar airfield from destruction. The Param Vir Chakra (India’s highest gallantry award equivalent to the US Medal of Honour) was posthumously awarded to Fg. Off. N.J.S. Sekhon. Apart from air defence operations, the aircraft performed multiple roles in the Bangladesh Liberation War being utilized in Anti-Shipping Operations, Ground attack, Bomber/Transport escort and Close Air Support with "devastating effects" on the PAF

### IAF Gnat Kills 1971 war

Date	Aircraft		Name of the Pilot	Sqn	Remarks
22 Nov 71	Canadair Mk.6	Sabre	Flt Lt Roy Andrew Massey	22	Boyra, W/C Chaudhary (14 sqn) / BO
22 Nov 71	Canadair Mk.6	Sabre	Flt Lt M A Ganapathy	22	Boyra, Eastern Sector. F/O Khalil Ahmed
22 Nov 71	Canadair Mk.6	Sabre	Fg Off Donald Lazarus	22	Boyra, Eastern Sector. F/L Pervez Quereshi

The Gnats served with frontline squadrons till 1974 till they were either replaced by HAL Gnat Mk.II “Ajeet” (No.2,9,18,22) or HAL Type 75 MiG-21bis Fishbeds (No.15,21,23,24).



**Sabre Slayer Brothers - Sqdn Ldrs Trevor (above) & Denzil Keelor(below)**





## HAL Gnat Mk.II (Ajeet)



**Year deployed:** 1976

**Crew:** 1

**Length:** 28 ft 8 in (8.74 m)

**Wingspan:** 22 ft 1 in (6.73 m)

**Height:** 8 ft 1 in (2.46 m)

**Wing area:** 136.6 ft<sup>2</sup> (12.69 m<sup>2</sup>)

**Empty weight:** 2307Kg

**Max takeoff weight:** 4171 Kg

**Powerplant:** 1TJE HAL (Rolls-Royce/Bristol Siddeley) Orpheus Bor.2 Mk.701-01

**Maximum speed:** 695 mph at 20,000 ft (1,120 km/h at 6,100 m)

**Fuel:**

- Internal tanks - 1350 Litres
- External tanks – 2 X 300 Litres

**Service ceiling:** 48,000 ft (14,630 m)

**Rate of climb:** 20,000 ft/min (101.6 m/s)

**Armament**

2 X 30 mm cannons Aden Mk 4 with 90 rounds

Warload - up to 1000 kg in 4 hard points

250 or 227 kg free fall, cluster bombs,

ML 55 or 68 mm UR

The IAF were impressed by Gnat's performance in the two wars, but the plane had problems like hydraulics, gun stoppages and some of its control systems were unreliable. To address these issues, the IAF issued a requirement for an improved "Gnat II" in 1972, at first specifying that the new version was to be optimized as an

interceptor, but then expanding the specification to include the ground-attack role. The HAL-built licensed version was called the "Ajeet"(Sanskrit for "Invincible / Unconquered / Unbeatable").The two initial prototype Ajeets(E-1083 & E-1084) were modified from the last production Gnats built by HAL. The first production Ajeet flew on 30 September 1976, with deliveries to the IAF beginning in 1977. A total of 79 Ajeets were built by the time manufacture ended in 1982, and ten Gnats were upgraded to Ajeet standards. The Ajeet was difficult to tell apart from a Gnat at a casual glance, but it incorporated many changes and improvements. The most visible change was that the Ajeet had four stores pylons, with a total carriage capacity of 900 kilograms (one ton), instead of the Gnat's two pylons. Other significant changes included:

- Improved hydraulics and controls.
- Fit of the Martin-Baker Mark GF4 ejection seat instead of the Folland-designed Type 2G seat.
- New avionics, including a modern Ferranti gunsight.
- A slab tailplane.
- Improved landing gear with an antiskid braking system.
- Fuel tanks built into the wings, with each integral wing tank storing 250 liters (66 US gallons) of fuel.

The integral wing tanks meant that all four stores pylons could be used for weapons. The small size of the Gnat had meant limited range without drop tanks, and with the Gnat's two stores pylons, drop tanks meant no weapons other than cannon. The Ajeet was much better suited to the ground attack role than the Gnat.

Four former Gnat Squadrons (No.2,9,18,22) converted to Ajeet. No.2 Sqdn was the last IAF squadron to operate the Ajeet. They retired their Ajeets in 1991 and converted to HAL MiG-27MLs. Incidentally, all Ajeet squadrons converted to MiG-27s.

The legacy of a "light fighter" continues to this day in India with the development of the HAL-ADA Light Combat Aircraft (LCA) "Tejas"

## **Strengths & Weaknesses of the Gnat**

The Gnat, a British all metal swept wing interceptor, the first prototype of which flew in 1955, was a compromise arrived at by the aircraft's designers to achieve the smallest possible size and high performance at low price. Its specifications were impressive: close to supersonic speeds, a rate of climb of 10,000 ft per minute, a high roll rate, a favourable thrust weight ratio and service ceiling of 48,000 ft. A Rolls Royce Bristol Orpheus 101 non-afterburning turbo-jet engine, giving it a phenomenal rate of climb and acceleration, powered it. Its pilots could go to 45,000 ft from "brakes off" in less than 4 minutes.

The Gnat's size, 10 ft in height, 37 ft in length, with a wing-span of 24 ft was its main asset. Difficult to spot visually- as more than one pilot remarked after air combat exercises against Gnats – 'you can only fight what you see' – and weighing half as much as its contemporaries, its agility and rate of tightness of turn were unmatched. Its Bristol Orpheus engine gave it a speed 50 miles greater than that of the F-86 Sabre at high altitude, this advantage was negated at lower altitudes, where most of the dogfights of the 1965 war took place.

To keep the weight down The Gnat dispensed with the airbrake, using instead the main gear and nose wheel bay covers to act as airbrakes in flight, in a semi-retracted position. Its light weight gave it an phenomenal thrust to weight ratio.

Its controls were extremely sensitive. requiring its pilots to be always alert for any nasty surprises thrown at them. The aircraft would twitch with even slight pressure on the controls. Some problems were encountered with the airbrake/Landing gear bay covers extending during normal flight, gun stoppages during combat while others had engine flame out problems. There were some pilot fatalities at both RAF facility at Chilbolton and at IAF's AATU at Kanpur. Both HAL and IAF evolved methods to overcome and rectify these deficiencies.

### **Performance against other fighters**

In a clean configuration with 30 mm ammunition, it weighed 6500 lbs. With the engine thrust of 5,000 lbs, its power to weight ratio was unmatched amongst its contemporary fighters, like the Hunter, Sabre and MiG-17.... The Gnat could outclass the Hunter at all altitudes and MiG-21 below 10,000 feet. Without afterburner, However, the MiG-21 was no match for the Gnat. Moreover, the Gnat could also out climb the MiG-21 (using afterburner) upto 10,000 feet. The Hunter, with its maneuvering flaps, could not out-turn the Gnat at low level. However, when it used the flaps, the Hunters bled its speed to 300 knots, while the Gnat could still maintain more than 400 knots at 5 g. The Gnats could always get behind the Hunter by superior maneuvering in the vertical plane.

IAF Gnat (and Hunter) pilots who were shot down in combat by PAF F-86s made the mistake of engaging the F-86s in the horizontal plane. The Gnat's power to weight

ratio was such that the pilots were told to get the F-86s in a vertical fight instead of a circular fight, where the F-86 had the advantage. Because of the Gnat's higher thrust to weight ratio, it could easily out climb and out-maneuver the F-86 in the vertical plane. The F-86 could not match the Gnat's climb performance and had to drop down to prevent itself from stalling, the Gnat could then reverse and go after the F-86.

## Installation

Copy the Gnat & Ajeet folder to the aircraft directory

Drop Gnat.111.bmp, Gnat111.LOD and Gnat111\_LOD002.bmp to Aircraft folder

Drop hun.wav in the sounds folder.

Drop Gnat-Tank.bmp, Gnat-Tank.LOD, Gnat-Tank.OUT in the Weapons folder.

Open Weaponsdata.ini and add the following lines

[WeaponDataXXXX]

TypeName=Tank-Gnat

FullName=Gnat Drop Tank 300 Litres

ModelName=Gnat-Tank

Mass=250.000000

Diameter=0.910000

Length=2.950000

AttachmentType=WP

NationName=India,Yugoslavia,Finland

StartYear=0

EndYear=0

Availability=2

BaseQuantity=2

Exported=TRUE

ExportStartYear=0

ExportEndYear=0

ExportAvailability=0

WeaponDataType=5

MaxFuelAmount=300.000000

Asymmetrical=FALSE

Change XXXX to the appropriate number. Open weaponsdata.ini with Weapons Editot and click save.

## CREDITS

**3D Models:** Marcelo (Marcfighter)

**Skins:** Marcelo (Marcfighter)

**Cockpit:** Mago(Paladrian) & Marcelo

**FM:** Starfighter2

**Load outs:** ghostrider883

**Decals:** ghostrider883

**Engine Sound:** dfang & ghostrider883

Special thanks to RussoUK2002, Sony Tuckson and USAFMTL for their suggestions in helping resolve a minor problem with the Gnat.

We are especially grateful to MK2 for his kindness. Thank you MK2.

Many thanks to Mr. P.V.S. Jagan Mohan, who was gracious enough to patiently answer our questions about Indian Gnats and Ajeets

## References

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6. **"India-Pakistan Air War of 1965"** – an Excellent detailed book on the Indo-Pak Air war of 1965 by PVS Jagan Mohan & Samir Chopra
7. **"My Years with the IAF"** – Book on the IAF by Air Chief Marshal P.C.Lal
8. **"Himalayan Eagles – History of the Indian Air Force, Vol. II & III"** by Pushpindar Singh

***"In the wars of 1965 & 1971, it was a little David slaying Goliaths like the Sabres"***

***- Air Chief Marshal P.C. Lal on the Gnat in his book  
"My Years with the IAF"***

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