English Electric Lightning

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Lightning XS897 of RAF 5 Squadron breaks over Lightning XR770 on one of the squadron's last sorties prior to disbandment

Type	Interceptor
Manufacturer	English Electric
Designed by	Teddy Petter
Maiden flight	1957-04-04
Retired	1988 RAF
Status	Retired
Primary users	Royal Air Force Kuwait, Saudi Arabia
Number built	329

The English Electric Lightning (later the BAC Lightning) was a supersonic British fighter aircraft of the Cold War era, particularly remembered for its great speed, and its natural metal exterior that was used throughout much of its service life with the Royal Air Force and the Royal Saudi Air Force. The aircraft was a stunning performer at airshows, former holder of the world air-speed record and the first aircraft capable of

supercruise. The Lightning was one of the highest performance planes in formation aerobatics.

In July 2006 the F-35 Joint Strike Fighter was officially named "Lightning II", a reference to the English Electric Lightning and the Lockheed P-38 Lightning.

Contents

History

The prototype, known as the English Electric P.1, was built to satisfy the British Air Ministry's 1947 specification F23/49 and flew for the first time from RAF Boscombe Down on 4 August 1954. This specification followed the cancellation of the Air Ministry's 1942 E.24/43 supersonic research aircraft specification which had resulted in the Miles M.52. The

Lightning shared a number of innovations first planned for the Miles M.52 including the shock cone and all-flying tailplane, the latter described by Chuck Yeager as the single most significant contribution to the final success of supersonic flight.

The P.1's designer was W. E. W. Petter, formerly chief designer at Westland Aircraft. The design was controversial and the Short SB5 was built to test wing sweep and tailplane combinations. The original combination were proved correct.

The Lightning was specifically designed as a point defence interceptor - essentially a guided missile-armed, air superiority fighter optimised to defend mainland Britain against incoming bomber attacks. In order to reduce cross sectional area of the fuselage and improve performance, the fuel capacity was highly restricted. It was armed with two 30 mm ADEN cannons and two air-to-air missiles, at first the Fairey Firestreak and later the Hawker Siddeley Red Top.

A unique way of minimising the drag of the twin engine installation was put forward by Petter. This involved stacking the engines vertically (staggered to avoid too much weight aft, with the lower engine forward of the upper), effectively tucking them behind the cockpit, fed from the nose and achieving minimum frontal area. This effectively gave twice the thrust of its contemporaries for an increase in frontal area of only 50%.

Limitations of fuel capacity dominated this aircraft's design as its fuselage was nearly all engines and ducting, and thus could not hold much fuel. Hence all available room was adapted to the purpose of holding fuel. The flaps were even used as fuel tanks, and the landing gear had very narrow tyres that retracted outward so that there could be greater tankage inboard. This also meant that when the addition of drop tanks for greater range was considered, they could not be placed beneath the wing and were mounted on top instead. When the aerodynamic principle of the area rule became standard practice, a ventral tank was added to the fuselage, so the plane could carry more fuel while being more aerodynamic.

The first operational aircraft, a Pre-Production P.1B (XG336), arrived at RAF Coltishall in Norfolk in December 1959. From 1960 the production mark F1 served initially with 74 Squadron. An improved variant the F2 first flew on 11 July 1961 and entered service with 19 Squadron at the end of 1962. The F.3 was first flown on 16 June 1962 and the longer-

range F.6 on 16 June 1965. The versions sold to Saudi Arabia were essentially similar to the T.5 and F.6 models in UK service and this final production batch reverted to the classic natural metal external finish which lasted well in the drier Arabian climate.

During the 1960s, as strategic awareness increased and a multitude of alternative fighter designs were developed by Warsaw Pact and NATO members, the Lightning's shortcomings in terms of range and firepower became increasingly apparent. The withdrawal of McDonnell Douglas F-4 Phantoms from Royal Navy service enabled these slower but much longer-ranged aircraft to be added to the RAFs interceptor force alongside those withdrawn from Germany which were being replaced by SEPECAT Jaguars in the ground attack role. Later the Tornado F3s also arrived to defend UK airspace. While slower and less agile than the Lightning, the Tornado carries a much larger armament load and much more advanced avionics. Lightnings were slowly phased out of service between 1974 and 1988, although much testing and modification was needed to keep them in air-worthy condition due to the high number of flight hours accumulated.

In their final years of UK service all RAF Lightnings were based at RAF Binbrook in Lincolnshire and many were camouflaged to make them less conspicuous when flying at low level. They tended to defend the Flamborough Head Sector of airspace above the North Sea. These later aircraft were the single seater F.3 and F.6 and the twin seat trainer variant T.5, all constructed by British Aircraft Corporation and distinguished from earlier versions by their flat topped fins. In their last year of service their pilots regularly pushed the aircraft to their limits as they used up the remaining hours of fatigue time.

Many Lightnings are conserved in museum collections where they delight visitors with their clean sleek lines, evocative of the high speeds that they once attained. The Short SB5 and a P1.A are at the RAF Museum, Cosford. The Civil Aviation Authority refused a licence for the surviving airworthy examples to perform at airshows in the UK but there are a few flying in South Africa.

Performance comparison

The Lightning’s speed and climb performance were excellent not just by 1950s or 1960s standards but even compared with modern operational fighters. Its initial rate of climb was 50,000 ft per minute (15 km/min). The Mirage IIIE climbed initially at 30,000 ft/min (9 km/min), the MiG-

21 managed 36,090 ft/min (11 km/min), and the Tornado F-3 43,000 ft/min (13 km/min).

Lightning XM215 at Farnborough Air Show, England, in 1964

The official ceiling was a secret amongst the general public and low security RAF documents simply stated 60,000+ ft (18 000 m), although it was well known within the RAF to be capable of much greater heights. Recently the actual operating ceiling has been made public by the late Brian Carroll, a former RAF Lightning pilot and ex-Lightning Chief Examiner, who reports taking an F-53 Lightning up to 87,300 feet (26 600 m) at which level "Earth curvature was visible and the sky was quite dark". In 1984, during a major NATO exercise, Flt Lt Mike Hale intercepted an American U-2 at a height which they had previously considered safe from interception. Records show that Hale climbed to 88,000 ft (26 800 m) in his F3 Lightning. Hale also participated in time-to-height and acceleration trials against F-104 Starfighters from Aalborg. He reports that the Lightnings won all races easily, with the exception of the low level supersonic acceleration, which was a dead-heat.

Carroll reports in a side-by-side comparison that the F-15C Eagle (which he also flew) that:

> "Acceleration in both was impressive, you have all seen the Lighting leap away once brakes are released, the Eagle was almost as good, and climb speed was rapidly achieved. Take-off roll is between 2,000 & 3,000 feet [600 to 900 m], depending upon military or maximum afterburner-powered take-off. The Lightning was quicker off the ground, reaching 50 feet [15 m] height in a horizontal distance of 1,630 feet [500 m]".

In British Airways trials in April 1985, Concorde was offered as a target to NATO fighters including F-15s, F-16s, F-14s, Mirages, F-104s - but

only Lightning XR749, flown by Mike Hale and described by him as " a very hot ship, even for a Lightning", managed to overtake Concorde on a stern conversion intercept [1].

However, later fighters greatly outclassed the Lightning in terms of range, radar and avionics, and weapons load, and were far more effective air-to-air fighters. The short range of the Lightning - just 900 miles - was particularly crippling.

Variants

Lightning landing, 1964

Prototypes

P.1A

- Single-seat supersonic research aircraft.
- 2 prototypes built and one static test airframe

P.1B

- Single-seat operational prototypes.
- 3 prototypes built
- 2 pre-production aircraft
- 3 test airframes

F.1

- Single-seat fighter
- Delivered in 1960
- 19 built (and one static test airframe)
- 2 × Rolls-Royce Avon 200R engines
- VHF Radio

- 2 × 30 mm ADEN cannons in nose
- 2 × Firestreak missiles
- Ferranti AI-23 "AIRPASS" radar

F.1A

- Single-seat fighter
- Delivered in 1961
- Now the "BAC Lightning"
- Avon 210R engines
- Addition of in-flight refuelling probe
- UHF Radio
- 28 built

F.2

- Single-seat fighter (an improved variant of the F.1)
- Delivered in 1962
- 44 built
- 31 later modified to F.2A
- 5 later modified to F.52 for export to Saudia Arabia

F.2A

- Single-seat fighter (F.2's upgraded to near F.6 standard)
- 31 converted from F.2
- Avon 211R engines
- Retained ADEN cannon and Firestreak of F.2 (The Firestreak Pack could be replaced with an Aden Cannon Pack to give the aircraft 4 Aden Cannon)
- About 2 hours endurance

F.3

- Single-seat fighter
- Upgraded radar - AI-23B
- Avon 301R engines
- Clipped tailfin
- Firestreak changed for Red Top missiles
- ADEN cannon removed

- 70 built (at least nine were converted to F.6 standard and the last 16 were built as an F3 Interim version (also known as the F.3A) before being fully modified to F6 standard)

F.3A

- Single-seat fighter
- Extended range, 800 miles
- 16 Built at the end of F.3 production, modified later to full F.6 standard

T.4

- Two-seat side-by-side training version, based on the F.1A.
- 2 prototyes and 20 production built
- 2 aircraft later converted to T.54

Lightning XM974 at Farnborough Airshow, England, in 1964

T.5

- Two-seat side-by-side training version, based on the F.3.
- 22 production aircraft built
- one former RAF aircraft later converted to T.55 for Saudia Arabia (crashed before delivery)
- two former RAF aircraft later civilian operated

F.6

- single-seat fighter (an improved longer-range variant of the F.3)
- New wings with better efficiency and subsonic performance, increased fuel storage
- Overwing fuel tanks and larger ventral fuel tank

- 30 mm cannons returned (Initially no cannons but later in the forward part of ventral pack rather than in nose).
- 2 x Red Top missile
- 39 built (also conversions from F.3 and F.3A)

Export

F.52

- Slightly modified ex-RAF F.2 single-seat fighters for export to Saudi Arabia (5 converted from F.2).

F.53

- Export version of the F.6 with pylons for bombs or unguided rocket pods (44 × 2 in (50 mm)
- 46 built and one converted from F.6 (12 F.53Ks for the Kuwaiti Air Force, 34 F.53s for the Royal Saudi Arabian Air Force, one aircraft crashed before delivery)
- Used air-to-ground in dispute near border with South Yemen in 1969 with great success

T.54

- Ex-RAF T.4 two-seat trainers supplied to Saudi Arabia (2 converted).

T.55

- Two-seat side-by-side training aircraft (export version of the T5).
- 8 built (6 T.55s for the Royal Saudi Arabian Air Force, two T.55Ks for the Kuwaiti Air Force and one converted from T5 that crashed before delivery)

Total production was 277 single-seat fighters and 52 two-seater trainers, including RAF and export aircraft.

Operators

[edit] Royal Air Force

The Royal Air Force operated the Lighting from 1959 to 1988.

Aerial display teams

- *The Tigers* of No 74 Squadron. Lead RAF aerial display team from 1962 and first display team with Mach 2 aircraft.

- *The Firebirds* of No 56 Squadron from 1963 in red and silver.

Preserved Lightning at East Fortune

Squadrons

- 5 Squadron operated the F.1A and F.6
- 11 Squadron operated the F.3 and F.6
- 19 Squadron operated the F.2 and F.2A
- 23 Squadron operated the F.3 an F.6
- 29 Squadron operated the F.3
- 56 Squadron operated the F.1, F.1A, F.3 and F.6
- 74 Squadron operated the F.1, F.3 and F.6
- 92 Squadron operated the F.2 and F.2A
- 111 Squadron operated the F.1A, F.3 and F.6
- 226 Operational Conversion Unit operated the F.1A, F.3, T.4 and T.5
- Air Fighting Development Squadron
- Lightning Conversion Squadron

Flights

- Binrook Target Facilities Flight
- Leuchars Target Facilities Flight
- Wattisham Target Facilities Flight
- Lightning Training Flight

Bases

- RAF Akrotiri
- RAF Binbrook
- RAF Coltishall
- RAF Geilenkirchen
- RAF Gütersloh
- RAF Leconfield
- RAF Middleton St. George
- RAF Leuchars
- RAF Tengah
- RAF Wattisham

Royal Saudi Air Force

The Royal Saudi Air Force operated the Lightning from 1967 to 1986

Squadrons

- 2 Squadron operated the F.53 and T.55
- 6 Squadron operated the F.52 and F.53
- 13 Squadron operated the F.52, F.53 and T.55
- RSAF Lightning Conversion Unit

Kuwait Air Force

The Kuwait Air Force operated both the F.53K single-seat fighter and the T.55K training version from 1968 to 1977

Thunder City

Thunder City is a civilian company based in South Africa that operates two Lightning T.5 and a one single-seat F.6 (current 2006). [2]

Specifications (Lightning F.6)

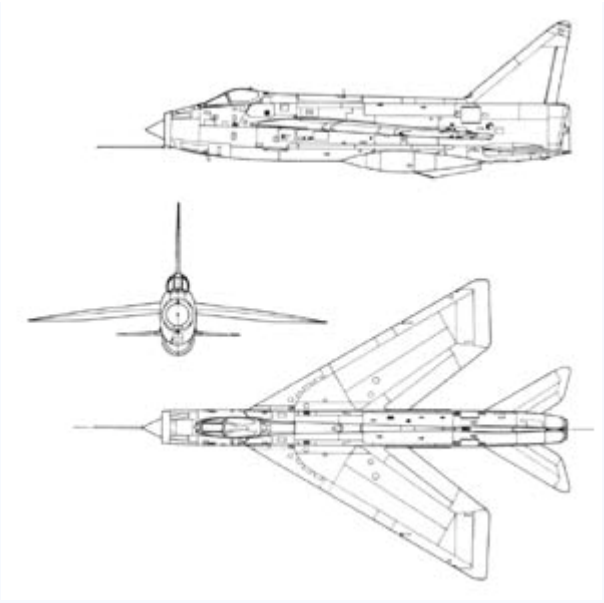

Image is of Mk. 1 aircraft- round tip to tail and no fuselage cable duct.
Data from Air Vectors[1]

General characteristics

- Crew: One
- Length: 55 ft 3 in (16.84 m)
- Wingspan: 34 ft 10 in (10.62 m)
- Height: 19 ft 7 in (5.97 m)
- Wing area: 474.5 ft² (44.1 m²)
- Empty weight: 28,040 lb (12 719 kg)
- Max takeoff weight: 41,700 lb (18,915 kg)
- Powerplant: 2× Rolls-Royce Avon 301R afterburning turbojets
    - Dry thrust: 13,220 lbf (58.86 kN)
    - Thrust with afterburner: 16,360 lbf (72.77 kN) each

Performance

- Maximum speed: Mach 2.27 (1,500 mph, 2,415 km/h) at altitude
- Range: 800 mi (1287 km) combat, 1,560 mi (2,500 km) ferry
- Service ceiling: 60,000 ft (18,000 m)
- Rate of climb: 50,000 ft/min (255 m/s)
- Wing loading: 87.9 lb/ft² (428.6 kg/m²)
- Thrust/weight: 0.63

Armament

- Guns: 2× 30 mm ADEN cannons
- Missiles: 2× Red Top missiles

References

1. ^ Goebel, Greg (2005-10-01). The English Electric (BAC) Lightning. *Air Vectors*. Retrieved on 2006-04-14.

External links

- Thunder and Lightnings
- XS458 preserved running lightning at Cranfield
- English Electric / BAC Lightning Information
- The Lightning Association
- Warbird Alley: Lightning page
- Silent Sentinel: The tale of an A1 milestone

Related content

Wikimedia Commons has media related to:
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Related development

- Short Brothers SB5

Comparable aircraft

- F-104 Starfighter
- Sukhoi Su-15

Designation sequence

- English Electric P1A - English Electric Lightning