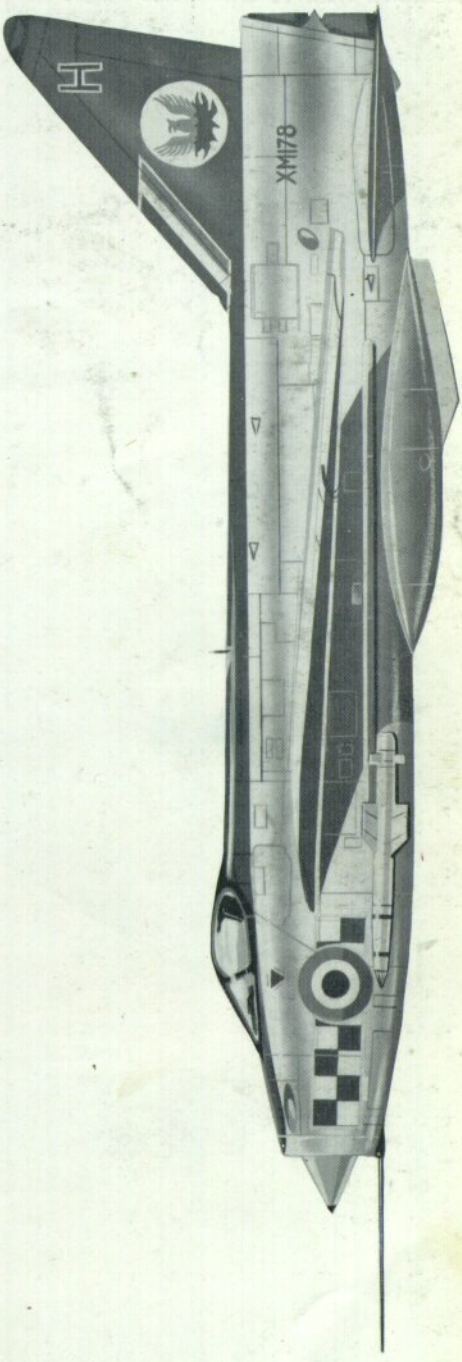
PROFILE PUBLICATIONS

The English Electric P.1 & Lightning 1



NUMBER 114

TWO SHILLINGS

LIGHTNING F Mk.Ia, XM178, of No 56 (F) Squadron. The aircraft is shown here in the revised colour scheme of March, 1963, when the Squadron provided the leading aerobatic team of R.A.F. Fighter Command for that year. Normally based at Wattisham, Suffolk, the aerobatic team was known as "The Firebirds".

The English Electric P.1 & Lightning 1

by H.G. James *

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Formation flying par excellence; *six Firestreak-armed Lightning F.1A's of No. 56 Squadron.*
(Photo: M.O.D.(R.A.F.) Crown Copyright Reserved)

The classic rôle of the fighter interceptor has given birth to many historic designs throughout the development of air fighting, and the extremely narrow and specialised requirements for this type of military aircraft set it apart from its contemporaries in these days of the multi-purpose fighter/strike machine. There is a reasonably strong body of opinion which holds that in the age of the Inter-Continental Ballistic Missile the manned bomber, and consequently the manned interceptor fighter, are totally anachronistic; witness the 1957 British Defence White Paper. However, the fact that nine years after the appearance of this document the manned interceptor is still felt to be a realistic investment by the major powers stands as evidence that in this instance scholarly theory and harsh military fact were seriously out of step. As probably the most efficient fighter interceptor currently in service anywhere in the world, the English Electric Lightning is the flying proof that the successors of the Camel, the Bulldog and the Spitfire will have a realistic contribution to make to national security for at least half a decade into the future; and many feel that this is a conservative estimate.

The massive fighter interception of vast bomber formation attacks is now a chapter of History; but the stand-off bomber and the ultra-high-altitude reconnaissance aircraft are still with us. It would seem hard to maintain that a fighter capable of intercepting the Lockheed U-2 at the peak of that much-vaunted aircraft's performance capability is an anachronistic weapon in any nation's armoury.

EARLY DEVELOPMENT

In 1948, in response to Ministry of Supply experimental requirement E.R.103 of the previous year, two British companies submitted designs for a transonic and limited supersonic research aircraft. The Fairey FD.2 was an experimental project pure and simple; the English Electric P.1, on the other hand, had a built-in operational application as a supersonic day fighter. The intensive work put in hand at the company's Warton plant, at a period when British research into supersonic designs was still at a fairly empiric stage, was rewarded by the favourable position the company later occupied to respond to Air Ministry specification F.23/49 calling for a supersonic day fighter. On 1st April 1950 a contract was awarded to English Electric for the construction of two P.1A research

P.1A WG760 *seen here at Farnborough in September 1957, three years after R. P. Beamont made the maiden flight. This illustration gives a good idea of the early configuration of the design.*
(Photo: J. M. G. Gradidge)

Compare the P.1A with these views of P.1B's XA847 *and* XG308. *The former, photographed at Farnborough in September 1957, was the aerodynamic prototype which took part in trials with the Double Scorpion rocket motor.* XG308, *seen here the following year, was the second aircraft in the development batch.* (Photo: J. M. G. Gradidge)

aircraft. This was to coincide with intensive wind-tunnel tests: and in late July of the same year English Electric ran for the first time at transonic speeds the only company-owned transonic tunnel outside the United States. The aerodynamic characteristics of the unique P.1A layout in the lower speed range were examined in the wind and water tunnels, providing valuable data on tailplane downwash angles and vortex flow from the early tip stall, and confirming the necessity for a low tailplane position if low-speed handling characteristics were to be satisfactory. The most obvious feature of the design was the unique vertical "stacking" of the two engines; in the original layout the upper powerplant was mounted forward, above a mid-low wing, and the tailplane was fin-mounted. The modified configuration involved moving the upper engine to the rear and the lower engine forward under a shoulder wing.

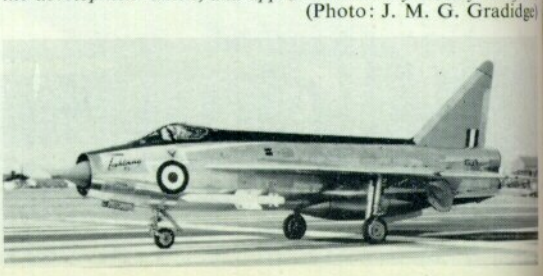
The layout of the P.1A did not progress further at this stage owing to wind tunnel development at Warton. The appearance of several French designs with low-mounted tailplanes at the 1951 Paris Show led to the order of the Short SB.5 research aircraft, to probe further into the handling characteristics of highly swept wing configurations in conjunction with various tail layouts. In flight trials commencing in December 1952 this machine successively tested 50° sweep wings with a high tailplane; 60° sweep wings with a high tailplane; and 60° sweep wings with a low tailplane. Following the experience of wing drop late in the SB.5 programme, and tunnel tests at Warton, two measures were adopted in attempts to ease tip stalls. These involved sharp leading edges, and wing notches. Both gave satisfactory results; but it was later proved that the wing drop noted in the SB.5 was due to the manual ailerons. (On its first 95 flights the P.1A used the wing notches, but they were then filled in as unnecessary for low-speed flight. They were later re-introduced for transonic reasons).

The small "saw-cut" notches in the wing leading edges are characteristic of all the P.1's descendants. The high tip lift which results from the involved vortex patterns set up by all highly swept and tapered wings gave rise to some assymetric flow break-down at low speeds, to the detriment of lateral control in a limited but important stage of the speed range. It was established that this phenomenon could be eliminated not only by the conventional wing fences but also by a small notch in the leading edge, which effectively altered wing tip vortex and boundary layer patterns. This solution was simpler and lighter than wing fences and obviously imposed a much smaller drag penalty. The experience gained during the SB.5 trials led eventually to the selection of a wing sweep of 60°, the trailing edge having a sweep of 52°, giving the aileron hinge line zero sweep and avoiding the loss of control effectiveness encountered in early examples of swept wing designs.

OPERATIONAL CONCEPT AND FIRST FLIGHTS

The development of the P.1 must obviously be considered in close association with its operational rôle. It has been said that the Lightning can be regarded as a "recoverable manned missile". It is equipped to operate within the framework of a sophisticated aerial defence system, in close liaison with an advanced ground control network which leads it to the immediate vicinity of its target, and launching missiles with the guidance of extensive radar and computer information. Furthermore, the

Left: *P.1B* XG313 *seen at Le Bourget in June of 1959, with Firestreak installation.* (Photo: J. M. G. Gradidge). Right: XG331, *photograph at Farnborough in 1959, was one of the last machines in the development batch, and approximated very closely the final F.1 production standard.* (Photo: J. M. G. Gradidge)

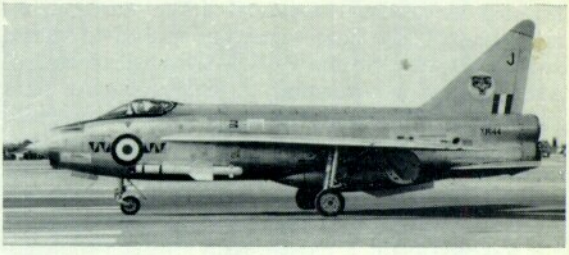


aircraft is fully capable of operating in complete independence of the ground echelons, hunting down its target with search and track radar and intercepting with the aid of anti-countermeasures and fire control devices. Although originally conceived as a pursuit interceptor, the Lightning in its current configuration is the first British design to fall within the category of a completely integrated weapons system, along American lines. The duplicated engines give the high power/weight ratio and excellent acceleration necessary for interception of high-speed targets, as well as the obviously improved safety factors; and the vertical layout simplifies the doubling up of systems and greatly improves the control of power asymmetry in the event of the loss of one engine. The nose intake was selected for maximum efficiency and minimum interference from weapon launching.

On 4th August, 1954 English Electric's chief test pilot, Wg. Cdr. R. P. "Roly" Beamont took *WG760* up on its maiden flight, which took place at Boscombe Down. The aircraft was powered by two Armstrong Siddeley Sapphire ASSa.5 turbojets each developing 8,100 lb. dry thrust (later 10,300 lb. with reheat). After achieving Mach 0·85 on this first flight, the P.1A went transonic seven days later on its third. This machine proceeded with handling and performance development (its performance on that third flight won it the distinction of being the first British aircraft to exceed Mach 1·0 in level flight) while *WG763* was employed in structural and armament research, joining *WG760* in the flight test programme in July 1955. This second prototype was something more than a simple research aircraft; it was fitted with some operational equipment including a ventral 250-Imp. gal. fuel tank and two 30 mm. Aden guns.

Both these prototypes provided useful aerodynamic experience of the supersonic flight regime and helped in control modification programmes including the revision of ailerons and tailplane gearing to cut down control over-sensitivity. Wing modifications were experimented with, using the basic ASN/P1/3 section. For a limited period *WG760* carried drooping leading edge flaps on the inner wing. These were soon abandoned in favour of a cambered extension to the leading edge and wide-chord tips, resulting in inset ailerons. This led to a marked improvement in take-off and landing approach handling characteristics and by reducing drag at subsonic speeds gave a bonus in increased combat endurance. (Although not adopted for the initial combat variants, the cambered leading edge has been re-introduced on the Lightning F.Mk. 3 currently coming into service with R.A.F. Fighter Command).

The second P.1A also carried out gun firing trials; and one or other of the machines was employed in extended supersonic research with the Aerodynamics Flight at N.A.E. Bedford. Despite the fact that it had only been conceived as a test vehicle for speeds of up to Mach 1·2, the P.1A recorded in this period a figure of Mach 1·53; its handling properties were first class and it displayed the ability to manoeuvre throughout its flight envelope without autostabilisation, although this was of course fitted in consideration



Lightning F.1's of No. 74 ("Tiger") Squdron, R.A.F. XM140 *and* XM144 *displayed the early markings in use in 1961, and* XM142 *displays the 1962 scheme. In 1960 the "Tigers" had been the first squadron of R.A.F. Fighter Command to receive the new type; and the introduction of the Lightning to squadron service coincided with a progressive return from camouflaged fighters, the drab legacy of the Second World War, to the colourful and individualistic unit markings which characterised the biplane fighters of the interwar period.* XM142 *shows this policy carried to its logical, and welcome, conclusion.*
(Photos: J. M. G. Gradidge)

of the Lightning's rôle as a sophisticated gun-platform.

The next step in the Lightning story is marked by the three operational prototypes, *XA847*, *XA853* and *XA856*, designated P.1B. These were covered by the original Ministry order; and under the supervision of F. W. "Freddie" Page, then chief engineer of English Electric, design work proceeded at Warton. The most extensive of the changes dictated by the integration of the operational features was the replacement of the Sapphire powerplants by Rolls Royce Avons, (and later by Avon RA.24R Mk.210's, as the most powerful and lightest engines available). The Lightning Mk.1 and 1A were powered by 200-series Avons, which did not have fully modulated afterburners; four nozzle settings were available. As the installation of these engines virtually doubled the thrust of the P.1A the intake was modified by the addition of a conical centre-body, giving a duct of high pressure recovery, low drag, and good distribution over a wide range of speed and incidence. This fixed cone is extremely efficient at subsonic speeds, and at the peak of the speed range deflects the shock

cone outside the lip of the intake. Although there is momentary choke in the transonic phase the Lightning has such reserves of thrust that the phenomenon lasts only seconds and has no bad side-effects, such as consumption increase. Another advantage of the Lightning intake is that the cone provides a self-contained pressurised housing for the Ferranti Airpass fire-control radar, with a bonus of easy maintenance.

The fuselage of the P.1B was extensively modified, with a higher cockpit the canopy of which was faired into the contour of the fuselage with a dorsal spine housing the Plessey iso-propyl-nitrate starter tanks and pumps. The nose wheel was altered to retract straight forward (in the P.1A it swivelled to lie flat) and became non-steerable. Simple hinged flaps replaced the P.1A's split surfaces; and these provided further internal fuel space. The air brakes were altered in shape and moved ahead of the fin.

The first P.1B prototype flew at Warton on 4th April 1957 with Roland Beamont again at the controls. On this first flight it passed easily through the transonic stage at Mach 1·2 and seven months later became the first British aircraft to attain Mach 2·0. This was achieved with minimum reheat, in level

(*continued on page 8*)

A Air conditioning
- A1 Ram intake to cabin-air heat exchanger at duct bifurcation
- A2 Cold-air unit and water boiler on starboard flank
- A3 Water header tank
- A4 Water extractor
- A5 Conditioned air duct to cockpit
- A6 Cockpit pressure test connection

C Flying controls and cockpit
- C1 Aileron p.f.c.u. (powered flying-control unit)
- C2 Rudder p.f.c.u.
- C4 Ultra amplifiers (tailplane and autostabilizer system)
- C7 Aileron mass-balance
- C8 Aileron control push/pull tubes
- C9 Triple-roller guides
- C10 Aileron autostabilizer actuator
- C14 Control column
- C15 Rudder pedals
- C16 Engine power control panel
- C17 Canopy external locking controls
- C18 E2B standby magnetic compass
- C19 "Canopy unlocked" warning lights
- C20 High-intensity cockpit lighting
- C21 Starboard airbrake shown open
- C22 Plain flaps

D De-Icing
- D1 Hot-air anti-icing around intake lip
- D2 Rain dispersal duct
- D3 Side-panel demisting ducts
- D4 Canopy top-panel demisting ducts
- D5 Demisting-air flexible bellows
- D6 Canopy-air desiccant packs
- D7 Embedded electro-thermal windscreen elements

E Emergency System
- E1 Martin Baker Mk 4BS ejection seat
- E2 Personal multi services connector (R/T, oxygen, air ventilated suit, and anti-G)
- E3 Face blind firing handle
- E4 Alternative between legs firing handle
- E5 Parachute pack
- E6 Survival pack in seat pan
- E7 Harness release, manual over-ride
- E8 Emergency cockpit ram intake (shown open)
- E9 Emergency canopy jettison handle
- E10 Canopy jettison units and striking blocks
- E11 Firewalls
- E12 Horizontal firewalls (titanium)
- E13 Graviner fire supression bottle on each side

F Fuel system
- F1 Integral fuel cells in wing
- F2 Collector tank with booster pumps
- F3 Fuel recuperator
- F4 Recuperator control valve
- F5 Fuel transfer valves
- F6 Air line to recuperator
- F7 Defuelling valves behind rear spar
- F8 Pressure-fuelling adaptor in fuselage
- F9 "Tanks full" green lights panel
- F10 Low-pressure fuel pipe
- F11 Ventral tank (jettisonable in emergency)
- F12 Multi-bolt inspection panel
- F13 Tank aerodynamic fin
- F14 Flap fuel
- F15 Detachable Flight Refuelling probe
- F16 Tank pressurizing intake/vent in sawcut slot

Power systems

H *Electrical*
- H1 Varley 28V battery behind canopy
- H2 Battery test socket
- H3 Neoprene drain tubes
- H4 No 2 battery in spine amidships
- H5 External a.c./d.c. receptacles in wheel well
- H6 Main accessory-drive unit, driven by bleed-air turbine
- H7 Gearbox and oil filter
- H8 Rotex 28V d.c. generator
- H9 English Electric 20kVA alternator
- H10 Cooling-air intake to accessory-drive unit
- H11 Turbine exhaust from (H6)
- H12 Teddington magnetic amplifier on door
- H13 External cable duct past No. 1 engine
- H14 Artificial horizon power supply control/inverter
- H15 Electrical duct

Hydraulic
- H16 Two Integral pumps on each engine
- H17 Accumulator group (air-brakes, ailerons 1 and 2, rudder, wheel-brakes) and nitrogen containers
- H18 Aileron accumulator pressure gauges
- H19 Tailplane accumulator, pressure gauge, and nitrogen bottle
- H20 Aileron hydraulic supply
- H21 Canopy actuator ram
- H22 Nosewheel jack
- H23 Shimmy-damper accumulator
- H24 Main-undercarriage jack
- H26 Flap actuator jacks
- H27 Airbrake synchronizing unit

P Powerplants
- P1 Two Rolls-Royce Avon reheat turbojets
- P2 No 1 engine-change unit below wing
- P3 No 2 engine-change unit above and behind wing
- P4 Main mounting trunnions
- P5 Front mounting points
- P6 Anti-icing bleed air to inlet guide vanes
- P7 Compressor section
- P8 Combustion section
- P9 Turbine section
- P10 Compressor air-bleed gate valve and ducts
- P11 External wheelcase driving tachometers, hydraulic pumps and other units
- P12 Fuel control system
- P13 Refrasil heat shrouds
- P14 Plessey LTSA 70 starter
- P15 Starter exhaust
- P16 Avpin tank (3 gal)
- P17 Plessey pump units
- P18 Solenoid valves
- P19 Voltage regulators
- P20 Starter control unit
- P21 HF igniter units
- P22 No. 2 engine igniter units
- P23 No. 1 engine igniter units on duct access panel
- P24 Elliott throttle actuator amplifier
- P25 Intermediate jetpipes
- P26 Reheat cooling air
- P27 Reheat fuel spray nozzles
- P28 Reheat igniter units and
- P29 Flameholder
- P30 Corrugated inner liner
- P31 Air-driven nozzle actuato
- P32 Variable propelling nozzle
- P33 Lucas bleed-air turbop reheat fuel (No 1 under spar, No. 2 inboard of
- P34 Bleed-air pipe to reheat
- P35 Turbopump exhaust

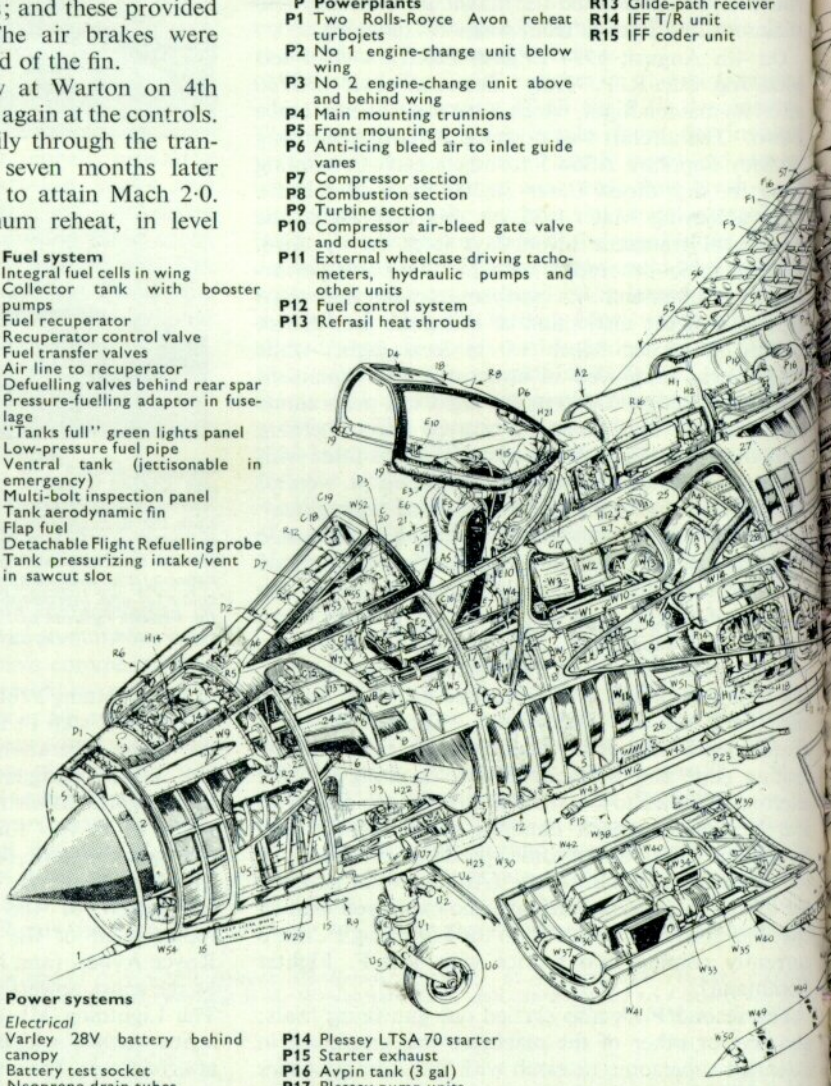
R Radio and Radar
- R2 Bullet conditioning-air h changer
- R3 Outlet from heat exchar wheel bay
- R4 Radar ground cooling air
- R5 Bullet conditioning-air d pack
- R6 Tacan aerials
- R7 Tacan T/R unit
- R8 IFF aerials
- R9 Communications aerials
- R10 Localizer aerial
- R11 Glide-path aerial
- R12 A1 display unit
- R13 Glide-path receiver
- R14 IFF T/R unit
- R15 IFF coder unit
- R16 Communications T/R unit

U Undercarriage
- U1 Dowty (formerly British M forward-retracting nose ge
- U2 Shimmy damper and ce unit
- U3 Downlock frame
- U4 Door linked to leg
- U5 Wheel-door operating cam linkage
- U6 Tubeless tyre

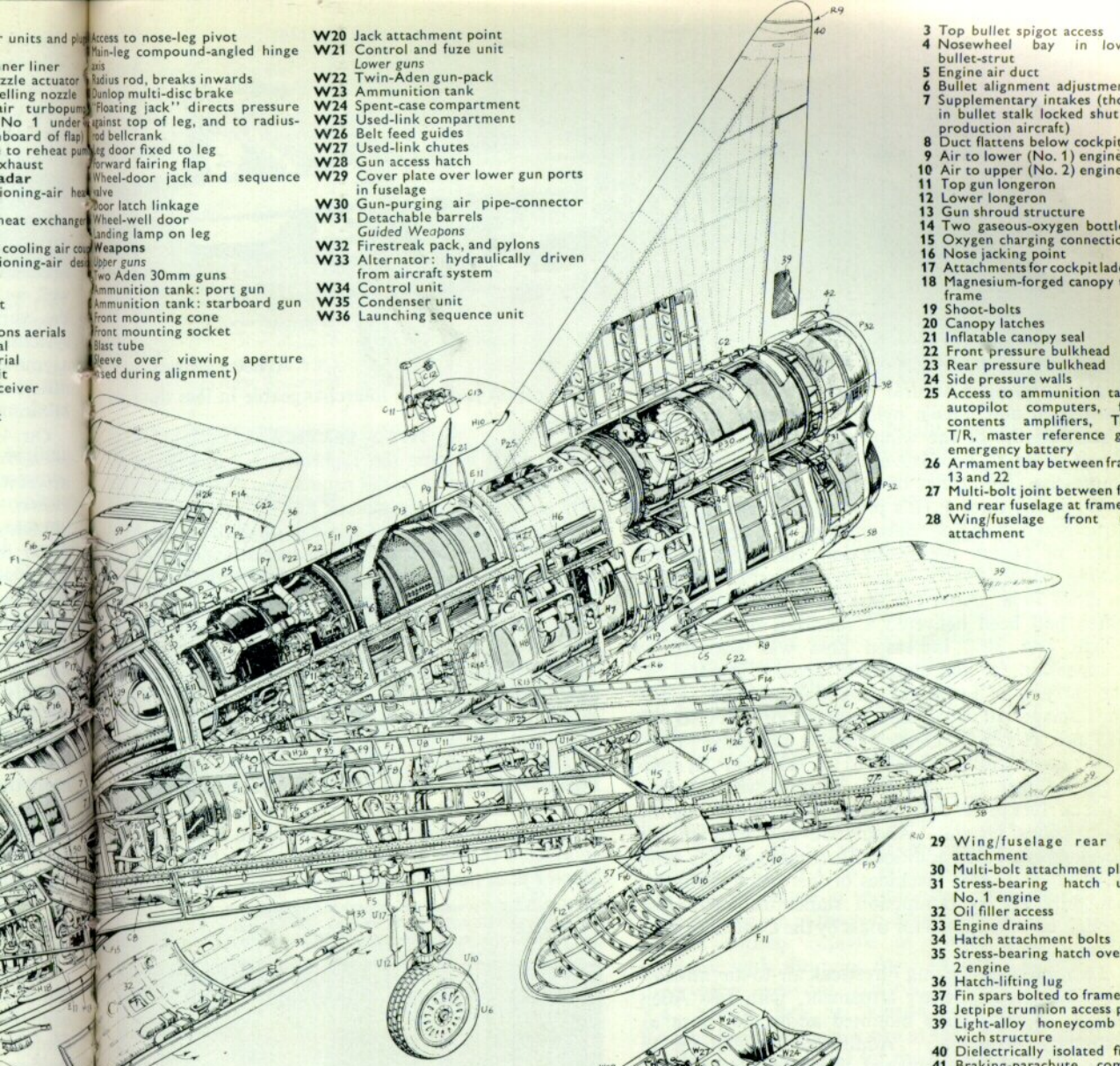
Access to nose-
Main-leg comp
axis
Radius rod, bre
Dunlop multi-d
"Floating jack"
against top of
rod bellcrank
Leg door fixed
Forward fairin
Wheel-door j
valve
Door latch link
Wheel-well do
Landing lamp

Weapons

Upper guns
Two Aden 30r
Ammunition t
Ammunition t
Front mountir
Front mountir
Blast tube
Sleeve over
osed during a



Blast-tube
Upper gu
Used-link
Used-link
Louvred
Used-case
Case coll
Gun-purg
pipes (se
Engine bl
Rockets
Microcel
rocket-la
24×2in
Hinge po



Access to nose-leg pivot
Main-leg compound-angled hinge axis
Radius rod, breaks inwards
Dunlop multi-disc brake
"Floating jack" directs pressure against top of leg, and to radius-rod bellcrank
Leg door fixed to leg
Forward fairing flap
Wheel-door jack and sequence valve
Door latch linkage
Wheel-well door
Landing lamp on leg

Weapons

Upper guns

Two Aden 30mm guns
Ammunition tank: port gun
Ammunition tank: starboard gun
Front mounting cone
Front mounting socket
Blast tube
Sleeve over viewing aperture (used during alignment)

W20 Jack attachment point
W21 Control and fuze unit

Lower guns

W22 Twin-Aden gun-pack
W23 Ammunition tank
W24 Spent-case compartment
W25 Used-link compartment
W26 Belt feed guides
W27 Used-link chutes
W28 Gun access hatch
W29 Cover plate over lower gun ports in fuselage
W30 Gun-purging air pipe-connector
W31 Detachable barrels

Guided Weapons

W32 Firestreak pack, and pylons
W33 Alternator: hydraulically driven from aircraft system
W34 Control unit
W35 Condenser unit
W36 Launching sequence unit

3 Top bullet spigot access
4 Nosewheel bay in lower bullet-strut
5 Engine air duct
6 Bullet alignment adjustment
7 Supplementary intakes (those in bullet stalk locked shut in production aircraft)
8 Duct flattens below cockpit
9 Air to lower (No. 1) engine
10 Air to upper (No. 2) engine
11 Top gun longeron
12 Lower longeron
13 Gun shroud structure
14 Two gaseous-oxygen bottles
15 Oxygen charging connection
16 Nose jacking point
17 Attachments for cockpit ladder
18 Magnesium-forged canopy top frame
19 Shoot-bolts
20 Canopy latches
21 Inflatable canopy seal
22 Front pressure bulkhead
23 Rear pressure bulkhead
24 Side pressure walls
25 Access to ammunition tanks, autopilot computers, fuel-contents amplifiers, Tacan T/R, master reference gyro, emergency battery
26 Armament bay between frames 13 and 22
27 Multi-bolt joint between front and rear fuselage at frame 25
28 Wing/fuselage front main attachment

29 Wing/fuselage rear main attachment
30 Multi-bolt attachment plate
31 Stress-bearing hatch under No. 1 engine
32 Oil filler access
33 Engine drains
34 Hatch attachment bolts
35 Stress-bearing hatch over No 2 engine
36 Hatch-lifting lug
37 Fin spars bolted to frames
38 Jetpipe trunnion access panel
39 Light-alloy honeycomb sandwich structure
40 Dielectrically isolated fin tip
41 Braking-parachute compartment
48 Tie-bars across four rear frames
49 Reheat-jetpipe mounting rail

Wing

50 Front and rear spars of hockey-stick form
51 Wing halves bolted through forged centre rib
52 Main wing-box skin machined from 0.2in light-alloy plate
53 T-section intermediate-spar booms pre-attached to skin
54 Rib/spar structure inside box bolted in Warren-girder lattice
55 Detachable leading-edge sections
56 Compass unit in starboard leading edge
57 Aerodynamic sawcut slots
58 Navigation lights
59 Corrugated-sandwich skin wheel bays

Blast-tube air-pressure relief duct
Upper gun-port detuner
Used-link chute
Used-link compartment
Louvred emptying door
Used-case delivery tube to
Case collector box in wing
Gun-purging valve and delivery pipes (see also de-icing)
Engine bleed-air to (W15)

Rockets

Microcell glass-fibre retractable rocket-launchers
24×2in rocket tubes in each half
Hinge points on outer edge

W37 Air bottle for missile cooling
W38 Ram-air for alternator cooling
W39 Explosive ejector-release units and attachment point on shoe
W40 Electrical distribution boxes
W41 Six attachment bolts
W42 Hoisting points and cables
W43 Winch brace-sockets
W44 Missile launching shoe
W45 Rear fairing carrying refrigerant cylinder
W46 24-way electrical connection
W47 Locating dowels and sockets
W48 Hot and cold air connections
W49 Fuze "windows"
W50 Seeker cell in segmented glass nose

General

W51 Armament safety-break panel (ground arming link: rocket launchers ground extend/retract switch)
W52 Airpass pilot attack sight
W53 Attack-sight recorder
W55 Weapons trigger and camera-button on control column.

General

Fuselage

1 Kelvin Hughes 91in pitot boom
2 Intake bullet housing Airpass, radar

ENGLISH ELECTRIC (B.A.C.) LIGHTNING F.1A

No. 56 Squadron F.1A's at R.A.F. Wattisham in 1963. (Photo: Stephen Peltz)

flight, carrying a ventral tank, heavy flight instrumentation and missile pylons. The good low-speed characteristics of the wings allowed the P.1B to be flown down to approximately 120 knots, giving the impressive speed range of 13:1.

While the three P.1B's proceeded to participate in structural and engine trials, the first of a development batch of twenty pre-production machines, ordered during the mid-1950's, began to roll out; the first flew in April 1958. After the first three machines of this batch had been delivered a modified fin of greater height and 30% increased area was adopted to compensate for the stabilising penalty imposed by the carrying of Firestreak A.A.M.'s on either side of the fuselage. All twenty development aircraft (*XG307-313* and *XG325-337*) were flying by December 1959; they were essentially similar to the original P.1B apart from the new fin, and these aircraft were allotted various rôles in the development programme covering the various systems. About half-way through the development batch additional fuel tankage was built in. The final three machines of this batch, although not fully up to production standards, were close enough to be accepted for trials by the Central Fighter Establishment.

Two infra-red-seeking Firestreak air-to-air missiles were selected as primary armament, with two Aden Mk. 4 30 mm. guns mounted above the nose as secondary weapons. Additional installations in the lower fuselage comprised either twin Aden guns in a removable pack, or 48 two-inch rockets in retractable reinforced plastic micro-cell packs. With any armament configuration the Lightning can be refuelled and re-armed in less than ten minutes, and the weapon packs are interchangeable in less than an hour.

An F.1A of No. 56 ("Firebirds") Squadron on display at R.A.F. Weathersfield in June 1961. Note the long cable duct low on the fuselage side which distinguishes the F.1A.
(Photo: J. M. G Gradidge)

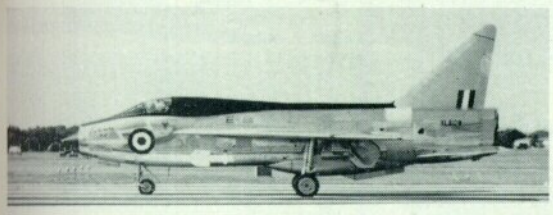
INTO SERVICE

The P.1B became the Lightning F.1 in 1958. Two years previously an initial production order for about fifty aircraft had been placed; and a further order for a developed version went through on 28th April 1958. On 29th October 1959 the first production Lightning F.1, *XM129*, was rolled out for its first flight at Samlesbury. The first C.A. release of an operational aircraft to the Central Fighter Establishment was granted in December 1959, and fully combat-equipped Lightnings entered squadron service with R.A.F. Fighter Command on 30th July 1960. The first unit to receive the type was No. 74 (Fighter) Squadron, the "Tiger Squadron" of World War One and Two fame. During the production of the initial production batch, Fighter Command quoted a top speed of approximately Mach 2·3 (1,500 m.p.h.); published reports indicate that the aircraft has been flown in level flight at Mach 2·0, and rolled without autostabilisation at Mach 1·8. It has also been reported that the Lightning

The striking "ghost" effect caused by cannon firing demonstrated by XM214, *an F.1A of No. 111 Squadron.*
(Photo: M.O.D.(R.A.F.) Crown Copyright Reserved)

Firebird at altitude; XM182 *"P" of No. 56 Squadron shows off the rather graceless but undeniably powerful lines of the F.1A.*
(Photo: M.O.D.(R.A.F.) Crown Copyright Reserved)

Nine aggressive silhouettes over the English countryside; note the scarlet wing leading edge strips carried by No. 56 Squadron.
(Photo: M.O.D.(R.A.F.) Crown Copyright Reserved)



The only side-by-side supersonic trainer in the world; T.4's XL628, XL629 *and* XM970 *photographed at Farnborough 1959, Farnborough 1960, and Le Bourget 1961 respectively.*
(Photos: J. M. G. Gradidge)

can go supersonic at any height without reheat; it can take off, cruise and land on either one of its engines, and was the first aircraft in the world to fly supersonically at half power.

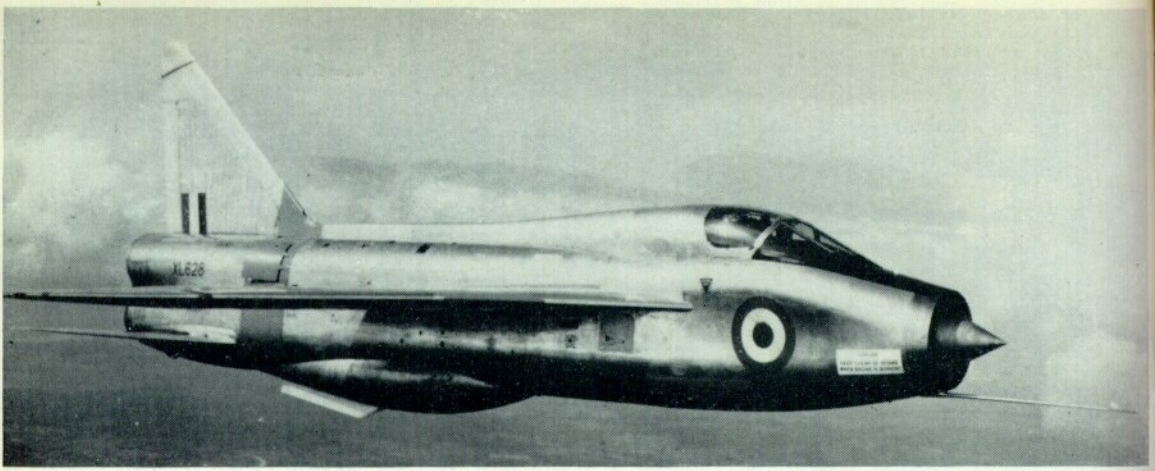
The Lightning F.1A is basically a Lightning F.1 with the addition of a flight-refuelling probe beneath the port wing, and U.H.F. A distinguishing feature is the long cable duct on both sides of the fuselage.

As early as 1957 it became evident that a dual control Lightning would be needed for operational weapons systems training by the R.A.F.; and work began on the Lightning T.4, the only supersonic side-by-side trainer in the world. The forward fuselage, which is only just large enough for a single pilot in the fighter variants, despite their massive size, was widened for the T.4 by just under one foot. It accommodates twin Martin-Baker 4BST ejection seats, full dual controls, and duplicated pilot attack sights and radar scopes. Like all Lightnings the T.4 is dimensionally unchanged. The only difference in specification from the Mk.1A is the ommission of the two Aden guns; and the trainer is thus entirely capable of two-man operational missions, with the pilot freed from the necessity of supervising weapons control systems. The first T.4, *XL628*, flew at Warton in May 1959 with Roland Beamont once more at the controls. A small number were produced for the Lightning Operational Conversion Unit, as well as one or two for each Fighter Command squadron.

THE LIGHTNING DESCRIBED

The Lightning represented a fundamental break with all traditional concepts of construction, manufacturing techniques and weapon control, sighting and delivery, at least in relation to British aircraft that had hitherto reached operational status. Furthermore, at the time of its design, it was certainly an exotic combination of more structural, aerodynamic and tactical advances within one envelope, than any rival in the world—including the American "Century" series fighters.

Basically the Lightning was an all-swept mid-wing twin-engine all-weather interceptor aircraft. The wings, basically of English Electric ASN/P1/3 section, were swept back 60° on the leading edges and 52°



XL628, *the prototype T.4, flew for the first time on May 6th 1959 with R. P. Beamont at the controls; at that stage it was simply designated P.11.* (Photo: B.A.C.)

on the trailing edges; with a mean thickness/chord ratio of about 5% the wings were five-spar structures built up in two panels, joined on the centre-line and skinned with 0·2 inch metal sheets to provide integral fuel tanks. The hydraulically-operated ailerons, hinged at right-angles to the fuselage centre-line, extended to the wing tips and incorporated metal-honeycomb tip and generous horn balancing. The large area plain flaps were also hydraulically operated and served as integral fuel tanks.

The fuselage was a parallel-section structure accommodating the two Rolls-Royce Avon 210 engines mounted one above the other, but staggered with the lower engine well forward of the upper. The engine intakes extended forward to the extreme nose to form an annulus with fixed conical centrebody. The cockpit was located forward of both engines. The rear fuselage carried lateral hydraulically-operated airbrakes high up and level with the intersection of the fin leading edge, and accommodated the long engine tail-pipes terminating in variable-area reheat nozzles in the extreme tail.

The tail unit comprised a tall triangular fin (with honeycomb sandwich tip) and parallel-sided hydraulically-operated honeycomb-filled rudder without trim tab. The single piece all-moving tailplane was low-set to alleviate pitch-up tendencies and its outline approximated to that of the wings.

Use of very high-pressure low-section mainwheels (tyre pressure 280 lb./sq. in.) permitted stowage of the wheels in the outer wings, hence bestowing an unusually wide track. These mainwheel units were equipped with Dunlop wheels, tyres and multi-cylinder disc brakes including Maxaret anti-skid units. The hydraulically-steerable nosewheel retracted forward into the nose. Design of the undercarriage was a joint effort by English Electric and British Messier, and an Irving ring-slot braking parachute was provided in the bottom of the rear fuselage.

The single-seat pressurised (3·5 lb./sq.in. normal pressure differential) and refrigerated cockpit accommodated a fully automatic Martin-Baker Type 4BS ejector seat with "through the hood" ejection, and was enclosed by an electrically-operated rearward-hinged canopy. The integrated flight system included an Elliott autopilot with altitude hold and ILS coupling, functioning in the intercept mode with Ferranti Airpass radar (with scanner situated in intake centre-body). Other equipment included U.H.F. radio, TACAN and IFF radar recognition equipment.

Conceived fundamentally as the launching vehicle of an integrated weapon system the Lightning F.1 and F.1A's principal armament was a pair of externally mounted de Havilland Firestreak infra-red-seeking air-to-air missiles which were principally effective in

Lightning T.4 XM970 *in service with the Lightning operational Conversion Unit at R.A.F. Middleton St. George.*
(Photo: M.O.D.(R.A.F.)
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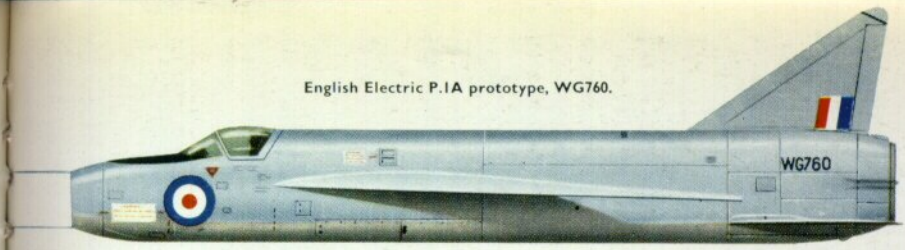
English Electric P.1A prototype, WG760.



Lightning F.1, XG331; demonstration aircraft as seen at S.B.A.C. Farnborough Show, September 1959, with T.4 XL628 in similar markings. Late development batch aircraft. Note roundels on fins of Firestreak missile.

Lightning F.1

se script of XG331.

Lightning F.1, XM141, "D" of No. 74 Squadron R.A.F.

No. 74 Sqn. crest.

Sqn. Ldr.'s flash.

ightning F.1A, XM184, "A" of No. 111 Squadron R.A.F.; this was the first aircraft to be painted in new scheme. Note Sqn. Ldr.'s flash on nose and fin.

No. 111 Sqn. cres

Lightning F.1, XM182, "P" of No. 56 Squadron R.A.F. in early markings.

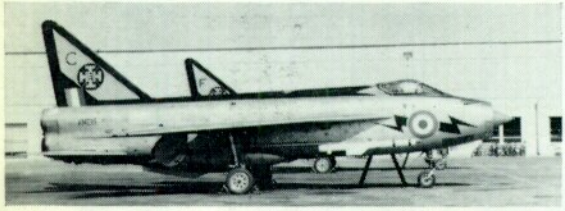
hoenix crest of No. 56 Sqn.

Lightning F.1A, XM139, of No. 226 Operational Conversion Unit. This aircraft was previously "C" of No. 74 Squadron.

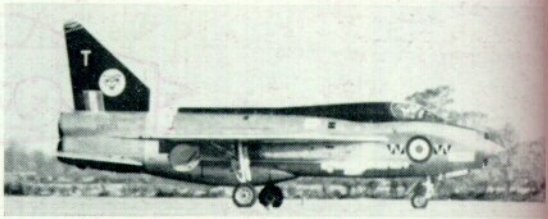
Lightning T.4, XM994, of No. 226 Operational Conversion Unit.

No. 226 O.C.U. crest.

A fine study of a T.4, XM997, *of No. 226 Operational Conversion Unit in the late colour scheme.*
(Photo: M.O.D. (R.A.F.) Crown Copyright Reserved).



F.1A XM215 *in the impressive markings of "Treble One" squadron, photographed at Luqa, Malta in November 1964.*
(Photo: J. M. G. Gradidge)



XM974, *one of the Lightning trainers issued to Fighter Command squadrons, seen here in the colours of No. 74 Squadron, with trainer identification band around the rear fuselage.*
(Photo: J. M. G. Gradidge)

the target's tail hemisphere, but which, in conjunction with the Airpass radar for target tracking and weapon release bestowed an additional 8-10,000 feet to the Lightning's combat ceiling.

The secondary armament consisted of a pair of 30-mm. Aden Mk.4 guns mounted high on the nose and there was provision for forty-eight 2-inch folding-fin unguided rockets in two retractable micro-cell plastic packs in the side of the nose. Additional guns or cameras could be carried in place of the missiles.

A large jettisable fairing under the fuselage, while contributing in some measure to favourable "area ruling", also accommodated 250 Imperial Gallons of fuel, ground pressure refuelling being carried out through an adaptor under the port wing trailing edge; for ferrying, in-flight re-fuelling could be performed using a detachable probe under the same wing.

PRODUCTION AND SERVICE ALLOCATION

Manufacture:

English Electric P.1A. Two research prototypes, *WG760* and *WG763*, designed to Ministry of Supply specification E.R.103 of 1947. First flight by *WG760*, piloted by Wg. Cdr. R. P. Beamont, on 4th August 1954. Armstrong Siddeley Sapphire ASSa.5 engines with elliptical annular intakes.

English Electric P.1B. Three prototypes, *XA847*, *XA853* and *XA856*, designed to Air Ministry specification F.23/49. First flight by *XA847* on 4th April 1957. Rolls Royce Avon engines with conical centrebody intakes.

English Electric Lightning F.Mk.1. Pre-production batch of 20 aircraft, *XG307-XG313* and *XG325-XG337*. Rolls Royce Avon R.A.24R engines.

English Electric Lightning F.Mk.1. Production batch commencing *XM129*; approximately fifty aircraft. Second order for similar number; details of this and subsequent production, if any, are not available.

English Electric Lightning F.Mk.1A. Converted from F.Mk.1; details not available.

English Electric Lightning T.Mk.4. Approximately thirty aircraft; no details available.

REPRESENTATIVE AIRCRAFT IN R.A.F. SERVICE

No. 56 (Fighter) Squadron: *XM171* ('A'), *XM172* ('B'), *XM173* ('C'), *XM174* ('D'), *XM175* ('E'), *XM176* ('F'), *XM177* ('G'), *XM178* ('H'), *XM179* ('J'), *XM180* ('K'), *XM181* ('L') *XM182* ('P'), *XM183* ('N'), *XM989* ('X'—Lightning T.Mk.4).

No. 74 (Fighter) Squadron: *XM139* ('C'), *XM140* ('M'), *XM141* ('D'), *XM142* ('B'), *XM143* ('A'), *XM144* ('J'), *XM146* ('L'), *XM147* ('P'), *XM163* ('Q'), *XM164* ('K'), *XM165* ('F'), *XM166* ('G'), *XM167* ('H').

No. 111 (Fighter) Squadron: *XM185* ('C'), *XM192* ('K'). All Lightning F.Mk.1A's.

SPECIFICATION

(LIGHTNING F. Mk.1A)

Powerplant: Two Rolls-Royce Avon 210 (R.A.24R) turbojet engines each rated to deliver 14,430 lb.s.l.s.t. with reheat.

Dimensions: Wing span; 34 ft. 10 ins. Length; 55 ft. 3 ins. Height; 19 ft. 7 ins. Tailplane span; 14 ft. 6 ins. Undercarriage track; 12 ft. 9¼ ins. Net wing area; 380·1 sq. ft.

Performance:*

Max. speed; approx. 1,500 m.p.h. at 36,000 ft. (Mach 2·3). approx. 820 m.p.h. at sea level (Mach 1·2).

Take-off distance; less than 1,000 yards at normal A.U.W.

Acceleration time from Mach 1 to Mach 2, less than 3½ minutes. Service ceiling; in excess of 60,000 ft.

**Extrapolated from Company statement dated 6th January, 1959.*

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