LARGE PRINT GUIDE

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RAF – First to the Future

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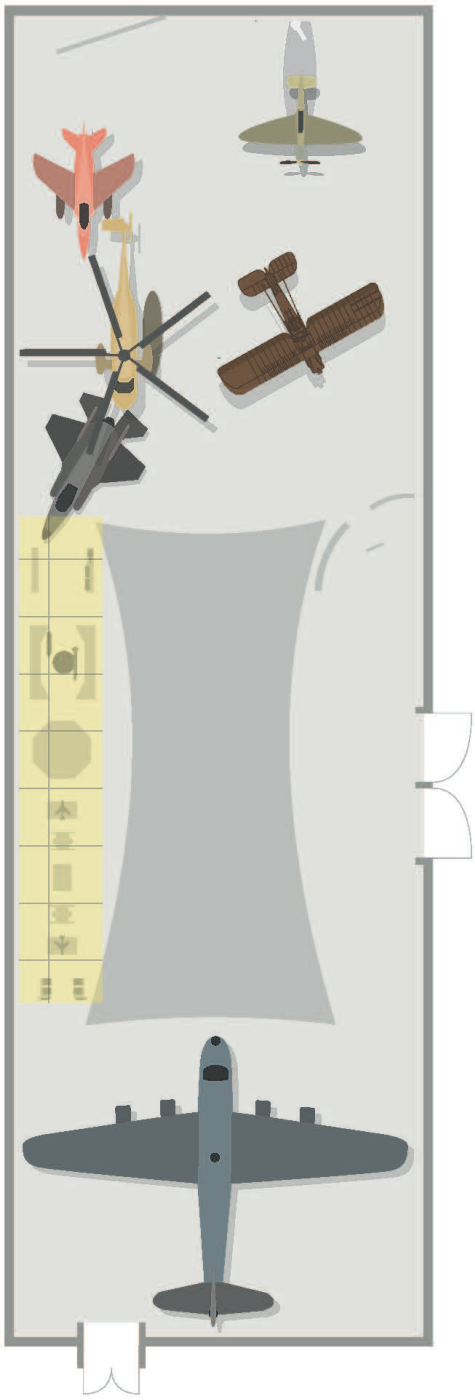
You are in Hangar 1



RAF – First to the Future

[Large screen at the exhibition entrance furthest from the café]

Chief of the Air Staff, Sir Stephen Hillier

Welcome to this exhibition, where you can explore the stories of the people, equipment, partnerships and innovations that keep the Royal Air Force at the leading edge of Air and Space Power.

Air Power allows us to control the air and space which is above all of us. If we don't have that control then we cannot protect ourselves and we don't have the freedoms we need to conduct any military campaign, in the air, on land or at sea. With effective Air and Space Power, the UK can conduct operations anywhere, at any time.

To deliver Air and Space Power, the Royal Air Force needs technology, to give us the capability and agility to respond quickly and effectively over long distances. We also rely on our outstanding people – well-trained, creative and forward-thinking women and men – working together with our global military and industry partners to develop new, innovative designs and practices.

The F-35 Lightning above me is a perfect example of that partnership in action.

Innovation has always been of vital importance to the Royal Air Force and will become ever more so in the future. This exhibition is about today, and that future. Please come in and discover more.

INNOVATION IN ACTION

Innovation is key to the successful future of the RAF. The service works with industry and global partners to develop and test the latest technologies. The Lockheed Martin F-35 Lightning II project involves 12 international participants and over 1,300 suppliers. The world's most advanced aircraft is now part of the RAF's fleet.

WHY IS THE F-35 LIGHTNING II A GAME CHANGER?

The F-35 is a multi-role aircraft operating in ground attack, bombing and air-to-air combat roles.

With advanced sensors and data handling/networking abilities, it is the first stealth aircraft to enter RAF service.

Intended to be the UK's main strike aircraft until at least 2040, the F-35 is the first production aircraft capable of both vertical take-off and landing and supersonic flight.

[Object label, touch model]

F-35 LIGHTNING II

The F-35 has been designed with an unusually short wing span. This is so that it fits into the holding areas inside US Navy warships.

F-35 NEW TECHNOLOGIES

A complex system of external infrared cameras and sensors is linked to the pilot's helmet-mounted display system. This enables them to see 'through' the aircraft.

The F-35's Autonomic Logistic Information System is designed to ease maintenance for ground crews by alerting them in advance about any parts which are likely to fail. They can then order replacements through a global supply chain before a problem even occurs.

[Object label in showcase]

F-35 test pilots represent different partner countries and companies. British test pilot, Peter 'Kos' Kosogorin of BAE Systems wore this flight suit when testing the F-35 in the USA.

Loaned by Peter Kosogorin

INTELLIGENCE AND PRECISION

The RAF gathers intelligence and shares it securely with UK and international allies. Gathering and analysing as much intelligence as possible from a range of sources ensures a high level of accuracy.

This enables the military to identify targets correctly and to decide when, or if, to strike.

DETECT

The RAF has a section dedicated to intelligence gathering and analysis – the ISTAR (Intelligence, Surveillance, Target Acquisition and Reconnaissance) Force. ISTAR includes some of the most important roles in the RAF, enabling operations to be conducted efficiently and effectively with maximum precision. 10% of RAF personnel work in the ISTAR Force.

WHERE INTELLIGENCE COMES FROM

Intelligence can come from anywhere, in any form. Information collected by RAF aircraft, including Remotely Piloted Air Systems, or drones, is analysed by 1 Intelligence, Surveillance and Reconnaissance (ISR) Wing alongside information from other sources including Google Earth and social media such as Facebook.

The RAF shares intelligence with other UK forces and agencies and with international allies. Drawing on a wide range of sources ensures that commanders and politicians are provided with accurate information to inform decision making.

[Image caption]
The RAF uses traffic analysis to identify which routes are being used by a local population and, therefore, reveal which roads are blocked or planted with hidden explosives.

[Object labels]

BAE SYSTEMS TARANIS [Touch]

BAE Systems and the Ministry of Defence have developed Taranis, an unmanned surveillance and strike attack aircraft with stealth capabilities. Could this be the future of RAF aircraft?

SKYNET 2B COMMUNICATIONS SATELLITE [Look up]

During the 1970s, Skynet 2B formed part of the UK's satellite communications network operated by the RAF. The current network is operated in partnership with Airbus Defence and Space.

DEFEND

The RAF needs secure, reliable communications on the ground, in the air, in space and cyberspace. This enables the service to co-operate effectively with allies and prevents friendly fire incidents.

Unsecure communications could allow hostile forces to gather intelligence and prevent operations from being successful.

Communication with the public is important too, as well-informed people are less likely to be influenced by enemy propaganda and fake news.

CYBER COMMUNICATIONS

The RAF uses digital technology to communicate, analyse and store information as well as to operate equipment.

Cyber communications specialists within the RAF are responsible for keeping digital systems functioning and defending them against malware or hacking. The RAF can also use cyber to gather intelligence from enemy computer networks or disrupt enemy communications and deliver successful operations.

SPACE COMMUNICATIONS

The RAF has been involved in space since the 1950s. It retains responsibility for space monitoring and satellites and shares this workload with its global partners.

The Skynet satellite network, now operated by industry on behalf of the RAF, is essential to ensure the UK armed forces have worldwide secure communications. Satellites are also used by the RAF to control Remotely Piloted Airborne Systems (RPAS), or drones, such as Reaper on operations overseas. A Skynet satellite is suspended above you.

The RAF uses satellites to control RPAS such as Reaper from ground stations like this one used by No. 39 Squadron at US Air Force Base Creech, Nevada.

DECIDE

Military commanders and politicians need
to receive accurate intelligence and detailed analysis to help them make the right decisions.

Timely, precise intelligence enables both the legal and ethical implications of any decision to be considered as well as its strategic impact.

WHY PRECISION STRIKE?

International law requires that armed forces minimise the risk of harm to civilians during conflict. The RAF uses modern technologies such as laser-guided missiles and GPS to meet this obligation – known as precision strike.

Precision strike is critical for ethical and legal reasons and is also practical. Incapacitating a target with one strike as opposed to many is more efficient, saving time and money as well as reducing risk to aircrew. Precision strike relies on accurate intelligence to select the correct target and to help decide when, or if, to strike.

The RAF Reaper shown here is equipped with precision weapons. It gathers intelligence via a video camera below the nose.

LOCKHEED MARTIN AGM-114 HELLFIRE AIR-SURFACE MISSILE [Look up]

Hellfire missiles have sophisticated guidance systems and small warheads to enable very precise targeting, for example in strikes against tanks, structures, bunkers and helicopters.

SPEAR NETWORK ENABLED PRECISION GROUND ATTACK MISSILE [Look up]

Designed for use by the F-35 Lightning II, SPEAR can deliver precision strike at long distances, in all weather conditions against moving and highly defended targets on land and sea with minimal collateral damage.

GENERAL ATOMICS AERONAUTICAL SYSTEMS CERTIFIABLE PREDATOR B [Touch]

This remotely-piloted armed surveillance drone has a huge range.

The upturned winglets at the wingtips both reduce drag, further increasing range and help directional stability.

DEBATE SPACE:
IMAGINING THE FUTURE

Cutting-edge innovations, whether used in everyday life or by the military, can present us with new and challenging issues.

In the Debate Space you can explore some of the complex ethical questions that arise in the development and use of technologies such as Artificial Intelligence.

Explore the topic, consider the evidence and join the debate.

Supported by

SPEED, REACH AND HEIGHT

The RAF has always challenged industry to push the aeronautical boundaries of speed, reach and height, to gain an advantage over the enemy. While some designs were doomed to failure, others have evolved to enable aircraft to travel faster, further, higher and lower.

[Suspended models]

BLACKBURN SHARK

The Shark served the Fleet Air Arm as a torpedo-bomber/reconnaissance aircraft, trainer and target tug from 1935. After it became obsolete it was used to test launch catapults on aircraft carriers.

GLOSTER JAVELIN

The Javelin was a high-altitude interceptor aircraft so needed to be able to climb rapidly. Its distinctive shape led it to its nicknames of Flying Flat Iron and Tin Triangle.

[Showcase lectern]

HEIGHT (ALTITUDE)

The RAF needs aircraft capable of both high and low altitude flight to operate effectively. Flying at high altitude increases the reach of sensors and reduces risk from small arms and anti-aircraft artillery fire.

Low altitude flight improves the resolution of sensor imagery and allows precision targeting. High altitude aircraft need powerful engines and wings which can provide high lift but which have low air resistance.

[Image caption]
The delta wing seen here on the Avro 707 is designed for high altitude flight.

Why not try the Height challenge in the Design in Action interactive?

HANDLEY PAGE HP120 TYPE 1960

The HP120 was a light army scout car designed for low-level flight. It used direct lift to negotiate obstacles such as rivers or railways not passable by land vehicles. The HP120 became known as the Jumping Jeep.

THROTTLE QUADRANT, BAC TSR2 1964

The TSR2 was designed to operate at low altitudes. This throttle quadrant, designed to control the two Rolls-Royce Olympus 320 engines was probably never fitted to an aircraft. A TSR2 is on display at the Museum's Cosford site.

AVRO 707 1948

This one-tenth scale model is fitted with air brakes. Four different variants of the Avro 707 were built. They were development aircraft for the high-altitude Avro Vulcan which is on display in Hangar 5.

CONTROL COLUMN GRIP, BAC TSR2 1964

This control column grip is believed to be from the only TSR2 to fly, XR219. The date the TSR2 project was cancelled (6 April 1965) is marked on the mount.

PANAVIA TORNADO 1973

Designed to operate at high and low altitude, the long-serving Tornado, known to the RAF as the Tonka, has operated with the British, German, Italian and Saudi air forces in tactical strike and supersonic interceptor roles. A Tornado GR1B is on display in Hangar 6.

INVESTIGATE …

To find out more about the success or failure of these and other aircraft design projects please explore the stories on the clipboards below.

[Touch model in showcase drawer]

HANDLEY PAGE HP120

Note the folding wings and tail. Short hops could be made with the wings folded, but they gave no obvious improvement in capability. Fan engines provided lift.

[Showcase lectern]

SPEED

Faster speeds enable the RAF to arrive in troubled areas and to build a force up quickly, creating a visible presence. The RAF uses quick-response aircraft to counter any unauthorised air activity around the UK.

Powerful engines, streamlined designs and lightweight construction all make aircraft faster. However, high speed is not always essential; some tasks such as reconnaissance need slower speeds to be effective.

[Image caption]
The Fairey Delta 2 is a good example of streamlining for speed. Take the Speed Challenge to test this design.

SHORT SB5 1951

The SB5 had a long career as a test aircraft. Built as a low-speed flying model, it tested wing sweep and tailplane settings for the supersonic English Electric Lightning.

SUPERMARINE SWIFT 1951

The first British swept-wing fighter entered service in 1954. Severe problems led to its withdrawal from Fighter Command use after barely a year. A later, camera-equipped fighter-tactical reconnaissance version was more successful.

DE HAVILLAND DH117 1956

The DH117 high-speed, high altitude fighter would have been powered by two turbojets and a rocket motor. It was cancelled in 1957.

AVRO 730 1956

The Avro 730 was designed as a supersonic, high-altitude reconnaissance and nuclear-bomb carrying aircraft. It was cancelled in 1957 when the first prototype was already under construction.

VICKERS WILD GOOSE 1951

A high-speed variable wing sweep aircraft designed by Dr Barnes Wallis, inventor of the bouncing bomb used in the Dams Raid.

12 rocket-powered, radio-controlled models were built and flown. Barnes Wallis also designed a similar aircraft, the Vickers Swallow.

HANDLEY PAGE HP46 1931

A two-seat, carrier-based torpedo bomber with wings positioned to improve crew visibility. It had an advanced combination of high lift, slow flying controls but suffered from handling and weight problems.

SARO SR53
(DITCHING MODEL) About 1956

This model may have been catapulted or towed in a water tank to assess behaviour and survivability if this high-speed fighter prototype had to ditch in open water.

INVESTIGATE …

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[Touch model in showcase drawer]

FAIREY FD2

This cutting-edge 1954 design was built to research the delta wing at transonic and supersonic speeds. Two were built – one was later modified to test the wing form for Concorde.

[Showcase lectern]

REACH

Extended reach in aircraft design enables the RAF to conduct operations from bases far away from the enemy, and to respond to changing global events. Early projects like the Fairey Long Range Monoplane, used large fuel tanks.

Later developments looked at reach differently, considering an aircraft's ability to operate without an airfield or from aircraft carriers. Other technologies like radar enable the RAF to see further and react faster.

[Image caption]
The Fairey Long Range Monoplane has large wings to enable it to fly further. Take the Reach Challenge to test this design.

FAIREY LONG RANGE MONOPLANE 1928

Just two of these aircraft, which were especially designed to capture the world's long-distance record for the UK, were built. The K1991, built in 1931, flew from Cranwell to Abu Sueir, Egypt, in 31.5 hours.

CAVITY MAGNETRON 1937

Cavity Magnetrons are part of the radar system used to detect approaching enemy aircraft. The electromagnetic waves it produced could also heat food, an accidental discovery which led to the invention of the microwave oven.

TARRANT TABOR 1919

Built by building contractors WG Tarrant, this mostly wooden heavy bomber prototype nosed over on take-off on its first attempted flight. in May 1919. The two pilots were killed.

INVESTIGATE …

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[Touch model in showcase drawer]

SARO SRA/1

This heavy but fast jet-powered British flying boat was the only one of its type actually to fly. Of the three examples which were built for testing and display at air shows, two crashed.