

The Royal Air Force Benevolent Fund's

# International Air Tattoo 85

RAF FAIRFORD JULY 13-14



£1.50

## Welcome to Fairford



We here at RAF Fairford are happy to welcome you to the International Air Tattoo and to our base. This, the first Tattoo to be held at Fairford, promises to be better than ever and we are proud to be associated with it. It's a day to enjoy an outing, to reflect on the past accomplishments and the future promise of flight, and—most importantly—to remember those for whom the RAF Benevolent Fund provides. It's an honour to be able to support this effort on behalf of those airmen who went before us.

*Wayne C. Pittman Jr.*

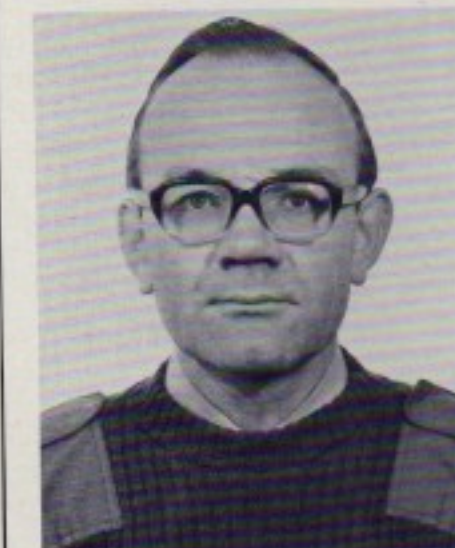
Colonel WAYNE C. PITTMAN JNR., USAF Commander  
7020th Air Base Group



I am pleased to welcome you on behalf of the men and women of the 11th Strategic Group (SAC) to the International Air Tattoo. The theme, Sky Tanker 85, fits well with the SAC Fairford mission of providing air refuelling for NATO aircraft throughout Europe. We believe the theme is very appropriate for this the first IAT at RAF Fairford. We have enthusiastically welcomed the opportunity to work closely with our British neighbours in producing the world's first tanker aircraft meet. We hope the show is one of the best in IAT history and most successful for the RAF Benevolent Fund.

*John D. Lunt*

Colonel JOHN D. LUNT, Commander 11th Strategic Group



This is the first time I have had any direct contact with the International Air Tattoo, which makes such a vital contribution to the Royal Air Force Benevolent Fund. A tremendous amount of work has been put in over the past few months by British and American personnel to ensure that the Tattoo is a success at its new location. I bid you all welcome to Royal Air Force Fairford and I hope that your visit will be a memorable one.

*D.H. Golby*

Squadron Leader D.H. GOLBY, RAF Commander



# Royal Air Force Fairford

RAF Fairford was opened by the Royal Air Force in January 1944. No 620 Squadron arrived on 18 March 1944, with Stirling bombers and Horsa gliders. It was joined a week later by No 190 Squadron.

Shortly before midnight on 5 June 1944, 45 Stirlings towing Horsa gliders set out from the base with nearly 900 paratroopers. During the early hours of D-day the paratroopers were dropped near Caen, France, to secure and hold bridges over the River Orne and establish a firm base east of the river in support of D-day operations.

That evening, after returning for service and repairs, 36 Stirling and Horsa combinations took off from RAF Fairford in less than an hour. In their bellies, 33 jeeps, 29 trailers, 11 motorcycles, eight 7mm guns and 254 troops were waiting to reinforce the troops dropped the previous night.



Short Stirling glider tug. IWM

Throughout the following weeks both Fairford squadrons carried huge quantities of supplies to the Normandy beachhead. In addition, they made nightly drops of supplies to resistance groups behind enemy lines.

On 17 September 1944, the first day of the Arnhem operation, 50 aircraft flew from the base, 38 of them towing gliders and 12 more acting as pathfinders for the main force. During the following week of intensive fighting they flew daily resupply operations in the face of heavy enemy opposition until the action was brought to an end.

In October 1944, two squadrons towed some 30 gliders from Fairford to Rome, returning with repatriated servicemen from Italy. Glider experimental work and

training took place at the base after the war until it was closed in December 1948.

In June 1950 RAF Fairford was reopened and began preparing to receive units of the U.S. Air Force. The airfield was enlarged, extended and, for a while, was jointly occupied by the U.S. Air Force and the RAF. It was handed over to the U.S. Air Force in July 1951, and the 7507th Air Base Squadron, a 3rd Air Force unit, was the first Air Force organization assigned to the base.



B-47E Stratojet at Fairford. PRM



A KC-97G refuelling tanker. PRM

In October 1952, the organization was converted into the 3919th Air Base Group under Strategic Air Command. In 1955 the group was changed to a squadron.

On 6 January 1958 the first B-47 Stratojets were deployed to the base from the 68th Bomb Wing at Chennault AFB, Louisiana, to initiate the continuing alert force concept. On 1 January 1959 the 3919th Air Base Squadron was redesignated the 3919th Combat Support Group, a Strategic Air Command unit. The 68th Bomb Wing continued to deploy six B-47s to Fairford until July 1961.

Reflex alert aircraft strength was doubled at RAF Fairford in July 1961 when the 68th Bomb Wing increased its deployment to nine B-47s, while the 96th Bomb Wing from Dyess AFB, Texas, began deploying three B-47s to RAF Fairford.



Horsa gliders lined up for take off. IWM



KC-135 Stratotankers of the 11th Strategic Group. PRM



The reflex posture at the base changed on 1 August 1962, when the 68th and 97th Bomb Wings were replaced by the 340th Bomb Wing from Whiteman AFB, Missouri.

On 1 December 1962, a SAC reflex alert posture was again implemented at Fairford. This was supported by one KC-97 aircraft from the 19th Refuelling Squadron, Otis AFB, Mass., and was on rotating alert for 28 days at a time.

The base continued to be used by the U.S. Air Force until 26 June 1964, when it was transferred back to RAF control. Later in 1964, the Central Flying School moved to Fairford with Gnat T1 aircraft. The Red Arrows, team was based at Fairford from the beginning of 1965 until September 1966. The base was then used by the growing Belfast and VC-10 fleets of the Royal Air Force until 23 May 1967, while the runway at nearby RAF Brize Norton was out of use.

The station lay dormant as a satellite of Brize Norton until September 1967 when it was reopened as an RAF Air Support Command Base and received two squadrons of C-130 Hercules.

In April 1969, Fairford became the British Aircraft Corporation test centre and home of Concorde 002. The two Hercules squadrons moved to RAF Lyneham in the summer of 1971, while Concorde test flying continued until 31 January 1977.

The U.S. Air Force returned to Fairford in early 1979 when the 7020th Air Base Group, a USAF unit was designated and activated on 1 February 1979. Preparations were made and in September 1979 KC-135 Stratotankers arrived at RAF Fairford. The tankers were the first USAF aircraft to be stationed at the base since 1964. The 11th Strategic Group (SAC) assumed control of tanker operations, and remains so today.

## Sir Douglas Bader Disabled Flying Scholarships

The lives of 12 Disabled People will never be quite the same.

Thanks to the 'Sir Douglas Bader Disabled Flying Scholarships' the lives of 12 disabled people will never be quite the same. Second World War fighter leader, Group Captain Sir Douglas Bader, who lost both his legs in that tragic pre-war flying accident, inspired the scholarships which were inaugurated in his memory by the IAT organising committee, after he died in 1982.

Sir Douglas was the IAT's President from 1976 until his death and the scholarships, first awarded in 1983, form a fitting tribute to a man whose bravery and fortitude are legendary.

Each worth over £3,500, the scholarships are endowed by Nationwide Building Society; Marshall of Cambridge—owners of Cambridge Airport where some of the flying instruction will take place; and the IAT organising committee.

The first six winners spent much of the autumn of 1983 in the Cambridgeshire skies and the outcome was highly satisfactory. Most of them gained their PPLs (Private Pilot's Licences) although in some cases subject to a qualified pilot being in the aircraft at all times.



The 1983 winners of the Sir Douglas Bader Disabled Flying Scholarship pictured at Cambridge Airport with one of the Cessna 152 training aircraft.

From the left they are: Tim Leonard (in wheelchair); Paul Lowe; Andrew Barrett; Tessa Mattinsley; Bill Somers and Graham Rann.

One of the scholarship winners in 1983—Paul Lowe from Cleethorpes, who suffers from spina bifida—plans to fly himself into RAF Fairford this weekend for IAT 85, having recently gained his full PPL. His arrival illustrates the great value of the scheme which has already opened a new chapter in the lives of twelve disabled people. What more fitting way could be found to pay tribute to the memory of Sir Douglas Bader—a man whose bravery and determination have inspired so many people.

However they, and this year's successful applicants, should soon be able to fly completely solo thanks to a modification (approved by the Civil Aviation Authority) which will convert some training aircraft (Piper Cherokee 140s) to hands-only operation.

This year's six winners were chosen from 99 applicants. Senior representatives from the RAF Benevolent Fund and IAT short-listed 20 candidates after seeking medical advice from the CAA. These finalists undertook the RAF's standard aptitude tests at RAF Biggin Hill before the six winners were selected.

All of these six winners together with the six who were successful in 1983, have each refused to admit that they are disabled people—as did Sir Douglas Bader.

Opposite are the six Sir Douglas Bader Disabled Flying Scholarship winners for 1985



ADRIAN 'BILL' BELCHER—  
from Abingdon, Oxfordshire

Ex-Royal Marine helicopter co-pilot/observer 'Bill' Belcher—from Abingdon—lost his right leg in action during the Falklands conflict. His Army 'Scout' machine was shot down, and the pilot killed, when they were flying to Goose Green to recover the body of Colonel 'H' Jones VC, who was killed during the assault on enemy positions. Following extensive medical treatment, 'Bill' can now run 50 metres using his artificial leg and he also enjoys swimming as well as gardening, photography, DIY, and helping out with his local Sea Cadet Corps (Marine Cadets Section). 'Bill' is looking forward to learning to fly a fixed-wing aircraft—"The scholarship will open up, once again, the world of aviation from which I have been cut-off since my episode on the Falkland Isles".



CAROLINE CROW—from Maidstone, Kent  
(at University of Glasgow)

Marine Biologist Caroline Crow (23), whose home is at Aylesford, near Maidstone, hopes that the flying scholarship will help her career. "Aerial surveys are of significant importance in marine science, and I'm sure that a pilot's licence will overcome employers' prejudices against me because of my disability". Caroline, who has wanted to fly since childhood, lost her left leg in a cycling accident. Like the others she doesn't really admit to being disabled. Indeed, she has attempted rock climbing, canoeing, fencing, sailing, cycling and sub-aqua diving. She is a research assistant in the Department of Botany at the University of Glasgow, and is studying marine algae for her PhD.



JOAN MARTIN—from Carrmonee, Northern Ireland

Belfast-born Joan Martin (35) contracted polio at the age of 3½. Although partially paralysed at first, a positive state of mind—coupled with considerable surgery over the years—has enabled her to triumph over the disease. A lecturer in occupational therapy at the University of Ulster, Joan specialises in anorexia nervosa and other related eating disorders. She has lectured in various parts of the world and was awarded a fellowship by the College of Occupational Therapists for her work on the subject. Starting this September, she'll be taking a year's sabbatical to study for a master's degree at Warwick University. "Although I will never match Sir Douglas Bader's heroism", says Joan, "I could, perhaps, emulate his qualities of leadership and fortitude—and who knows, I might even be a great pilot!"



JONATHAN MORRIS—from Barkingside, Ilford, Essex

Schoolboy Jonathan Morris, who recently took 'A' levels at Ilford County High School, is a keen sportsman despite losing his left leg in 1981 due to bone cancer. Soon after his leg was amputated, Jonathan received a letter from Sir Douglas Bader encouraging him to lead an active life. "He told me how he had made the most of his 'disability' and how he had become a martyr to golf. He also said that if you decide to be fit and well, you will be". Jonathan (18) is hoping to study accountancy once he has obtained his private pilot's licence of course! A keen snow skier, Jonathan was extremely proud to represent his country in the Swiss Alpine Racing Championships for the Disabled—only 15 months after the amputation.



GRAEME PAULEY—from Bedford,  
(at University of Southampton)

Graeme Pauley (22) is a student at Southampton University where he's in the final year of a BSc honours degree course in electronic engineering. He was 13 years-old when bone cancer was diagnosed in his right leg resulting in an above-knee amputation. A keen member of the RAF section of his school's Combined Cadet Force, Graeme gained his gliding 'A' badge and also enjoyed some powered flying. He has managed to do a little gliding at university, but finds it difficult to finance on a student grant. "I lead an active, full and enjoyable life where disability isn't allowed to interfere", says Graeme. He has always been determined to fly and became—after a 'considerable battle' the first amputee CCF cadet to fly solo and gain a gliding licence.



ROGER SCADENG—from near Gravesend, Kent

Student Roger Scadeng (22) has been interested in aviation for as long as he can remember and hoped to join the RAF when he left school. However, a motor cycle accident left him with a shortened and weak right leg, so the flying scholarship is something of a dream come true. "I actively participated in a number of sports before my accident, most of which are no longer possible", he says. "Sport was a large and important part of my life, and I feel that flying could have a dual benefit. Firstly it's something I've always wanted to do and secondly it will fill a large gap in my life". Like all the other scholarship winners, Roger drives a car and can't wait to get behind the controls of an aircraft.





# 11th Strategic Group

*IAT takes a personal look at RAF Fairford's resident air-to-air refuelling unit.*

The 11th Strategic Group was formed at RAF Fairford on 15 November 1978 and received its first KC-135 Stratotanker in September 1979. The group has a complement of 15 KC-135As which provide refuelling facilities for the US Air Forces in Europe and other NATO aircraft on exercise, training or deployment flights. Forward locations in Saudi Arabia and Keflavik, Iceland are also served from the base at Fairford. The aircraft are detached from their parent units in the USA, with crews, on a rotation basis. None of the tankers is permanently based at the Gloucestershire airfield.

We were able to see the 11th Strategic Group at work at Fairford on a foggy morning last March, joining the crew at their routine briefing session. The captain, co-pilot and navigator were from the permanent staff of the 11th Strategic Group at the base and were making a regular weekly 'staff' flight to maintain their combat readiness. The captain was Maj. Jim Van Ness, the co-pilot was Lt-Col. John Hallgreen, Chief of Tanker Operations Division, navigator was Capt. Ray Neall and the boom operator was SSgt. Don Baughman.

The mission was to refuel General Dynamics F-111F strike aircraft flying on training missions from the 48th Tactical Flying Wing at Lakenheath. Owing to fog over much of southern England take-off was subjected to a 30min delay. The aircraft was to be operated at a gross weight of 235,000 lb (some 62,000 lb less than the maximum permissible) which included 53,000 lb of



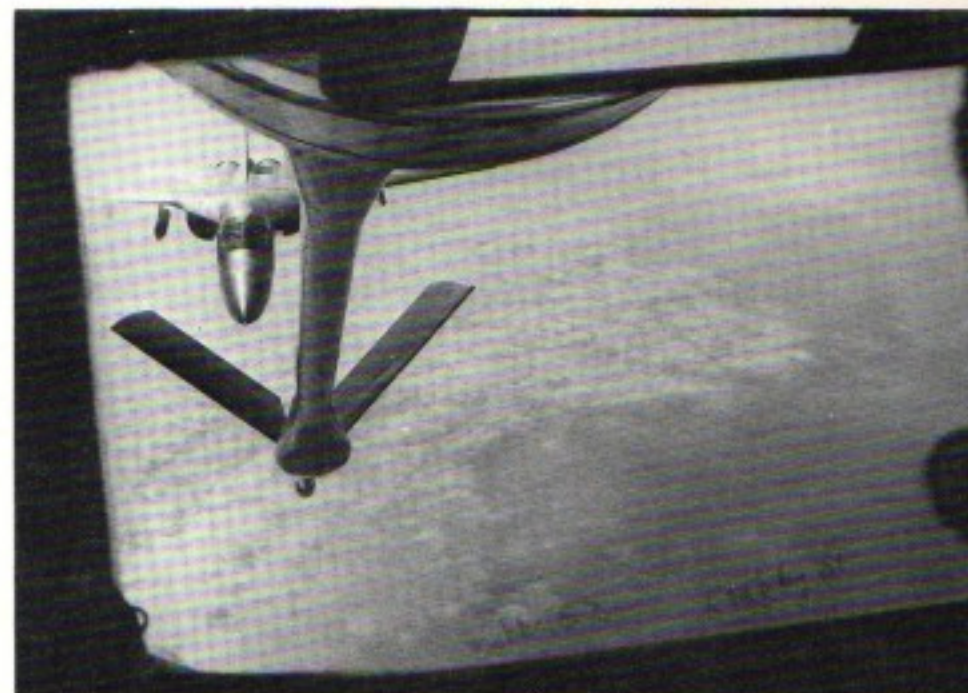
561 climbing away from Fairford. PRM

transferable fuel. At this weight the maximum expected ground roll for take-off was 7,387ft with a V1 of 120mph and rotation at 151mph. Planned mission time was 3hrs 20min, climbing to the operating area via Daventry and Otringham to a flight level of 24,000ft. The refuelling area, some 100 miles by 30 miles over the North Sea to the north east of Middlesbrough was to be our rendezvous. Diversion air-fields in the event of bad weather or operational problems were Upper Hayford, Mildenhall, Lossiemouth or Leuchars. The F-111s were to be directed to the tanker under fighter ground control, with our KC-135 operating under the radio

call sign Dobby 52. Each crew member explained their emergency and safety procedures to finalise the briefing.

The crew then proceeded to weather briefing where it was soon obvious that there would be a further delay due to fog but Maj. Jim Van Ness decided to go ahead with checks up to engine start. The crew bus took us along the shrouded tarmac past other tankers to KC-135A 62-3561, where the crew chief handed over his 'cleared for flight' machine and the appropriate documentation was signed up. Walking round the aircraft with the Captain on his pre-flight check we were able to take a close look at this 20 years plus KC-135. It was in pristine condition, belying its age with just a few signs, such as the incorporation of some structural fatigue modifications to show that it had probably flown at least 15,000 hours. We were told that there were significant 'hidden' improvements particularly in updated avionics as well as the incorporation of rudder control power assistance. The groundcrew are permanently posted with their aircraft, wherever it is based, so that they are continuously up to date with any particular operational problem, and its modification standard. This KC-135 Bluesmobile had joined the 11th Strategic Group on rotation from the 96th Bomber Wing at Dyess AFB Tx.

Entering the aircraft through the large forward fuselage freight door, one could appreciate the multiple role that could be played by the Stratotanker. Both sides of the cabin were lined with lightweight trooping seats and the centre fuselage held two large baggage containers—showing its ability to carry



The thirsty F-111F approaches. EAS

either groundcrews on base transfer or trooping. There were five rearward facing airline seats immediately aft of the flightdeck and four high level bunks to provide sleeping accommodation for the crew should they be required to stay on board at a remote deployed airfield. At the rear of the cabin was a Solar turbine ground power unit for emergency use should normal ground facilities be unavailable for start up.

Once notified by air traffic control that the mission was to proceed, engines were started and we taxied to Fairford's Runway 27 holding point while the sun threatened to break through the cloud cover. The standard



The operator flies the boom into the F-111. PRM

issue ear defenders were a useful asset as the J-57s took us clear of Fairford's 10,000ft runway in just 50 seconds.

As the KC-135 climbed above cloud cover, we joined SSgt. Don Baughman at his boom operator's position at the rear of the aircraft. This was approached down short steps on either port or starboard side to three couch positions where Don occupied the central location with his chin on a comfortable rest. The flying boom was lowered on a cable and was controlled by the two moving tail surfaces from the 'boomies' joystick. The boom angle has an operating arc of 10° each side, 20°, up and 40° down, from the neutral position. The pneumatic boom extension and retraction was accomplished using a left hand control stick. The field of vision from the rear panel was increased by movable mirrors.

Just 45 minutes after take-off the first 'receiver' F-111 was seen climbing over the broken cloud layer, with brief views of ships' wakes on the North Sea far below. The captains of both aircraft and the boom operator spoke only briefly on their radios as the F-111F appeared to slide sideways to line up with the flying



Contact is made. EAS

boom and its hose receiver hatch opened behind the cabin. The boom was then extended, precisely and quickly as the background noise changed, indicating that fuel flow had automatically commenced on connection. In two minutes some 4,000 lb of fuel was transferred and the receiver broke contact. Further refuelling link-ups were completed in similar manner for a further 45 minutes before this mission was concluded and we returned to Fairford. Here the 11th Strategic Group Stratotankers were lined up ready for their next mission, perhaps a training link-up with Luftwaffe F-4Fs over Europe or refuelling a trans-Atlantic E-3A Sentry on its way to the Middle East.



The replenished F-111 breaks away. PRM



Major Jim Van Ness and Lt-Col. John Hallgreen carry out their pre-flight cockpit checks. EAS



Mission over 'Dobby 52' on approach to land at Fairford. PRM

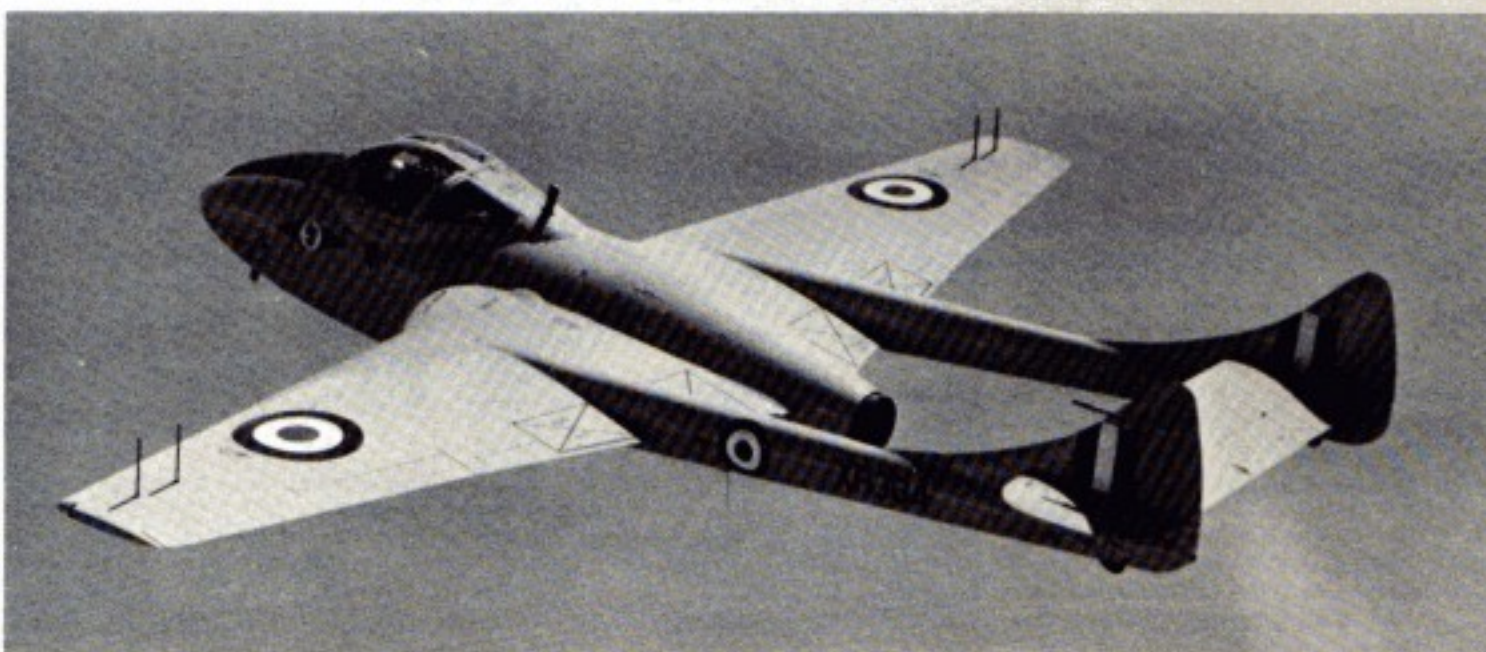


# THE VINTAGE PAIR

The Meteor and Vampire aircraft which comprise the Vintage formation Pair are from the RAF Central Flying School at Leeming, N. Yorkshire. This is their eleventh demonstration season. The two aircraft are flying history, representing almost a quarter of a century of aviation. A Meteor was the first jet aircraft to enter operational service with the RAF—an aviation milestone recorded in August 1944 in operations against V1s.



A training version, of the type, Meteor T Mk 7 flown in the formation pair was the first jet trainer in RAF service, and the Vintage Pair's example of the mark, WA669, first flew on 15 March 1950. The Vampire T Mk 11 XH 304, which completes the Pair is also a training aircraft and was first flown late in December 1955. It is the last Vampire flying with the RAF. Both



aircraft are fully aerobatic and were in service with the Examining Wing of CFS until their role was changed to demonstration flying for the 1972 season. 'Vintage' is the call sign of the historic pair for their display of synchronised manoeuvres.

Squadron Leader Bruce McDonald AFC the Meteor pilot and Manager of the Vintage Pair, joined the Royal Air Force in 1949 after Service in the Royal Navy. He flew Meteors and Sabres on No66 Sqn before flying in operations against the Mau Mau in Kenya. After a tour instructing on piston Provosts Squadron Leader McDonald became a member of the staff of CFS in 1959 and was a founder member of the Red Pelicans aerobatic team. After a further nine years operational flying on Hunters and Lightnings, he went onto become a member of the Examining Wing in 1971. In 1974 he started a three year tour on Jaguars and returned to his present post in 1979, he now has over 8,000 hours on single seat aircraft. In his seventh season with the Vintage Pair, he reluctantly admits to being a grandfather.



## 65 Years of Air-to-Air Refuelling.

Recalling the history of aerial refuelling, one might think of Sir Alan Cobham and his company Flight Refuelling Limited; the American endurance flights of the 1930s, the large fleet of bombers and tankers maintained by Strategic Air Command; or the vital role played by Royal Air Force tankers in the South Atlantic War in 1982. The genesis of aerial refuelling however, goes back beyond all these, to the First World War and possibly even before.

The problem of extending aircraft range or endurance was considered by several aviators during the Great War, but nothing came of their ideas. The first successful patent application for a means of air to air refuelling was made in June 1921 and in November of that year the first recorded transfer of fuel from one aircraft to another was made. This was in the form of a stunt with a wingwalker carrying a can of fuel on his back whilst clambering from one aircraft to another.



Pioneer Sir Alan Cobham began refuelling experiments in 1930. *FRL*

Early in 1923 a group of US Army Air Service pilots began experimenting with air to air refuelling using DH4B aircraft, with the intention of raising the world endurance record. This was eventually achieved in August with a flight of 37 hours. Although nothing further was done in America for some years this flight stimulated interest in other countries and between 1924 and 1928 refuelling trials were carried out in France, Britain, and Belgium—the latter country raising the endurance record in 1928 to 60 hours.

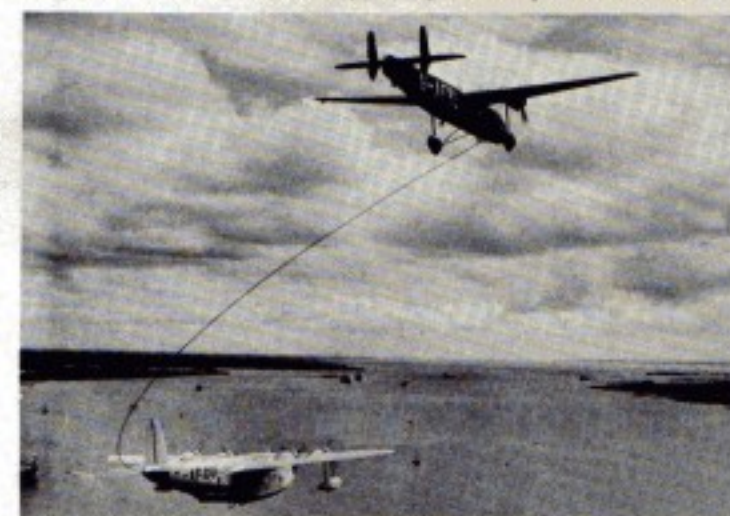


Vickers Virginia X was converted as a 'tanker', here refuelling a Westland Wapiti. *FRL*

Late in 1928 the US Army Corps announced plans for an 'official' refuelled flight, to assess the effects of long flights on man and machine. A flight of 150 hours was made in January 1929 by the Fokker C-2A *Question Mark* with a crew led by Major Spatz. This flight started an American craze for refuelled endurance flights and more than 50 such flights were carried out between 1929 and 1935, by which time a flight began in 1930 in which light aircraft took on fuel cans from a speeding car, and these culminated in a flight of over 1,500 hours in 1959.



A Handley Page W10 was used by Cobham to refuel his Airspeed Courier in an attempt to fly non-stop to Australia. *FRL*



H.P. Harrow refuelling a Short 'C' Class flying boat on a mail flight from Southampton to New York in 1939. *FRL*



Avro Lancaster refuelling using the looped hose method during trials by Flight Refuelling Ltd.



These duration flights encouraged others to experiment with air to air refuelling, and during the 1930s experiments were carried out in Germany, Japan, Russia and Britain. An official programme of air refuelling development began in 1930 at the RAE Farnborough and this continued until 1937, when the work was taken over by Flight Refuelling Ltd.

A famous pioneer aviator of the 1920s Sir Alan Cobham began refuelling experiments late in 1931, with the object of flying non-stop to Australia. After many years of experiments he set out for his destination, now changed to Karachi, in September 1934 but unfortunately the flight had to be terminated at Malta due to a disconnected throttle rod. Determined not to waste his efforts and expense Cobham established the company Flight Refuelling Ltd in October, to develop equipment and techniques for air to air refuelling. Fifty years later, this company is still very much in the business.

Cobham's efforts to get flight refuelling adopted for civil aviation were rewarded when, in August 1939, Imperial Airways began a flight-refuelled trans-Atlantic mail service with Short S.30 Empire flying boats. Due to the outbreak of



Flight Refuelling Ltd. invented the probe and drogue system for AAR of jet fighters. The first contact was made in April 1949 by this Meteor and Lancaster tanker. FRL



The USAF tested the probe and drogue system fitted to a B-29, here refuelling RAF Meteor F8s. FRL



The USAF first used the looped hose method of AAR with its B-29/B-50 bombers of Strategic Air Command. USAF



The flying boom system was adopted by the USAF in 1950, as fitted to this KC-97. PRM



Trials were conducted by FRL's Canberra refuelling most of the RAF's front-line fighters, such as the Javelin. Russell Adams

war the service was short-lived and various attempts to use the technique with operational aircraft during the war were rejected, although a large-scale operation to use 500 Lancaster tankers and a similar number of bombers for the long-range bombing of Japan reached an advanced stage of preparation.

FRL's system was adopted by the RAF for its V-bombers, the Valiant becoming the first jet tanker. PRM

Flight refuelling was seen as a means of assisting the re-establishment of British air routes after the war and trials were carried out between 1946 and 1948 with converted Lancaster and Liberator bombers to Bermuda and across the North Atlantic. In spite of reliable and promising results, the attraction of the technique for civil use was offset by adverse pilot reaction, the potential risk, and the general improvement in design and operation of civil aircraft.

Increasing East-West tension in the post-war years led to the adoption of AAR by Strategic Air Command in 1948, to enable it to carry out its mission on a global basis. The British 'looped hose' system as used in 1939 was originally employed but this was obviously un-

suitable for modern aircraft. In 1948 Boeing produced the 'flying boom' system and this was introduced into USAF service in 1950.

Also in 1948 Flight Refuelling Ltd studied means for refuelling jet fighters and eventually produced the 'probe and drogue' system. The first contact with this system was made in April 1949, between a Lancaster tanker and a Meteor receiver. This method of refuelling was evaluated by the RAF with a Meteor squadron in 1951 and by the USAF in combat operations in Korea.

In Britain, the probe and drogue system was adopted by the RAF, initially for V-bomber refuelling but from the early 1960s it was increasingly used by tactical and strike aircraft of the Royal Navy.



The USAF's Tactical Air Command had 3-point drogue units on the B-29s/KB-50s for AAR. Here an F-101 Voodoo, B-66 Destroyer and F-100 Super Sabre are all hooked up. PRM

In America SAC introduced the boom system for use with bombers and fighters, while Tactical Air Command and the US Navy used the probe and drogue system. In 1961 SAC became responsible for all KC-135 tanker operations and carried out refuelling for other commands and aircraft of NATO and other friendly countries. Both refuelling systems are catered for in the new KC-10A Extender and a separate hose unit is to be installed in the KC-135 to enable it to refuel both boom and probe receivers on a single flight, instead of the boom-drogue-adaptor which has been in use for many years. This can only be fitted on the ground and thus limits the aircraft to single system operation.



An RAF Victor tanker refuelling a Navy Buccaneer and Sea Vixen. PRM



The Victor has provided the backbone to RAF tanker operations for over 20 years. Here a pair of Lightnings of No 5 Squadron take on fuel for a combat air patrol. PRM



The 'buddy' system allowed smaller tankers to be used for carrier operations, like this Navy Buccaneer refuelling a Phantom. FRL

Originally used by the major powers for strategic bombing purposes AAR is now in use or is planned to be used, by the air arms of at least nineteen countries, with tankers ranging in size from the A-4



RAF Hercules were hastily modified during the Falklands conflict as tankers and receivers. FRL



Latest tanker in service is the VC10 K3 which operates from RAF Brize Norton with No 101 Squadron. PRM

In Vietnam Hercules tankers refuelled Marine Corps helicopters. PRM

Skyhawk to the Boeing 747. The technique has been used in combat conditions in Korea, South-East Asia, the Middle East, Africa, and the South Atlantic.

In the future the technique will see even more widespread use, and several manufacturers are offering AAR equipment and tanker conversions. Among the many types of aircraft proposed for the tanker role are the adaptations of old and new civil airliners such as the Boeing 707, Boeing 737 and 757, DC-9, and Fokker F-28.

For some years tanker spacecraft have been transferring propellants to orbiting stations and 'space-to-space' refuelling may prove to be as useful and widespread as has AAR for aircraft. The sky has no limit for the aerial refuelling tanker. The vision of the pioneers of 50 and 60 years ago has come to fruition with AAR now an everyday feature of the military aviation scene.



# Battle of Britain Memorial Flight



## The Battle of Britain Story

The Battle of Britain was one of the most crucial conflicts of the Second World War. It lasted from July 10th to October 31st, 1940 and was narrowly won by the Royal Air Force. The then Fighter Command lost 915 aircraft but inflicted bomber and fighter aircraft losses totalling 1733 on the German Luftwaffe. This saved Britain from invasion.

The German intention had been to destroy the RAF, as the air forces of Poland, France and the Low Countries had been destroyed in *blitzkriegs* across Europe from September 1939 to May 1940. With air superiority assured, the Luftwaffe's bombing force would have been used to support a cross-Channel invasion of southern England.

Once the German Army had been landed in Britain (though its seaborne passage would have been bitterly contested by the Royal Navy) it would have aimed to eliminate the country as a base for operations against Germany, even if this meant complete occupation.

The consequences of this, in terms of the Allied war effort, would have been incalculable: the British Government would have had to move, probably to Canada; there could have been no UK-based strategic air offensive against Germany; the Americans would probably never have entered the European war; and there would have been no base for the eventual Allied re-entry into Europe—on D-Day, June 6th, 1944.

When the Battle for Britain began the Germans were undefeated, at the height of their military power in Europe. Their air forces in northern France and the Low Countries (Luftflotten 2 and 3) had 2600 aircraft—1200 long-range bombers, 760 twin-engined fighters, 280 dive bombers, 220 single-engined fighters and 140 reconnaissance aircraft. Against these, RAF Fighter Command mustered 603 single-engined fighters—Spitfires and Hurricanes.

Of the five phases in the battle, which began with probing attacks to test UK air defences, the most critical phase was 24th August—6th September when the Luftwaffe assaulted airfields in south-east England—apparently to clear the air over Kent and Sussex preparatory to establishing an invasion bridgehead on the coast between Dover and the Isle of Wight. During this desperate period, Fighter Command had more than 230 pilots killed or seriously wounded and over 450 aircraft shot down or put out of action.

But the Luftwaffe attempt to eliminate the RAF, which had been planned to take four weeks, failed—and during October 1940 the daylight offensive which was to have been a prelude to invasion was called off. The Germans never again attempted such an operation. Because the Battle of Britain averted possible occupation and defeat, it ranks in significance with Nelson's victory over the French fleet in 1805 and with the Elizabethan destruction of the Spanish Armada in 1588.



Lancaster PA474 leading Spitfire P7350 and Hurricane PZ865

## History of the Flight

The Battle of Britain Memorial Flight was formed at Biggin Hill in 1957. It then consisted of two Spitfire Mk 16s, two Spitfire PR Mk 19s and a lone Hurricane. In 1958 the flight moved first to North Weald and then in to Martlesham Heath. During this time the two Mk 16s were lost in flying accidents. In 1960 the flight moved to Horsham St. Faith and whilst there was further reduced in size by the decision to ground one PR 19 (PS 853). In 1964 the flight moved to RAF Coltishall and since then has gradually increased in size to its present strength of seven aircraft. PS 853 was returned to flying condition; a Mk 5 Spitfire (AB 910) was presented by BAC in September 1965; a Mk 2 Spitfire (P 7350) joined the flight at the end of the Battle of Britain film and the last Hurricane ever produced (PZ 865) was presented by Hawker Siddeley in March 1972. The Lancaster PA 474 from RAF Waddington joined the flight in November 1973. In March 1976 the Flight moved to its present base at RAF Coningsby Lincolnshire. The Flight is now one of the RAF's established display teams. With the exception of the Flight Commander and 13 groundcrew all the rest of the members are volunteers on secondary duties.



Spitfire PR19 PS853 breaking from Hurricane IIc LF363

## The Spitfire

Destined to become the most famous of all fighter aircraft the prototype Spitfire was first flown from Eastleigh Airport, Southampton on March 5th, 1936. So successful were the advanced ideas incorporated by designer R J Mitchell that developments of the Spitfire were to establish and maintain the air superiority so vital to the defence of the United Kingdom and ultimate victory throughout the war that was to follow.

The first service aircraft was delivered to the Royal Air Force at Duxford in August 1938 and by the beginning of the Battle of Britain 19 squadrons were operational in Fighter Command. Production and development at an unprecedented rate, in shadow factories dispersed throughout the United Kingdom, resulted in over 22,000 Spitfires of 36 distinct operational marks, including photographic reconnaissance and carrier born versions, being built. Serving with all the Allied Air Forces, the Spitfire achieved outstanding success in every theatre of the war.

Powered by the famous Rolls-Royce Merlin and Griffon engines and renowned for its superb manoeuvrability, flying the Spitfire was the ambition of every pilot. Present day pilots who are privileged to fly these historic aircraft, though finding them very different from their modern equivalents are delighted with their handling qualities.

## Spitfire Mk VB AB910

Built 1941 at Castle Bromwich. During the war it flew on Nos 222 (Natal), 130 (Punjab), 133 (Eagle) 242 (Canadian), 402 (Canadian), and 527 Squadrons. On August 4th, 1945 while at No 53 OTU Hibaldstow an ACW 2 Margaret Horton was holding the tailplane down for an engine run when the pilot, Flight Lieutenant Cox—who thought that she had got off—took off and flew a circuit, wondering why the tail was reluctant to come up! She was unhurt and visited the flight in 1968.

In 1947 the aircraft was sold privately and used for racing and displays. BAC presented it to the flight in 1965.

## Spitfire Mk 11a P7350

Built at Castle Bromwich in August 1940, this aircraft was delivered to No 266 Squadron on September 9th at RAF Wittering. Between the end of 1940 and August 1941 it served on Nos 603 (City of Edinburgh), 616 (County of South Yorkshire) and 64 Squadrons. During its operational life, from the Battle of Britain until 1942, pilots flying this aircraft shot down three enemy aircraft. However, P7350 did not escape completely unscathed and a close inspection of the upper wings will show four metal inserts—one on the left and three on the right. These inserts were the standard battle repair for bullet holes in those days. From 1942 until the end of the war it flew at various training units. In 1947 it was sold to Messrs John Dale who presented it to RAF Colerne where it was used as a static exhibit. In 1967 it was renovated for use in the 'Battle of Britain' film and then joined the BBMF. P7350 is currently marked EB-Z of No 41 Squadron.



Spitfire 11a P7350 in 41 Squadron markings

## Spitfire PR Mk XIX PM631

Built in January, 1945 and delivered to Benson in that year. The aircraft served on various Reconnaissance Flights before being modified to a Meteorological Observation standard and flew from Hooton Park and Woodvale. It joined the Memorial Flight at Biggin Hill in June 1957 and has remained with Flight since that date.

Marked DL-E the aircraft is currently coded in No 91 Squadron letters representing a Mk 21.

## Spitfire PR Mk XIX PS 853

Built in January 1945 it was delivered to the Central Photographic Reconnaissance Unit at Benson. Later that year it joined No 16 Squadron where it remained until 1950. It was then converted to a Meteorological Observation aircraft and served at Hooton Park and later Woodvale. In June 1957 it was flown to Biggin Hill by Group Captain Johnny Johnson to join the Battle of Britain Memorial Flight. In 1960 it was decided to ground the aircraft and it was flown to West Raynham as a decoration for the main gate. It was however kept in flying condition and in May 1964 rejoined the Flight. It is painted in Photo Reconnaissance Blue and wears no squadron markings as this was typical of this mark of Spitfire since they served on Reconnaissance Flights rather than Squadrons.

## The Hurricane

One of military aviation's most outstanding machines the Hurricane opened a new era in RAF fighter equipment. It was the first interceptor monoplane to be adopted by the RAF and its first combat aircraft to exceed 300 mph in level flight. Responsible for destroying three-fifths of the enemy aircraft brought down during the Battle of Britain, the Hurricane has been somewhat overshadowed by its more famous contemporary the Spitfire. Designed by Sydney Camm in 1934, the Hurricane is a descendant of the famous Fury and Hart and is a forerunner of the Hunter. The first monoplane RAF fighter to enter Squadron service it carried twice the armament of its predecessor, the Gladiator. Having eight .303 Browning machine guns mounted in the wings, it was the first fighter in the world to bring this number of guns to bear on a target. The Hurricane flew throughout the war, later marks carried increasingly heavy armament especially in the ground attack role where two 40mm cannon were employed as 'Tank Busters'.

Still delightful to fly, the Flight maintains two of the three remaining flying Hurricanes in existence.



Hurricane LF363 taking off for a display

## Hurricane IIc LF 363

Built at Langley, Bucks in January 1944 the aircraft saw service on Nos 63, 309 (Polish) and 26 Squadrons. At the end of the war the aircraft saw service on the numerous Station Flights and again joined a Squadron when it went to No 41 Squadron at Biggin Hill in August 1951. This Aircraft has featured in 'Angels One Five' and 'Reach for the Sky', and also 'The One That Got Away'. This aircraft was probably best known as the leader of the annual fly-past over London on Battle of Britain Sunday. LF 363 has been on RAF charge since 1944.

The aircraft is presently wearing the markings VY-X of No 85 Squadron.

## Hawker Hurricane PZ 865 'The Last of Many'

PZ 865, the last of some 14,000 Hurricanes to be built, was constructed at Langley in July 1944. Allotted to Hawker Aircraft it was retained at Langley and purchased by the Company in 1945. In 1950 it featured in the film 'Angels One Five' and was converted to civil requirements and markings. Registered G-AMAU it appeared at air displays throughout the country in royal blue and gold colours. Restored to its original war-time camouflage and markings in 1960, PZ 865 was displayed at the Hawker Museum for several years. After extensive reconditioning it was presented by the Company to the Battle of Britain Memorial Flight in March 1972 and currently carries the markings borne by the aircraft when it was retained by Hawkers.



PZ865 'The Last of the Many' Hurricanes





# SKY TANKER 85



"In 1982 the dreams of Sir Alan Cobham and Sir Richard Atcherley came true. After 25 years in a support role the tanker force proved that air-to-air refuelling (AAR) is an essential element of air power." So starts a "History of Air to Air Refuelling at RAF Marham", the main base since 1958 of the Royal Air Force's Tanker force.

The vital role of AAR was dramatically demonstrated during *Operation Corporate* when air-to-air refuelling by Victor, Vulcan and Hercules tankers enabled Nimrod, Vulcan, Hercules and Harrier aircraft to support the British Task Force in the South Atlantic and to operate effectively as far away as the Falkland Islands.

This rapidly developing and vital aspect of modern air operations has been chosen as the special theme of International Air Tattoo 85. SKY TANKER 85 is the world's first International In-Flight Refuelling and Tanker Aircraft Meet.

Many tanker aircraft, which now range from widebodied jets such as the Tristar and KC-10 Extender, a development of the DC10 airliner, through modified versions of the VC10, Boeing 707 and C-130 Hercules to the Buccaneer, S3 Viking and Eten-dard, of which each type can be configured in a buddy-buddy role for mutual AAR support, have assembled this week at RAF Fairford to participate in the Meet.



The armed forces of many countries were invited to come to this unique event in a spirit of friendship and to display air-to-air refuelling aircraft to the public. The aim of the Meet is to promote international goodwill and understanding and the exchange of information amongst the participants and with industry.

An important feature of SKY TANKER 85 has been a one day symposium at which an international team of speakers from the armed forces, industry and research organisations presented papers on the history and development of in-flight refuelling, operational techniques and requirements, technological progress and human aspects. Competitive activities added another dimension to the Meet. Teams consisting of both air and ground crew personnel of the aircraft took part in ground competitions for which trophies were awarded, whilst the preparation and presentation of their aircraft was assessed by an international panel of judges for the Concours d'Elegance Trophy.

The support and sponsorship of industry is essential for the success of a major event such as SKY TANKER 85. Aerospace and avionics companies were invited to join the SKY TANKER Industries Team and have received special facilities in return for their financial and other support of the various activities during the Meet. These included social events which allowed for more informal exchanges between participants and concluded with the SKY TANKER Dinner and Presentation of Trophies Ceremony which marked the end of the Meet.

Today, at IAT 85, an impressive line-up of tanker aircraft is on display. The crews are standing by and will be pleased to explain their aircraft and to answer questions from members of the public. The SKY TANKER 85 organising team thanks all who are supporting and participating in the event and hopes that everyone here this weekend will enjoy this interesting and special feature of IAT 85.

## SKY TANKER 85

ROLLS-ROYCE engines provide the power for aircraft at both ends of the hose in air-to-air refuelling. They range from the Conway turbofans in the VC10 tanker to the Pegasus turbofan in the Harrier. Indeed, the first RAF jet aircraft converted to the tanker role in 1958 was the Vickers Valiant powered by Rolls-Royce Avon turbojets. The Valiant was followed eight years later by the Victor K1 and then, in 1974, by the K2—both powered by the Conway which has now achieved nearly 20 years and thousands of hours in the tanker role.



VC10 K2 (RR Conway) and Tornado F2 (Turbo-Union RB199)

The range of Rolls-Royce engines powering donors and receivers is wide and is a major contribution to the growth of the company's military engine service—currently about 70 million hours—with 119 armed forces around the world. The major engines in the world of Sky Tankers are: The Conway which powers both the Victor and the VC10 in the tanker role. Victors are powered by the Mk 201 of 19,000 lb thrust and the VC10s are all powered by the Mk 301 with 21,580 lb thrust. The Conway has been in service since 1958 in the Boeing 707-420 and more than 100 Conway-powered aircraft, including 32 Douglas DC8-40s were built. The RB211 is the power plant for the British Airways TriStars that will be used as tanker/freighters by the RAF. The difference in fuel that can be transferred—about eight times that of a Victor—is as emphatic as that between the Victor's Conway and the RB211. Lockheed L1011-1 and -100 versions of the TriStar are powered by the RB211-22B with a take-off thrust of 42,000 lb. The -524 version, launched for the extended range



TriStar C1K (RR RB211)

## ROLLS-ROYCE



Victor K2 (RR Conway) and Phantom FGR 2s (RR Spey)

many and Fiat Aviazione of Italy. The RB199 is a three-shaft turbofan with a dry thrust of 8,000 lb and enhanced versions are capable of more than 18,000 lb thrust with reheat. In all, RB199 engines in service with four Armed Services of the three countries have logged 250,000 flying hours and more than 1,200 engines have been built. Pegasus vectored thrust turbofan engines power the BAe Harrier and Sea Harrier, as well as Harrier VSTOL aircraft in the US Marine Corps, Spanish and Indian Navies. They are powered by the Pegasus 11 of 21,000 lb thrust. The advanced Harrier, the AV-8B Harrier II, is now in service with the US Marine Corps and the first Harrier GR5 for the RAF has flown recently. Engines for these aircraft have internal improvements that enable a further 500 lb of thrust to be achieved in addition to an increase in engine overhaul life.

The Adour turbofan was developed to power the Anglo-French Jaguar super-sonic strike/trainer aircraft. Design, development and manufacture are shared by Rolls-Royce in the United Kingdom and Turbomeca in France and the engine is now also manufactured under licence overseas. The Adour-powered Jaguar entered service in 1972. More than 2,200 Adour engines have now been built and more than 2 million hours service experience has been accumulated. In addition to the Jaguar, Adours power the British Aerospace Hawk ground attack/trainer and the Japanese T-2 and F-1 trainer and fighter support aircraft. The engine is in service with the air forces of 13 countries.



VC10 K2 (RR Conway) and Jaguar GR1 (RR Adour)



# SKYTANKER 85

A number of aircraft built by Lockheed Corporation divisions are on display at International Air Tattoo SKYTANKER '85. This is a follow-on to the California-based aerospace firm's IAT support in previous years and the close relationship of Lockheed and Great Britain extending back to the early World War II days when Lockheed Hudsons were among the first American aircraft used by the RAF in its defence of the United Kingdom.

The Lockheed-Georgia Company, known as the 'Airlift Centre of the World', and based at Marietta, Georgia, is the builder of the C-130 Hercules 'flying truck' transport, a number of which are on display at the Air Tattoo. Among more than 40 Hercules versions are four models that, in keeping with the Air Tattoo theme, have to do with air refuelling. These are the KC-130 tanker-transport flown by the US Marines and Marine Reserve, as well as a number of international operators; the HC-130P, a helicopter-refueller rescue aircraft flown by the US Air Force; the MC-130, operated by US Special Mission Forces; the Royal Air Force's C-130K versions modified for aerial refuelling.

The versatile KC-130 is used to refuel both high speed fighters as well as low-speed helicopters, including the largest US helicopter, the CH-53E 'Super Stallion'. A squadron of KC-130s can support an entire fighter wing flying across



An SR-71 comes into land

the Atlantic or Pacific. In a battlefield situation, the tanker/transport serves as a 'flying service station' to Marine fighters, attack aircraft and helicopters, loitering high in the sky over or near battle zones.

A key Lockheed-Georgia Company partner on many C-130 projects including the MC-130H—is the Lockheed Aircraft Service Company. Headquartered at Ontario, Calif., LAS is the World's most experienced aircraft modification and maintenance organization. LAS engineers and modifies aircraft to special airborne platform configurations. In the case of the MC-130H special mission aircraft, LAS installs special modifications, including high speed low-level aerial delivery systems.

# Lockheed



HC-130N Hercules refuelling a rescue HH-3E

Among the Hercules on display will be Royal Air Force C-130K versions, including those featuring modifications performed by Marshall's of Cambridge. A number of these specially-modified Hercules aircraft gained accolades for their outstanding airlift role in the Falklands campaign. An HC-130P from the USAF 67th Air Recovery and Reconnaissance Squadron at RAF Woodbridge will also be on hand. This aircraft is used to refuel H-53 helicopters and A-10 close air support aircraft.

The Lockheed SR-71 Blackbird, developed and built by Lockheed-California Company's famed Advanced Development Projects—more familiarly known as the 'Skunk Works'—is again participating at the Air Tattoo, coming from the US Air Force's 9th Strategic Reconnaissance Wing at RAF Mildenhall. The SR-71, which began flying over 20 years ago—continues to hold world records as the highest flying, fastest flying aircraft. The reconnaissance aeroplane flies in excess of Mach 3 and above 80,000 feet.

Another Lockheed-California Company product, the TR-1, a follow on to the U-2, is also on display, coming from the USAF 17th Reconnaissance Wing at RAF Alconbury. The TR-1, a tactical reconnaissance aircraft, operates at altitudes over 70,000 feet and at a speed of 430 miles per hour. Lockheed will build at least 24 of the TR-1s.

Among Lockheed companies serving as SKYTANKER '85 co-sponsors are the Lockheed-California Company and suppliers, Lockheed-Georgia Company, and Lockheed's Aviation Service (JetPlan) division.



The TR-1 operates with the 17th RW from Alconbury

# SKYTANKER 85

Flight Refuelling Limited was founded in 1934 by the pioneer aviator, Sir Alan Cobham, to develop techniques by which one aeroplane might be refuelled by another in mid-air. FRL's air-to-air refuelling systems have been in service with the RAF for more than 25 years and its new technology Mk.32 Probe-and-Drogue refuelling pod is fitted on the BAe VC-10 Tanker. The Company's air-to-air refuelling equipment has also been ordered by the Ministry of Defence for the Lockheed Tri-Star tanker aircraft.

The selection of FRL by Panavia as prime contractor to develop and manufacture the external fuel tanks for the Tornado ADV and the IDS aircraft is a notable example of the Company's expertise in both airframe structures and fuel systems equipment.

Its Aerospace Components Division has more than 30 years experience in the design, development and manufacture of aircraft fluid and, in particular, fuel systems equipment. With its dedicated engineering staff supported by extensive laboratory and test facilities, FRL is a leader in fuel systems technology.

Flight Refuelling Limited is a key UK designer and manufacturer of target systems. Its Rushton Long-tow system, Low Level Height Keeping Target, Marine Surface Target together with its advanced Subsonic Aerial Target, FALCONET, fulfil a wide range of weapons trials and service training requirements.

The Company is also involved in the design and development of Remotely Piloted Vehicles (RPV) for surveillance and decoy purposes, and a range of RPVs is being developed to meet a variety of operational and training requirements in this field.

Flight Refuelling Limited is a key UK Division, located at Bournemouth (Hurn) Airport accommodates the Company's Flight Test Department. Full engineering support and facilities are available for the conversion of jet aircraft to the pilotless target role. Here FR Aviation also operates services for aerial target presentation, crew training, weapons evaluation, coastal surveillance and fisheries protection. A further major activity is the management of Ministry of Defence and Service Establishments including the maintenance and operation of aircraft and the provision of all required engineering support, such as the Fleet Requirements Unit at RNAS Yeovilton.

FRL introduced its world renowned probe-and-drogue system in 1949 and produced the first multi-point tanker equipment in 1958. All the air-to-air refuelling equipment in service with the Royal Air Force has been supplied by Flight Refuelling Ltd.

# Flight Refuelling Limited FR



The latest product in Flight Refuelling's family of underwing probe-and-drogue refuelling pods is the Mk.32-2800. This pod is a self-contained store which enables the conversion of transport or bomber aircraft to the multi-point tanker role. It provides fuel rates up to a nominal 2800 lb/min. with a pressure of 50 lb/in<sup>2</sup> at the end of the hose. All transfer fuel is drawn from the tanker aircraft. The Mk. 32 pod achieves a significant advance in reliability and a reduction in maintenance costs compared with previous pods. High pressure hydraulics are eliminated by using fuel as the operating medium, and electronic digital control replaces the previous analogue system. The number of components is reduced to about one-third of that of previous pods.

At sea, surface-to-air refuelling from ships can add a new dimension to the tactical capability of helicopters. Flight Refuelling Ltd's H.I.F.R. equipment enables helicopters to be refuelled from vessels which may not have a flight deck or whose flight deck is obstructed. The equipment is currently in service with the Royal Navy and many other navies. Flight Refuelling Ltd. has expertise in the design and installation of complete systems for the storage and transfer of aviation fuel in ships of all sizes.

During 1982 events in the South Atlantic FRL's equipment proved again and again its strategic and tactical importance and its outstanding reliability. Air-to-Air refuelling provides extended reach, endowing today's air power with undisputed strategic and tactical advantage. Missions impossible with unrefuelled aircraft become possible—increasing operational flexibility and reducing the numbers of aircraft required for a particular task. Air-to-air refuelling is the true force enabler and force multiplier.





# SKYTANKER 85

cfm  international



A joint company of SNECMA, France and  
General Electric Company, USA.



The new CFM 56 series of engines is not only revolutionising the veteran DC-8 airliner but also the Skytanker world. The CFM56-2 engine has passed the one million-hours-in-service mark aboard McDonnell Douglas DC-8 Super 70s, with a dispatch reliability rate of 99.9 per cent and a shop visit rate of 0.14 engine-related events per 1,000 flight hours. 'This exceptionally high dispatch reliability rate means that aircraft powered by CFM56-2 engines take off 999 out of 1,000 times without being delayed for any engine-related reason,' said Jacques Chausse, president and chief executive officer of CFM International, the joint company of General Electric and SNECMA of France that produces the CFM56 family of engines. Super 70 aircraft re-engined with the CFM56-2 have proven to be 16 to 21 per cent more fuel efficient than DC-8 with older technology engines.



DC-8 Super 70—CFM56-2.

The CFM56-2, which entered service in April 1982 aboard the Super 70, today powers 75 Super 70s flying with Air Canada, Delta, Emery, German Cargo, Minerve, National, Transamerica, United,

United Parcel Service, the French Air Force and six VIP owners. The engine also powers the US Air Force KC-135R tanker aircraft, which entered service in July 1984.

This ever-widening experience base directly benefits the latest CFM56-3 engine, which entered revenue service with Southwest Airlines on 7 December last year and with USAir on 18 December, aboard the new Boeing 737-300. Because the CFM56-2 and the CFM56-3 share a common engine core, the -3 can take advantage of the -2 service experience and the continued technological improvements being made to the engine core. Both engines feature reliability, durability and fuel efficiency advantages. The CFM56-2 is rated at 22,000-24,000 lb thrust, and the -3 is available at 20,000 or 22,000 lb thrust.

Besides powering the Super 70 and the KC-135R, the CFM56-2 engine has been selected for the French C-135F tanker, Royal Saudi Air Force E-3 airborne warning and control system (AWACS) aircraft and KE-3 tankers, and US Navy E-6 submarine communications aircraft.



Boeing KC-135R



CFM 56-2 on a DC8-72F



Boeing 737-300—CFM 56-3



707 tanker/transport refuelling an F-105

The Boeing Military Aeroplane Company of Wichita, Kansas, has begun a programme to modify existing Boeing 707-320 aircraft into aerial refuelling tanker/ transports. Using this approach aerial refuelling can be obtained at a fraction of the cost of a new tanker. The multiple benefits of aerial refuelling to the tactical air forces is becoming increasingly important.

One 707 tanker/transport will also more than double the time-on-station of a flight of six Tornados on a typical combat air patrol mission. The Boeing 707 tanker is being offered in a variety of refuelling configurations compatible with all free world fighters. In addition, the 707-320C can transport 30 tons of cargo 4,200 nautical miles. The same aircraft can carry 170 military personnel 4,800 nautical miles which is equivalent to a non-stop flight from London to Los Angeles.

The Boeing KC-135A tanker was put into service with the United States Air Force during the late '50s and early '60s and remains the only aircraft in the world specifically designed for aerial refuelling. Increasing refuelling requirements of the armed services has led to a re-engining programme for the KC-135A to increase its performance with a modern engine—the CFM56—that would require less fuel.

The increased performance and lower fuel consumption of the new engines permit the re-engined KC-135s to take off

with more fuel and carry it farther. Consequently, two re-engined KC-135s can do the work of three KC-135As, because the ability to carry more fuel and burn less during its mission makes it possible for a re-engined KC-135 to transfer substantially more fuel to more receiver aircraft.

Due to the increased efficiency of the modern engines, the re-engined KC-135 tanker will burn 27 per cent less fuel than the present version. The use of CFM56 engines also results in significant noise reductions. The areas surrounding airports exposed to decibel noise levels will be reduced from over 240 square miles to about 3 square miles, more than a 98 per cent reduction in the noise-impacted area.

In addition to the US KC-135 fleet of more than 600 aircraft, the French Air Force operates 11 C-135F tankers, which will also be re-engined with the CFM56. The productive life of the aircraft will extend well past the year 2000.

Boeing Military Aeroplane Company has developed a series of low-cost drones called BRAVE-200, which have a wide variety of military applications. The BRAVE-200 is a 265 lb (120kg) unmanned vehicle which can be serviced, programmed and launched by a two-man crew. The basic structure is a low-cost, yet durable injection moulded composite, suitable for economical high-rate production. The seven-foot-long vehicle is powered by two-cylinder, 28 hp engine, with a four-blade propeller.



French Air Force C-135F with a Mirage



CFM56 powered KC-135R

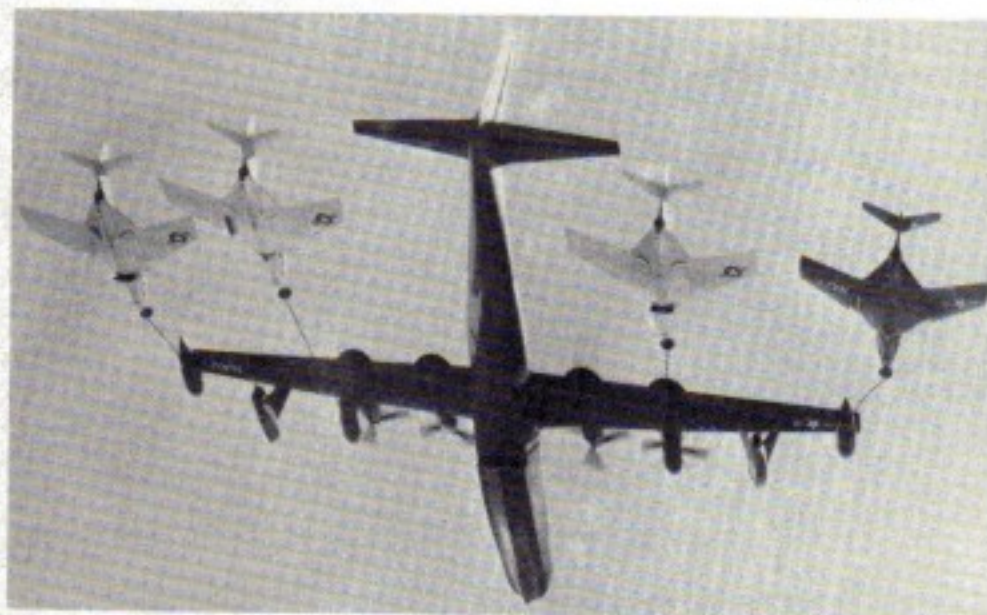
The BRAVE-200 can be used for any number of missions, including electronic counter measures, defence suppression and reconnaissance. The vehicle is surface launched from a train, truck, or ship. Zero-length rocket assisted launch was chosen for simplicity, reliability, and rapid fire rate. Total payload, including fuel is approximately 110 lb (50 kg). Range will depend on payload of the hardware for a particular mission, however, ranges in excess of 400 miles (640 km) are achievable.



Sargent-Fletcher Company has been active in aerospace technology since its organisation in 1940. Top level engineering and manufacturing specialists have made the company a US leader in the design, development and production of aircraft external fuel tanks and probe-and-drogue refuelling systems.

To date the company has built and delivered over one million fuel tanks of various types and capacities as well as a large number of special purpose instrumentation pods for installation and in-service use on high performance military jet aircraft.

Sargent-Fletcher Company has been specifically engaged in the field of aerial refuelling since 1952 when the company initiated the design and development of the first hydraulically powered, servo controlled hose reel assembly. This



US Navy R3-Y flying boat with four wing-mounted refuelling hose reels in 1956



A French Air Force Transall refuelling a Jaguar using a Sargent-Fletcher centreline hose reel

assembly was produced and installed on the Convair R3Y seaplane, two per wing or four per tanker. Sargent-Fletcher delivered 11 ship sets or 44 hose reel assemblies with individual control panels.

Also during the mid 1950s, the company designed a 900 gallons per minute hose reel assembly for installation in the Boeing B-47 Stratojet. On this aircraft the all metal 32in diameter drogue was found to be unstable at speeds above Mach 0.56. Sargent-Fletcher Company invented



F-100 Super Sabre with a 'Buddy' refuelling system under the port wing supplying an RF-101 Voodoo

the paradogue to replace the then standard all metal drogue which solved the problems of high speed refuelling and, in addition, reduced the stowage requirements from 32in to 12in diameter (the paradogue immediately became the accepted standard for all probe/drogue refuelling systems).

Today Sargent-Fletcher's prominence in hose-and-drogue aerial refuelling is seen in such widely used systems as those in the HC and KC-130 series Hercules, the US Navy KA-6D and S-3 and

the USAF's KC-10A. The Sargent-Fletcher 'buddy' store concept is in use on the Navy's A4, A6 and A7 as well as the Panavia Tornado fighter. A centreline installation developed for use in the upgraded KC-135 programme has been successfully tested by the USAF. A three point system similar to the 707 installation and a revised 'Buddy' system are being produced for the Israeli Government and the Singapore Air Force respectively.



An HC-130P Hercules refuels a CH-3E helicopter

The combined resources of the specialist companies within the THORN EMI Electronics product group demonstrate an impressive breadth of capability in the demanding fields of avionics and aerospace. To date, a wide range of products and systems from these companies are fitted in over 80 aircraft types worldwide.

THORN EMI Electronics' main areas of achievement in this important market sector are centred on such technologically demanding fields as aircraft systems; weapon systems; space vehicles; satellite communications; aircraft instrumentation sensors and transducers; and the company has built up an enviable capability in command, control, communications and intelligence (C3I) systems which it supplies to the UK MoD and NATO.

Aircraft systems currently being supplied include the Searchwater maritime surveillance and airborne early warning radars, which are installed on RAF Nimrods and RN Sea Kings respectively. Maintenance-free pneumatic fire and overheat detection systems are also available and are fitted to a great many military and civil aircraft including the new Boeing 757 and 767.

THORN EMI Electronics is Europe's leading manufacturer of proximity fuzes for munitions, ordnance and guided weapons. The company designs and supplies fuzes for a wide variety of weapon systems including Sky Flash, Sea Wolf, Sea Dart and Alarm—the RAF's new anti-radar missile. The company is also the UK national prime contractor in the multinational team which is currently developing a terminally-guided warhead for the Multiple-Launch Rocket System (MLRS).



Sea King AEW with Searchwater radar

In the world of space, THORN EMI Electronics is a major supplier of high reliability inertial systems, sub-systems and sensors for a large number of applications on a variety of spacecraft including the Space Shuttle and Delta launch vehicles. Linear acceleration sensors are supplied for Skylab, Spacelab, Intelsat V and VI, Geos, Meteosat and Galaxy satellites and THORN EMI also supplies space qualified photomultipliers, image intensifiers, klystrons and specialised plastic scintillator mouldings.

The company also offers a broad selection of ground communications equipment for satellite earth stations.

Flight systems often require highly specialised ground support instruments and test sets. To meet this requirement a broad range of standard equipment is

provided which finds widespread applications for the commercial and military avionics market.

The successful application of advanced computing techniques to military communications has led THORN EMI Electronics into the complex and demanding areas of command, control, communications and intelligence (C3I) systems provided in this area include the powerful ground-based mission support systems to support the RAF's maritime surveillance operations with Nimrod MR2 which feature the fastest processing of acoustic data of any system in the world. Others include a radar integration system for NATO in Denmark and a data link buffer for UK MoD to process radar data transmitted to the ground from airborne early warning aircraft for input to the UK air defence ground environment.



Searchwater operator in the Sea King

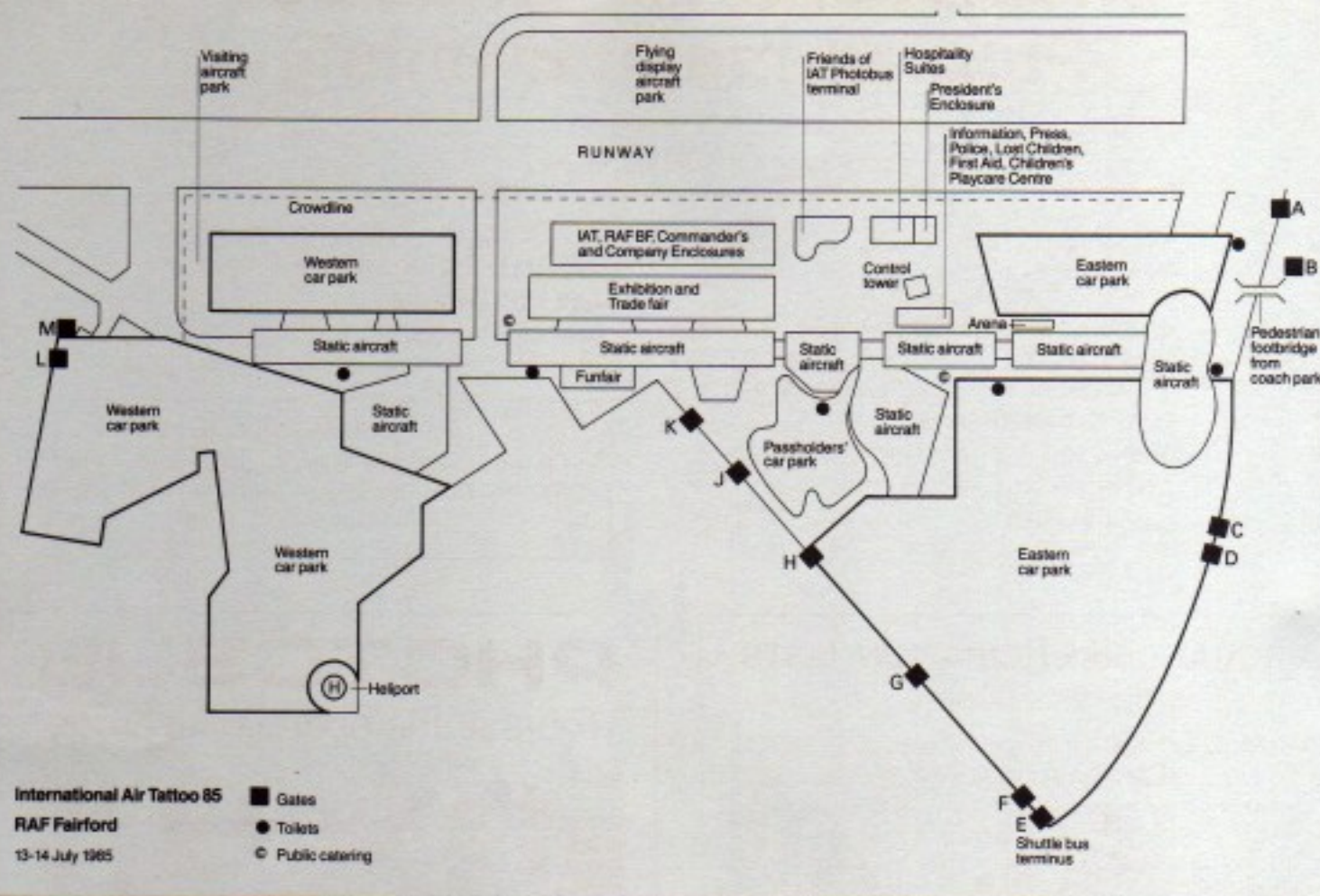


The Mission Support System for the RAF



# International Air Tattoo 85 Static Aircraft on Display

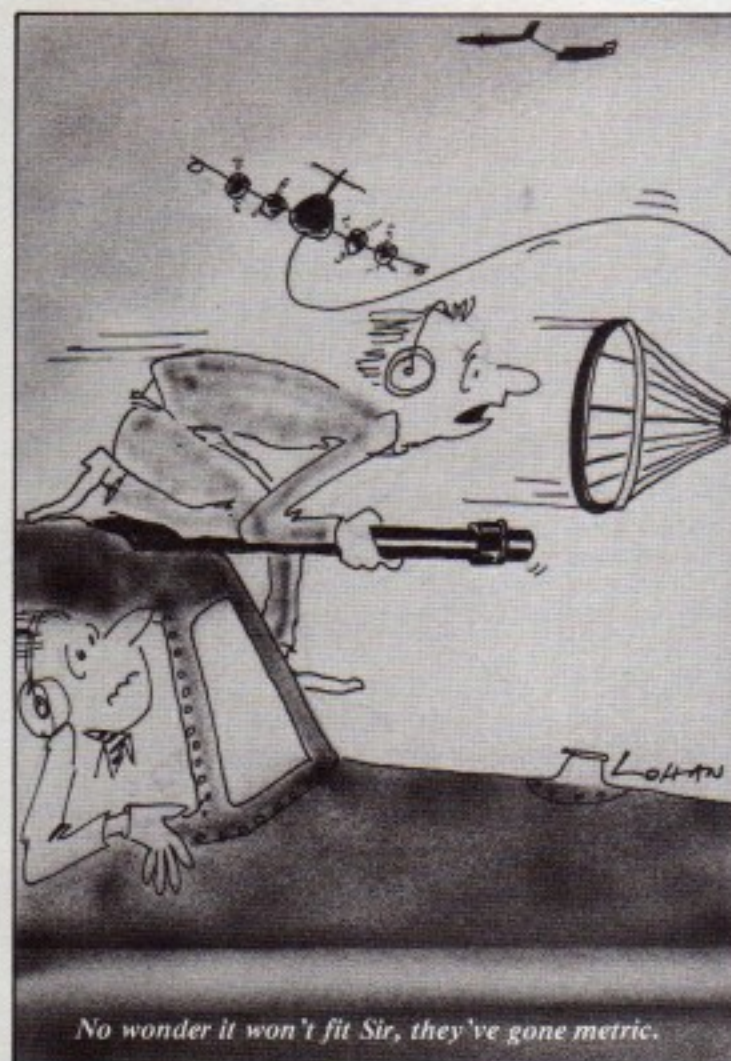
It is hoped that the following aircraft will be available to take part in the static aircraft displays here at Fairford.



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## ROYAL AIR FORCE

Harrier GR3 (233 OCU)  
Phantom FGR2 (56 Sqn)  
Jaguar GR1A (41 Sqn)  
Buccaneer S2 (12 Sqn)  
Lightning F3/6 (LTF)  
Hawk T1 (4 FTS)  
Chipmunk T10 (6 AEF)  
Bulldog T1 (Northumbrian UAS)  
Dominie T1 (6 FTS)  
Jetstream T1 (6 FTS)  
Jet Provost T3/5 (7 FTS)  
Nimrod MR2 (42 Sqn)  
Victor K2 (55/57 Sqn)  
VC10 K2 (101 Sqn)  
Tornado GR1 (27 Sqn)  
Hercules C1P (Lyneham Transport Wing)  
Canberra T17 (360 Sqn)  
Hunter T7 (237 OCU)  
TriStar C1K (216 Sqn)

## ROYAL NAVY

Sea Harrier FRS1 (899 Sqn)  
Canberra TT18 (FRADU)  
Wessex HU5 (845 Sqn)  
Hunter T8M (899 Sqn)  
Sea King HC4 (707 Sqn)  
Wasp HAS1 (829 Sqn)  
Jetstream T2 (750 Sqn)

## ARMY AIR CORPS

Lynx AH1 (Army Air Corps Centre)  
Gazelle AH1 (Army Air Corps Centre)

## MINISTRY OF DEFENCE (Procurement Executive)

Varsity T1	Hunter T7
Comet 4	Sea King
BAC 1-11	Gazelle
Canberra	Lightning
Viscount	Hawk T1
BAe 125	Basset CC1
Hercules W2	Phantom FG1
Harvard T2B	

## BELGIAN AIR FORCE

SIAI SF260MB (EFS)  
Mirage VB (3 Wing)

## CANADIAN ARMED FORCES

CF-104 Starfighter (421 Sqn)  
CT-133 Silver Star (Base Flight Sollingen)

## FRENCH AIR FORCE

C160NG Transall (ET64)

## FRENCH ARMY

Puma (6 RHC/EHM3)

## FRENCH NAVY

Super Etendard  
SA321 Super Frelon  
Nord 262

## GERMAN ARMY

Bell UH-1D (LHFT-10)  
Sikorsky CH-53G (MHFT-15)

## GERMAN AIR FORCE

F-104G Starfighter  
F-4F Phantom (JG71/JBG35)  
RF-4E Phantom (AKG51)  
Tornado (JBG31)  
Alpha Jet (JBG49/JBG43)

## GERMAN NAVY

Tornado (MFG1)  
F-104G Starfighter (MFG2)  
Sea King Mk41 (MFG5)

## GERMAN FORCES TEST AIRCRAFT

F-4F Phantom (EST61)  
F-104G Starfighter (EST61)  
OV-10 Bronco (Rheinflugzeugbau)  
Fiat G-91T (Condor Flug)  
Canberra B2 (MilGeo)

## ITALIAN AIR FORCE

Aeritalia G222 (46 Aerobrigata)  
F-104S Starfighter (5 Stormo)

## ROYAL DANISH AIR FORCE

F-104 Starfighter (726 Sqn)  
F35 Draken (729 Sqn)  
F-16B Fighting Falcon (727 Sqn)

## ROYAL NETHERLANDS AIR FORCE

F27M Troopship (334 Sqn)  
F-16 Fighting Falcon (322/323 Sqn)  
Northrop NF-5 (316 Sqn)

## ROYAL NORWEGIAN AIR FORCE

Northrop F-5 (336 Sqn)  
C-130 Hercules (335 Sqn)

## UNITED STATES ARMY

CH-47C Chinook (11th AVN GRP)  
UH-1H Huey (11th AVN GRP)  
AH-1S Cobra (11th AVN GRP)  
OH-58A Kiowa (11th AVN GRP)  
UH-60A Blackhawk (11th AVN GRP)  
OV-10 Mohawk (VII Corps)  
RC-120 Super King Air (VII Corps)

## UNITED STATES AIR FORCE—

Air Force Communications Command  
North American CT-39A (1868 FCS)

## USAF—Air Training Command

Boeing T-43A (323 FTW)

## USAF—Europe

HC-130P Hercules (67 ARRS)  
Sikorsky HH-53 (67 ARRS)  
F-4E Phantom (57 FIS)  
Sikorsky CH-53C (20 TASS)  
F-16B Fighting Falcon (401TFW)  
GD F-111E (20 TFW)  
GD EF-111A Raven (42 ECS)  
A-10A Thunderbolt II (81 TFW)  
F-15 Eagle (36 TFW)  
F-5E Tiger II (527 AS)  
RF-4C Phantom (1 TRS)  
F-4E Phantom (52 TFW/86 TFW)  
F-4G Phantom (52 TFW)  
C-9A Nightingale (55 MAS/58 MAS)  
C-12F Super King Air (58 MAS)  
C-21A King Air (58 MAS)  
C-23A Sherpa (10 MAS)  
MC-130E Hercules (7 SOS)  
VC-140B Jetstar (58 MAS)

## USAF—Reserve

C-130A Hercules (440 TAW)  
HC-130H Hercules (305 ARRS)  
KC-135A Stratotanker (452 ARW)

## USAF—Air National Guard

KC-135E Stratotanker  
(Ohio/Maine/Pennsylvania)  
C-130B Hercules (179 TAG)  
EC-130E Hercules (193 ECG)  
C-130H Hercules (176 TAG)  
HC-130P Hercules (129 ARRS)

## USAF—Military Airlift Command

C-5A Galaxy  
C-141B Starlifter

## USAF—Strategic Air Command

Lockheed TR-1A (17 RW)  
Lockheed SR-71A (9 SRW)  
KC-135Q Stratotanker (306 SW)  
KC-135R Stratotanker (384 ARW)  
KC-135A Stratotanker  
RC-135 Stratotanker (306 SW)  
KC-10A Extender (2 BW)  
B-52G Stratofortress (416 BW)

## UNITED STATES NAVY

P-3C Orion (VP-45)  
C-130F Hercules (VR-24)  
Beech UC-12B (NAF Mildenhall)

## CIVILIAN AIRCRAFT

DH Devon	Messenger
Metro II	Gemini
Seneca	F4U Corsair
Optica	Steamer
Learjet	F-100F Super Sabre
Viima	

## DOUGLAS DC-3 DAKOTAS

DC-3 Air Luton  
R-4D Confederate Air Force  
DC-3 Dutch Dakota Association  
DC-3 Hibernian Dakota Association  
DC-3 Transvalair  
C-47 Royal Aircraft Association  
DC-3 Aces High  
DC-3 Air Atlantique  
C-47 Basler Airlines  
DC-3 Foreningen Flygende Veteraner  
DC-3 Swedair



Wheels! Wheels! It's all I ever see at the Air Tattoo.



# International Air Tattoo 85 Flying Programme

The organisers of IAT 85 reserve the right to alter the programme according to the availability of aircraft, aircrew and the weather conditions prevailing at the time.

Item	DISPLAY	Item	DISPLAY	Item	DISPLAY	Item	DISPLAY	Item	DISPLAY
<b>10.00am</b>		16	<b>Edgley Optica</b> Edgley Aircraft Ltd. Old Sarum	27	<b>Lockheed C-5A Galaxy</b> Military Airlift Command, USAF	38	<b>The Red Arrows</b> <b>9 BAe Hawk T1</b> Royal Air Force Aerobatic Team, RAF Scampton	44	<b>Boeing B-17G</b> <b>Flying Fortress</b> B-17 Preservation Ltd, Duxford
1	<b>2 Boeing KC-135A</b> 11th Strategic Group, USAF, RAF Fairford	<b>12.00 Midday</b>		28	<b>Westland Gazelle HT3</b> Central Flying School (Helicopter), RAF Shawbury	39	<b>Battle of Britain</b> <b>Memorial Flight</b> <b>Avro Lancaster,</b> <b>Hawker Hurricane IIC,</b> <b>Supermarine Spitfire PR19,</b> <b>BAe Tornado F2</b> RAF Coningsby	45	<b>Dassault-Breguet</b> <b>Super Etendard &amp;</b> <b>Etendard IVP</b> French Navy
2	<b>Dornier Do28</b> Naval Air Wing 5, German Navy	17	<b>The Vintage Pair</b> <b>Gloster Meteor T7 &amp;</b> <b>De Havilland Vampire T11</b> Central Flying School, RAF Scampton	29	<b>De Havilland (Canada)</b> <b>Beaver AL1</b> Beaver Training Flight, Army Air Corps Centre, Middle Wallop	<b>4.00pm</b>		52	<b>2 Colomban Cri-Cri</b> Y. Duval Esq.
3	<b>2 Boeing KC-135A</b> 11th Strategic Group, USAF, RAF Fairford	18	<b>General Dynamics</b> <b>F-16A Fighting Falcon</b> 401st TFW, USAF, Torrejon AB	30	<b>Army Air Corps</b> <b>Historic Flight</b> <b>Auster AOP9,</b> <b>Sioux AH1 &amp;</b> <b>Skeeter AOP12</b> Army Air Corps Centre, Middle Wallop	<b>3.00pm</b>		53	<b>Fleet Air Arm</b> <b>Historic Aircraft Flight</b> <b>Fairey Firefly,</b> <b>Hawker Sea Hawk,</b> <b>Hawker Sea Fury &amp;</b> <b>Fairey Swordfish</b> RNAS Yeovilton
4	<b>Morane MS 733 Alcyon</b> Y. Duval Esq.	19	<b>BAe Hawk T1</b> Central Flying School, RAF Valley	31	<b>PBY5A Catalina</b> Plane Sailing Ltd, Barkston Heath	40	<b>Lockheed HC-130P</b> <b>Hercules and</b> <b>Sikorsky HH-53C</b> <b>Jolly Green Giant</b> 67 ARRS USAF, RAF Woodbridge	46	<b>General Dynamics</b> <b>F-16A Fighting Falcon</b> 332 Squadron, Royal Norwegian Air Force
5	<b>A-10A Thunderbolt II</b> 81st TFW, USAF, RAF Bentwaters	20	<b>Skytanker Formation—</b> <b>VC10 K2, Hercules C1K,</b> <b>Victor K2, TriStar C1K</b> RAF Brize Norton, RAF Lyneham & RAF Marham	32	<b>Lockheed C-141B Starlifter</b> Military Airlift Command, USAF	41	<b>General Dynamics</b> <b>F-15C Eagle</b> 36 TFW, USAF, Bittburg AB	47	<b>Douglas DC-3 Dakota</b> Aces High Ltd, Duxford
6	<b>BAe Concorde</b> British Airways	21	<b>Lockheed Hercules C1</b> Joint Air Transport Establishment, RAF Brize Norton	<b>2.00pm</b>		42	<b>DHC Dash-7</b> 412 Squadron, Canadian Armed Forces, Lahr	48	<b>4 Lockheed</b> <b>F-104G Starfighters</b> Starfighter Support Unit, German Air Force
7	<b>Skyship 600 &amp; Skyship 500</b> Airship Industries	22	<b>Mitsubishi Zlin</b> <b>Zlin Z50L</b> V. Norman Esq. Kemble	33	<b>Westland Lynx AH1</b> Lynx Conversion Flight, Army Air Corps Centre, Middle Wallop	43	<b>Royal Jordanian Falcons</b> <b>3 Pitts S2 Special</b> Alia Airlines, Amman, Royal Hashemite Kingdom of Jordan	49	<b>The Sharks</b> <b>4 Westland Gazelle HT2</b> 705 Squadron, RNAS Culdrose
8	<b>Westland Sea King HAR3</b> RAF SKTU, RNAS Culdrose	23	<b>Alpha Jet</b> 9 Squadron, Belgian Air Force	34	<b>General Dynamics</b> <b>F-16A Fighting Falcon</b> Leeuwarden AB, Royal Netherlands Air Force	<b>6.00pm</b>		50	<b>Fokker F27M Troopship</b> 334 Squadron, Royal Netherlands Air Force
9	<b>Transall C160D</b> LTG 61 German Air Force	24	<b>Westland Lynx HAS1</b> 702 Squadron, RNAS Portland	35	<b>Messerschmitt-Bolkow-</b> <b>Blohm BO105P</b> Heeresflieger Regiment 16, German Army	51	<b>BAe Sea Harrier FRS1</b> 899 Squadron, RNAS Yeovilton	54	<b>De Havilland Mosquito T3</b> British Aerospace, Chester
<b>11.00am</b>		25	<b>The Vikings</b> <b>2 Lockheed F-104G</b> <b>Starfighters</b> Naval Air Wing 2, German Navy	<b>2.15pm</b>				54A	<b>Alpha Jet</b> 9 Squadron, Belgian Air Force
10	<b>UNIPART DUO,</b> <b>2 Fournier RF4</b> ASDS Ltd. Biggin Hill	<b>1.00pm</b>		36	<b>The Red Arrows</b> <b>9 BAe Hawk T1 &amp;</b> <b>BAC Concorde</b> Royal Air Force Aerobatic Team & British Airways			55	<b>Pilatus PC-9</b> Pilatus Aircraft Company, Switzerland
11	<b>BAC Jet Provost T5A</b> No. 1 FTS RAF Linton-on-Ouse	15	<b>The Grasshoppers</b> <b>4 Alouette III</b> 300 Squadron, Royal Netherlands Air Force	37	<b>BAC Concorde</b> British Airways, London (Heathrow) Airport			56	<b>Vulcan Display Team</b> <b>HS Vulcan B2</b> RAF Waddington
12	<b>TOYOTA Pitts Special</b> <b>Pitts S2S</b> Firebird Aerobatics Ltd. Denham							57	<b>Boeing KC-135A &amp;</b> <b>3 General Dynamics</b> <b>F-111F</b> 11th Strategic Group, USAF, RAF Fairford/ 48th TFW USAF, RAF Lakenheath



## International Air Tattoo 85 Souvenir Programme

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The first DC-3/Douglas Sleeper Transport to fly.

Without doubt one of the most famous aircraft types ever built is the Douglas DC-3 (Douglas Commercial-3) which, on 17 December 1985, reaches the 50th anniversary of its maiden flight from Santa Monica, California. International Air Tattoo 85 celebrates this unique landmark in aviation history with a special 50th Anniversary Dakota Meet.

Little could Arthur E. Raymond, designer of the DC-3, have realised that besides becoming the most successful airliner of its time, his creation would also be the most widely used military transport aircraft in the history of aviation. Confederate Air Force Colonel J. T. S. Preston looks back at half a century of the DC-3.

Donald Douglas, proprietor of a small firm with a solid military and airmail reputation, took on the task of developing a new airliner for TWA to compete with American Airlines' successful Boeing 247. His first effort, the Douglas Commercial Model Number 1, was a giant step forward. It was fast, had long range, retractable landing gear and wing flaps which enabled it to land in short fields. While most airline safety specifications called for three engines, the new Douglas airliner proved capable of flying on either one of its two air-cooled power plants.



In the beginning the Douglas Commercial No 1.

While the DC-1 was an instant technological success, it still suffered from a serious economic handicap. It would not make a profit carrying passengers alone. Consequently only one DC-1 was built. Douglas didn't quit there, however. Shortly after the DC-1 came the DC-2. Somewhat larger, it was built in quantity. While far advanced compared with the Boeing 247, it still would not turn a profit carrying passengers only. No mail—no money! But otherwise, the DC-2 flew to a well-deserved place in history.

In the early 1930s, American Airlines placed specifications with the Douglas Company for a fast, long-range sleeper transport to replace the elderly Curtiss Condors. Douglas engineers stretched the DC-2 once more and rolled out the Douglas Sleeper Transport, or DST as American Airlines called it, making its first flight at Santa Monica on 17 December 1935. It enabled the transcontinental traveller to sleep comfortably for

many of the 16 hours still required for a US coast to coast flight. It was not long before a companion aircraft with seats and no bunks was offered to airlines. This was named the DC-3 and a legend was born.



The DC-2 followed in 1934.

Shortly, all major US airlines and a surprising number of foreign airlines, ordered the new Douglas transport. It was fast and comfortable. Public acceptance was dramatic. Almost overnight, the number of people who had flown in any transport reached into the millions. Confidence grew both on the part of the passengers and the crews. The DC-3's broad wings opened the door to air transportation throughout the world. Panagra began service up and down the South American continent. KLM used its DC-3s to serve its far-flung routes from Europe to the Dutch East Indies. If the DC-3 revolutionized the passenger business, it also started the air freight industry.



DC-3s revolutionised pre-war airline operations.

As war clouds began to gather, there was scarcely a major airport in the world which did not count the ubiquitous Douglas transport among its traffic. And it was still in production even though most major companies had four-engined, longer ranged, and larger transports on their drawing boards and in their development hangars.

Almost since its beginning, the Douglas Aircraft Co. built both civilian and military aeroplanes. The Army Air Corps and the US Navy were among its customers. Most military officers tended to think first of fighters and bombers but they did not completely neglect transports. A small number of Douglas C-33s joined the US Army Air Corps. These were DC-2s with modifications to suit them to a cargo role. Brigadier General Hap Arnold convinced Congress to purchase 35 C-39s, a Douglas transport with features of both the DC-2 and the DC-3.

With the outbreak of war Douglas transports from many airlines were pressed into military service. When called to military duties, each version of the famous airliner was assigned a different designation. Thus there were C-48s, C-49s, C-50s and so on up through the C-53. All were just variations upon the well-known DC-3.



A USAAC C-48 which had been in service with United Airlines before the war.

If the airlines specified differences among their aeroplanes, the military was even more demanding. All in all, more than 50 different versions of the DC-3 took to the skies in WW2. Few aeroplanes of any type were as versatile as this erstwhile transport. Without question however, the best-known and most common version was the C-47 (or R4D as it was called when operated by the US Navy). Douglas publicity men preferred to have it called the Skytrain. In a USAAF troop carrier role, it was known as the Skytrooper, and when operated by the RAF it was called the Dakota.

Whatever its name, the C-47 earned a reputation with those who flew it and with those who depended upon it for supply and evacuation, unmatched by any aeroplane before or since. It became almost a universal flying machine. Designed as a transport, it carried troops and supplies in every part of the world. It also served well as a large multi-engined training aircraft. One version was equipped with floats and became a large



RAF Dakotas were used for supply dropping in the Far East

amphibious transport. Another version was equipped with skis. Still another version had the engines removed and became what was then the world's largest glider!

Stock C-47s were even more varied in their operational roles. Many towed gliders. The skies over the Normandy beaches were darkened for miles with C-47s towing gliders to support the invasion. This, plus the resupply support caused General Eisenhower, the Supreme Allied Commander, to call the Douglas transport, "one of our most important secret weapons".

The US Navy equipped its R4Ds for anti-submarine work with the then top-secret radar. Others were used for mine-laying. Cargo was as varied as the missions. C-47s carried countless troops and untold tons of ammunition. But they also carried rations, bull-dozers, aircraft parts, mules, wounded soldiers, refugees and in fact anything which could be loaded inside the door. In some cases, they carried things which wouldn't even fit inside... They carried complete aircraft wings strapped under the belly!



C-47A "The Argonia", ready to load Paratroops of the 307th Engineer Battalion, 82nd Airborne Division, at Balderton Field near Newark-upon-Trent, 17 Sept 1944

The capacity was also astounding. The original airliner was designed to carry 21 passengers and a crew of three. One emergency evacuation from China had on board 60 known passengers, and a crew of four. However, unknown to the crew were eight stowaways in the tail, for a grand total of 72 people on board a 24 passenger aeroplane.





USAAF C-47s heading in formation towards the French coast during Operation 'Overlord'.

By 1945, more than 10,000 DC-3s, C-47s and R4Ds had been built. That is more than any other aeroplane of its type before or since. Nor is it likely that that record will ever be matched. Even then Douglas Aircraft Co. made a valiant effort to revive the historic transport. It upgraded the engines to new, more powerful Wrights. Flush rivets were used in an attempt to cut the drag. The fuselage was stretched and with it, a new enlarged tail appeared. The wheels, previously hanging out in the slipstream, were fully enclosed within new landing gear doors. But it was not enough. The aeroplane just could not compete with the new Martin and Convair transports.

Just three of these *Super* DC-3s were initially released to the civilian market. But the US Navy liked them and ordered a number for Navy and Marine Corps use. They were given a new designation (C-117D) and soldiered on to the late 1970's when the last were finally retired. Virtually no other aeroplane and few military pieces of equipment of any type can boast an operational life of 40 years. Nor is their military life completely over. C-47s and C-117s are still operational with many smaller air arms around the world, and it is likely that they will remain so for some years to come.



A US Navy 'Super Dakota'.

Most military planes and vehicles quietly become obsolete in military forces. They slip from first line units, to second line, then to training, and finally out of the inventory. Not so with the DC-3. If anything, its history became even more colourful after WW2.

A Navy R4D made good use of the skis developed for it in WW2. It became the first plane to land at the South Pole and subsequently the first to land at both Poles. Rockets had been developed to assist its take-off, and these further extended the ability to get off the ground under difficult circumstances.



The ski and rocket equipped 'Que Sera Sera' in Antarctica.

Three decades after it joined the USAAC, it finally became a combat aircraft. During the Vietnam War, special rapid-fire machine guns were mounted firing through the side windows. The aircraft then became a nightfire support weapon. Crew members would kick very bright parachute flares from the cargo door. The pilot would fly lazy circles around the suspected target

and aimed through a special side window sight. If the process sounds cumbersome, it was not. The effects were deadly. "Puff the Magic Dragon" as it was dubbed was feared by the Viet Kong.



DC-3s are operated by Air Atlantique and Air Luton in the UK.

What about the DC-3s today? Some are still in airline service in developing nations. Few aeroplanes can carry cargo and passengers to remote dirt strips found in many parts of the world. But the DC-3 can. And it probably will for the foreseeable future. A few C-47s and R4Ds have gone to a well-earned repose in military museums around the world. There they can be admired by throngs of visitors who marvel at this historic transport. Several airlines and national museums have done the same thing with their old DC-3s.



The last Dakota in RAF colours is the RAE's ZA947.

Various historians have put together lists of the all-time greatest aeroplanes in history. Most include the Wright Flyer and many include various fighters and bombers from the World Wars. Some include rocket planes and even the orbiting space shuttle. But no list can be considered complete without a special niche for that greatest of all transports, the Douglas DC-3. May it fly on forever...

#### Page Engineering Co. Ltd. — sponsors of the DC-3 Dakota Meet.

The Page Engineering Company Limited is a long established Aerospace and Defence electronic equipment company and is a member of the fast growing AB Electronic Products Group PLC. Page is a high technology company and its products, which are mainly related to aircraft cockpit systems, will be found on many of the aircraft on-show at the IAT. For example, the Tornado is fitted with Page Central Warning Systems, a cockpit display installed in both cockpits which displays aircraft systems status to the crew. Similar warning displays are fitted to the *Red Arrows'* British Aerospace Hawks, Westland Lynx and Sea King and the VTOL Harrier. Additionally, both the VC10 and Tri-Star tankers are fitted with a wide range of Page lighting control and switching systems. In fact, today Page is supplying a wide range of electronic cockpit associated systems to Aerospace companies throughout the world and its products will be found on nearly half the aircraft on display at the IAT.

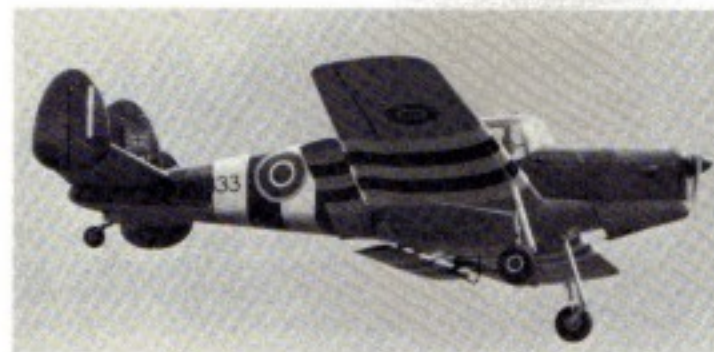
For the future, Page is already developing new advanced technology systems and this year has announced major contract successes including orders for the new Saab Gripen multi-role combat aircraft.

In sponsoring the Douglas DC-3/C-47 Meet, Page recognises the significance that the Dakota has played in the development of air transport and which for many third world countries is still a major element in their transport systems. Few transport aircraft will be remembered with such affection as the Dakota and its length of service to mankind is unparalleled in aviation history.

For the future, Page and the all British parent company, AB Electronic Products, who like the Dakota are also celebrating their Golden Jubilee in 1985, sees Britain playing an increasingly important role in the supply of advanced technology electronic systems to the world's Aerospace industries.

## On display—Warbirds

Look out for these veteran warbirds in the flying and static displays.



Miles Messenger—James Buckingham



Fairey Firefly—RN Historic Flight



Douglas Dakota—Aces High Ltd.



B-17 Flying Fortress—B-17 Preservation



DeHavilland Mosquito—British Aerospace PLC



Valtion Viima—Paul McConnell



North American Harvard—MoD(PE)



Consolidated Catalina—Plane Sailing Ltd.



# Royal Air Force front-line aircraft—on display

The Royal Air Force is making a major contribution to the large static aircraft display. In the air too you will see the RAF in action.

## Phantom

The Phantom is the standard RAF air defence fighter in Strike Command and RAF Germany. Its two powerful Rolls-Royce Spey 202 turbojets can each generate 20,515 lb of thrust with reheat to give the Phantom a Mach 2 plus performance.



The FG Mk 1 was originally designed as a naval interceptor, but entered service with the RAF in 1968, supplementing the Lightnings at RAF Leuchars in Scotland.

The FGR Mk 2 also entered service in 1968 and, was operated in the strike/attack and reconnaissance roles. It is now used as an air defence fighter in the UK alongside the FG1s and remaining Lightnings, and in Germany.

## Jaguar



The Anglo-French Jaguar entered RAF service in 1973 and replaced the Phantom FGR2s previously used by the strike and reconnaissance squadrons of RAF Germany and Strike Command.

Powered by two Rolls-Royce/Turbomeca Adour engines, the Jaguar was built by the BAC/Breguet consortium SEPECAT. Two RAF versions are in service—the single seat GR1 and the two seat T2.

Designed specifically for low level strike missions, the Jaguar is capable of Mach 1.6 and can carry up to 8,000 lb of bombs or rockets on its five external pylons. Two 30 mm Aden cannon are carried internally.

An important feature of the Jaguar is its highly advanced and automated navigation and attack system. Its 'chisel' nose contains the Laser Ranging and Marked Target Seeking equipment. In addition to an on-board computer, there is a moving map and head-up display which projects flight and target location data directly into the pilot's line of vision.

## Tornado



Jointly produced in Britain, Germany and Italy, the first Tornado flew in August 1974. It features many advanced design features such as swing wings, highly economical turbo-fan engines and the most up-to-date navigation and attack systems available. It is capable of all-weather day and night operations with particularly good capabilities at low level.

There are two basic versions for RAF use—an interdictor strike (IDS) aircraft and an air defence variant (ADV), the latter entering service early next year.

The Tornado is a comparatively small aircraft, yet with wings extended it can lift a very heavy weapon load from a short runway. Once airborne the wings are swept to suit the flying speed, the wing pylons turning to remain parallel to the fuselage.

In turbulent air at low altitude fully swept wings give Tornado high speed and stability for strike missions.

In any weather, day or night, the Tornado can penetrate enemy territory at tree top height, automatically dodging hills and obstacles. With its terrain following radar and advanced navigation and attack computer it makes a formidable bomber.

## Harrier



The British Aerospace Harrier was the world's first fixed wing vertical/short take-off combat aircraft. Capable of operating from small natural clearings close behind a battle area, the Harrier has been designed to provide close support for ground troops.

Five weapon pylons—four underwing and one below the fuselage—enable the Harrier to carry up to 5,000 lb of weapons in various combinations of free fall, retarded and cluster bombs or rocket projectiles. In addition two 30 mm Aden cannon can be mounted in external fuselage pods.

The Harrier first entered RAF service in 1969 and serves in the UK and with RAF Germany. The GR Mk 3, with the latest series Pegasus engine, generates 21,500 lb thrust and gives the aircraft a speed of Mach 0.95 in level flight. The Harrier has been fitted with an extended nose containing a Laser Ranging and Marked Target Seeker (LRMTS) to improve its close support capability.

Although designed as a close support aircraft, the Harrier is capable of outmanoeuvring many faster conventional fighters by using its vectored thrust nozzles to reduce its turning radius.

## Nimrod



Based on the Comet 4C airliner, the Nimrod is one of the world's most sophisticated maritime reconnaissance aircraft. Its four Rolls-Royce Spey engines can take it quickly to patrol areas far out in the Atlantic or the North Sea. Once on station two engines can be shut down and the Nimrod can patrol for long periods, submarine searching with its electronic equipment. The sonobuoys which can be dropped give the precise location of underwater vessels and, if required, the Nimrod can attack with homing torpedoes carried in its large weapons bay. In peacetime the Nimrod carries out very efficiently the task of off-shore fishery protection.

## Wessex



Powered by two Bristol Siddeley Gnome turboshaft engines, the Wessex can lift a payload of 3,000 lb, either in the cabin or slung below the fuselage. For a helicopter it features a long range performance of 290 miles at 115 kt. It is equally useful in a short distance 'shuttle' role as it can carry up to 14 troops or, for aeromedical duty, be equipped with eight stretchers. RAF Wessex helicopters also provide a valuable Search and Rescue service around Britain's coasts and mountain regions.

## Vulcan



The Vulcan was the RAF's last long range strategic bomber. Apart from its nuclear capability, the Vulcan's ability to carry up to twenty-one 1,000 lb bombs over a considerable range at low level and to attack accurately at night or in any weather made it a formidable offensive aircraft. Powered by four Bristol Siddeley Olympus turbojets, the first Vulcan entered RAF service in 1957. It was finally replaced by the Tornado in 1982, despite a return for Falklands operations.

## Victor



Previously used as part of the RAF's V-bomber force, the Victor was converted to an air-to-air refuelling tanker, an important role in Britain's air defence system. If an RAF interceptor is

scrambled a Victor will often take off as well, to rendezvous with the fighter and 'top it up' with fuel. This gives the fighter the extra endurance and range so valuable on interception missions. With a crew of five, the Victor is easily recognisable by its crescent shaped wings. These tankers are now supplemented by the newly converted VC10 K2s (below).



VC10 K2

It is also hoped that the following RAF aircraft will be participating:



BAe Hawk T.1



BAe HS125 C3

## Buccaneer



The Buccaneer is a highly effective long range, low-level strike/attack aircraft. It has a two man crew and is powered by two Rolls-Royce Spey turbojets, each generating over 11,000 lb thrust. In addition to its nuclear capability the Buccaneer can carry a wide range of weapons internally or on wing pylons, including 1,000 lb bombs, rockets and Martel air-to-surface missiles. It is used in both the overland and maritime roles.



# On display— The United States Air Force

The USAF is participating in all aspects of International Air Tattoo. Skytanker 85 is dominated by the huge number of KC-135 Stratotankers and the KC-10 Extenders. In the air you can see the Lockheed SR-71 reconnaissance aircraft, the A-10 Thunderbolt tank-buster, F-15 and F-16 fighters together with an in-flight refuelling demonstration by KC-135 and F-111 aircraft. Many more types are lined up in the static display including aircraft flown over to Fairford from the USA by the Air National Guard, Air Force Reserve, Strategic Air Command and Air Training Command.



Stratotanker and F-111s.



Boeing T-43



F-15C Eagles



C-5A Galaxy



F-5E Tiger IIs



A-10 Thunderbolt II



A-7E Corsair II



RF-4C Phantom

# On display . . .



F-16—Royal Norwegian Air Force



Vikings Starfighters—West German Navy



Boeing E-3A—NATO



Etendard IVP—French Navy



Grasshoppers Alouette IIs—  
Royal Netherlands Air Force



Aeritalia G222—Italian Air Force

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# On display—aerobatics

## Unipart Aerobatic Team

One of the more original airshow display items to emerge in recent years is the Fournier RF4 Duo flown by John Taylor and Brendan O'Brien. It all started in the 1983 season and, during 1984, the Duo flew more than 60 displays at events in the UK, Eire and five European countries. The Fournier RF4 is essentially a powered glider. It has a wingspan of 40ft and is powered by a 39hp/1,200cc Volkswagen engine. The airframe is very strong, allowing high G loads for a sailplane wing of up to +6 and -3 and a maximum speed of 160mph. The Duo's sequence blends a combination of synchronised and opposition manoeuvres, including a unique 'gliding inverted mirror'. As the RF4 has no inverted fuel system this tricky formation has to be skillfully executed, with the top man relying on a 100mph glide, without power, and the aircraft below carefully nursing airbrakes to adjust its position, all just 3ft apart.



The display is designed around a specially chosen piece of music—part of 'Wish You Were Here' by Pink Floyd. This is a particularly evocative and haunting melody and the whole impression is one of an elegant and flowing aerial ballet. The attractive wing-tip smoke system, designed especially for the team, contributes to this effect; the double smoke trails linger in satisfyingly symmetrical tram lines, tracing the paths of the aircraft, undisturbed by vortices or exhaust.

Leader of the Unipart Duo is Brendan O'Brien who has an extensive aviation background which includes ballooning, hang-gliding, parachuting and long-distance ferry flying. He has flown with both the Rothmans and Marlboro aerobatic teams as well as performing solo aerobatics. Wingman John Taylor is now in his eighth season as a display pilot. He first flew with the Tiger Club, leading the Turbulent team and flying in the Stampe Duo. Subsequently, he went on to solo aerobatics in the Ford Pitts and led the Marlboro team in 1981.

## Toyota Pitts Special

An aerobatic display by the Toyota Pitts Special is always a breathtaking attraction. In the hands of display and film pilot Brian Lecomber, the tiny biplane performs manoeuvres such as the *Lomcovak*, in which it tumbles end-over-end, and the *Torque Roll*, where it slides down vertically backwards, rolling at the same time.



One of the most advanced aerobatic aeroplanes in the world, the Pitts Special is to conventional aircraft what a Grand Prix racing car is to a family saloon. Built in America, it weighs less than 1,000 lbs and has a wingspan of 17½ feet. At the end of the first display year in 1981, the aircraft was extensively rebuilt and 'hot-tered up'. Among other modifications, the original 180 hp Lycoming engine was replaced with a tuned 220 hp unit, giving the machine a maximum speed of over 200 mph, along with the capability of performing such exotic manoeuvres as a triple roll whilst climbing vertically upwards.

Brian is one of perhaps a dozen professional aerobatic pilots in the western world. He has led a varied life: at different times he has been a racing mechanic, a journalist, a flying instructor on an island

in the Caribbean, a wing-walker in a flying circus, and a best-selling author of aviation novels. He has won a number of national aerobatic competitions, and will be flying the Toyota Pitts in the next British Aerobatic Championships.

## Mitsubishi Cars Zlin 50L

Local pilot Vic Norman from North Cerney flies the unique Zlin 50L in the colours of Mitsubishi Cars which has its UK headquarters at Cirencester, Glos. Vic is also known as an enthusiastic and successful driver of historic and sports racing cars. He started go-karting as a school boy, graduated up to racing cars, and then even higher to flying the Zlin 50L. He still races his Mk2 Cooper-Bristol car in historic events, when his flying permits.

He started flying in 1965, his first lesson appropriately given by the late Neville Browning of early Zlin fame. He is a member of the British Aerobatic Association and this is his third full season displaying the superb Zlin 50L. Vic is 38 years old and married with three children.

The Mitsubishi Cars' Zlin 50L is manufactured by the world's largest and most successful designer of aerobatic aeroplanes, the Zlin factory in Czechoslovakia. The Zlin has a string of world and European championships to its credit. Following the first appearance of the Z50L at the World Championships in 1976, Ivan Tucek of Czechoslovakia, won the 1978 World Aerobatic Championships in a Z50L, and three Zlins finished in the first eight in the 1982 Championships, first and second in the 1983 European Championships and first in the 1984 World Aerobatic Championships.

Its staggering manoeuvrability and power makes it the finest of all aerobatic planes. Its full-span ailerons and massive elevators also give it an extraordinary rate of roll and pitch, whilst at the same time much of the fascination of the Z50L lies in its extreme agility and character. The construction is of all metal, and built to very high standards of engineering, being immensely strong with operation 'g' limits of  $\pm 9g$  and an ultimate 'g' tolerance of 16.2g.



# International Air Tattoo Awards 1985

Three magnificent trophies will be awarded at IAT '85 for performances in the flying display on Sunday 14 July.

## The SIR DOUGLAS BADER TROPHY presented by SHELL (UK) OIL for the best flying demonstration.

Shell (UK) Oils has kindly agreed to present a special trophy in memory of Sir Douglas Bader (President of IAT 1976—1982) which will be awarded at the International Air Tattoo for the best overall flying demonstration. The trophy will be presented to the pilot or team leader, who, in the opinion of the judges, gives the best overall flying demonstration on Sunday 14 July.

All participants, excluding aerobatic teams of more than six aircraft, and solo jet demonstrations that qualify for the Superkings Solo Jet Trophy will be eligible for the Sir Douglas Bader Trophy.

Participants will be assessed by the judges on the presentation of their aircraft, orientation of display and accuracy of manoeuvres.

The panel of judges will be chaired by Mr. V. A. Hester representing Shell (UK) Oil who will be assisted by Air Vice Marshall B. Huxley, CB, RAF—Deputy Controller, National Air Traffic Services and Mr. G. C. Wilkinson, AFC, CEng, FRAeS—Principal Inspector of Accidents, Accident Investigation Branch, Board of Trade.

The Shell (UK) Oil Trophy was won in 1983 by Captain Karl Zimmerman of the German Army flying a MBB 105.



## The SUPERKINGS SOLO JET AEROBATIC TROPHY presented by Imperial Tobacco for the best solo jet demonstration.

In 1972 Imperial Tobacco generously donated a Solo Jet Trophy, valued at £2,000, to be awarded at the International Air Tattoo for the best solo jet demonstration.

At IAT 85 all single/two seat jet demonstrations in the flying programme on Sunday 14 July will be considered for the award of the Superkings Solo Jet Aerobatic Trophy.

Participants will be assessed by the judges on the same criteria as for the other flying trophies.

The panel of judges will be chaired by a senior representative of Imperial Tobacco, who will be assisted by Mr. Derek Morter—former leader of the RN Blue Herons display team and Major Barney Booi—former F-16 display pilot, Royal Netherlands Air Force.

The Solo Jet Aerobatic Trophy winner in 1983 was Flight Lieutenant M. L. Thompson, RAF, flying a Lightning.



## The INTERNATIONAL DISPLAY SWORD presented by Nationwide Building Society for the best flying demonstration by an overseas participant.

Nationwide Building Society will again present a Wilkinson Crusader Sword, mounted on a teak block and especially commissioned for IAT 85, to the pilot/team leader, who, in the opinion of the judges, gives the best flying demonstration by an overseas participant on Sunday 14 July.

All overseas participants will be eligible for this award.

The panel of judges will be chaired by Colonel D. Mallam, OBE on behalf of Nationwide Building Society, who will be assisted by Major Robert Haas—Austrian Air Force and Captain P. A. Mackenzie, DSO, DFC, FRAeS—Managing Director, American Airlines Training.

Captain Karl Zimmerman, German Army, flying a MBB/105 won the Nationwide Building Society International Display Sword in 1983.

