

# MACH 2

Concorde  
magazine

First flights to USA  
*40th anniversary*

Concorde watch  
*News from Filton and Seattle*

Supersonic successors  
*After Concorde, what next?*



Issue 4  
May 2016

# INTRODUCTION

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*This issue commemorates another milestone in Concorde's history – the 40th anniversary of the first commercial flights to the USA, on 24 May 1976. There had been a fierce political struggle to have Concorde accepted, and there were still major hurdles to overcome, but the landing of Concordes G-BOAC and F-BVFA at Washington Dulles airport began a unique, and so far unrepeated, chapter in commercial aviation.*

*In our main feature, we look at different aspects of that momentous day: the events leading up to that day, an eyewitness view from record-breaking Concorde passenger Fred Finn, and the relationship that later blossomed between the great white bird and the American people.*

*Contributing editor Nigel Ferris also considers the possible next steps in aviation after Concorde, and looks at designs currently taking shape today.*

*As ever, we also include Christopher Orlebar's view from the pilot's seat, and the latest news from the Concorde museums.*

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## Fascinating facts

Nigel Ferris gives an insight into Concorde's prowess and characteristics in supersonic flight, as the aircraft carried her passengers safely and comfortably beyond the speed of sound.

**1** The British and French Concorde's have broken the sound barrier over 50,000 times. The term 'sound barrier' was coined in the early days of high-speed flight, and is a misnomer – there is no such barrier. Early aircraft attempting to travel faster than sound were subjected to buffeting and sometimes loss of control. With aerodynamic development and improvements, when Concorde went into service and regularly achieved high-speed flight, there was no noticeable indication that that point had been reached and passed – other than the indicators at the front of the cabins. Indeed, on one early flight, Captain Brian Walpole announced "Ladies and Gentlemen – Mach 2, 1350 mph – no bumps, no bangs. Concorde".

**2** It took 2.75 seconds for Concorde to travel one mile at Mach 2 at 58,000 feet, or 11 miles high. At this speed the London Marathon could be completed in a mere 1 minute and 9 seconds.

**3** The British Airways fleet of Concorde's has flown over 100,000 supersonic hours – more than all the world's Air Forces put together.

**4** A 'supersonic cycle' (not somebody pedalling madly on a bike!) was the way by which Concorde's flying time was measured. The cycle comprised take-off in ambient conditions, transonic acceleration, supercruise at Mach 2, deceleration to sub-sonic speed, and landing in ambient conditions. A half-cycle was considered to be a flight without going supersonic. Flying hours for the structure and major components was also an important factor, and dictated when all components were due for inspection/overhaul.

**5** At supercruise, when the kinetic heating caused by compression of the air over the sur-

face made the airframe increase in length by 8-10 inches, gaps appeared in certain parts of Concorde's interior. One readily visible gap would open between the flight engineer's control panel and the bulkhead (where the 'hat in the gap' is shown on some of the static displays). Additionally, in front of row 1 was a furnished panel; between this and the sidewall was a gap into which a newspaper could be inserted. When the aircraft returned to ambient temperature, this newspaper could not be removed without tearing.

**6** It used to be said that if a passenger wanted two flights for the price of one, he (or she) could put their hand in the gap by the engineer's panel and leave it there until Concorde landed, when the hand would be trapped. This (farsighted?) passenger would then have to wait until the next supersonic flight to retrieve their extremity!

### Concorde's wings: an ogival curve

The name given to the shape of Concorde's wings is 'ogee'. An ogee (or ogival) shape is a double curve (often used in moulding), shaped somewhat like an S, consisting of two arcs that curve in opposite senses, so that the ends are parallel. This shape has uses in architecture, mathematics, and fluid mechanics.



#### Similar forms

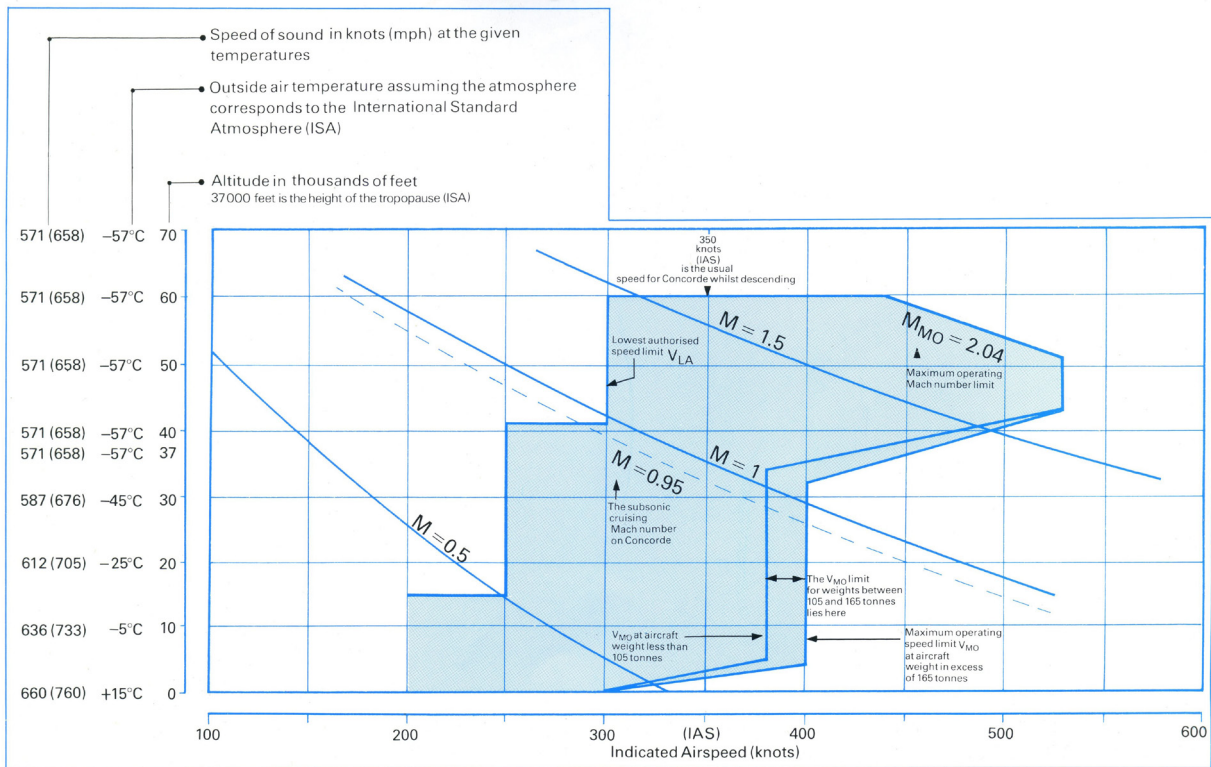
An ogee-arched doorway in Pirna, Germany (left). A similar ogival curve was found to be the most effective shape for Concorde's delta wings. Photos: Norbert Kaiser / Wikimedia Commons; unknown.



# Concorde's flight envelope

Christopher Orlebar, former Concorde pilot with British Airways

A 'flight envelope' shows the limits of Indicated Air Speed (IAS), Mach number and altitude within which a particular aircraft must be flown. Here, Christopher Orlebar describes the boundaries within which Concorde operated during flight and shows why it was so crucially important to observe these limits.



Concorde's flight envelope is presented graphically with indicated airspeed (IAS) on the horizontal (x) axis and altitude on the vertical (y) axis. A copy of it is shown in the appendix of my book *The Concorde Story* and is reproduced above.

### Adjustments in flight

For best performance Concorde had to be flown as fast as possible. The line on the right-hand side of the graph indicates this limit. Rather than having to memorise the intricacies of a maximum operating speed that varied with altitude, each Air Speed Indicator (ASI) on the flight deck was fitted with a pointer (see box). This "wasp" pointer was

driven by the most limiting of  $V_{MO}$  (maximum operating indicated airspeed),  $M_{MO}$  (maximum operating Mach number, Mach 2.04) and  $T_{MO}$  (the maximum operating temperature, 127°C). From the graph  $V_{MO}$  is 300 knots IAS on the surface, increasing to 400 knots IAS by 5,000 feet, then from 32,000 feet it starts increasing to 530 knots IAS, which is reached at 43,000 feet. Climbing at a constant IAS causes the Mach number to increase. At 50,000 feet 530 knots IAS corresponds to twice the speed of sound or Mach 2. Here the "cruise climb" commences.

"MAX CLIMB" would be replaced by "MAX CRUISE" on the automatic flight system, and by

### Concorde flight envelope

Graph from *The Concorde Story*, by Christopher Orlebar, 6th edition (2004), p224; © Osprey Publishing

making small up and down adjustments to the angle of pitch the aircraft would adhere to the outer limit of the envelope. As the weight reduced, then the aircraft climbed. A drop in the static outside air temperature would also cause a climb, but a rise caused a descent.

The flight path was above the jet streams. Above the tropopause (37,000 feet in the standard atmosphere) the wind speed reduces with altitude. If the westbound Concorde climbed into a reducing headwind the Mach number would decrease,

## Observations during flight

The images here, taken by Christopher Orlebar, show information given by Concorde's Air Speed Indicator and Machmeter at two points in a flight.

### Air Speed Indicator

Indicated Air Speed

'Wasp' pointer

Bug showing  $V_{LA}$



### Machmeter

'FWD' indicator

Pointer showing Mach limit

'AFT' indicator

### Air Speed Indicator

Indicated Air Speed

'Wasp' pointer

$V_{LA}$  bug



### Machmeter

'AFT' indicator

Mach limit

'FWD' indicator

### Altitude 60,000 feet, Mach 2.02

The orange and black  $V_{MO}$  'wasp' pointer on the ASI is at 440 knots, the IAS is 432 knots, and  $V_{LA}$  (lowest authorised speed) is 300 knots (white bug). The letters 'ADC' are on a flag and indicate that the data is coming from one of the two Air Data Computers.

On the Machmeter there is another orange and black pointer showing the limit in terms of Mach number – in this case M 2.04. The 'FWD' and 'AFT' indices on the perimeter of the machmeter indicate the speed range allowable for a given centre of gravity.

### Altitude 28,000 feet, Mach 0.95

Notice that the orange and black  $V_{MO}$  'wasp' pointer on the ASI is at 400 knots, the IAS is 380 knots, and  $V_{LA}$  is 250 knots. Again, the letters ADC indicate that the data is coming from one of the Air Data Computers.

On the Machmeter the orange and black pointer is showing the limit as M 1.00. The 'FWD' and 'AFT' indices on the perimeter of the Machmeter indicate the speed range allowable for a given centre of gravity.

which would initiate a descent. On entering the stronger wind lower down the Mach number would rise, causing a pitch up. Concorde used to fly the Atlantic in a gentle upward-climbing phugoid (a phugoid being a climbing-and-sinking oscillation of an aircraft along its flight path) with a period of about 10 minutes. Climbing at a constant Mach number, the IAS decreases. Should the 60,000 feet ceiling be reached, it would be maintained and the speed would be controlled with thrust changes rather than pitch changes. The speed had to be very closely

monitored. It was all too easy to rely on the thrust changes to maintain the speed but once it started to drop, descending was the only option.

At the deceleration point, the altitude, whatever it was, would be held, and the throttles retarded; not to idle, but to sufficient setting to keep the air conditioning effective, and to avoid an engine surge. At this point a whiff of ozone could be smelt. As the bleed air for air conditioning became cooler it no longer converted the ozone ( $O_3$ ) into oxygen ( $O_2$ ). Then at 350 knots IAS the descent would commence.

At 41,000 feet VLA the Lowest Authorised speed became 250 knots. Although a Mach 0.95 cruise would be possible, usually, after a brief maintenance of 41,000 feet to become subsonic, the throttles were set to idle and the descent continued at 280 to 350 knots.

### Pushing the limits

The following two stories illustrate the difficulties of Concorde flying too slowly when heavy.

Westbound on track SM (the supersonic route to New York, Washington, etc), with the accelera-

tion well under way – reheats still lit, 40,000 feet at Mach 1.5 and 480 knots IAS – we were informed by Shanwick Oceanic Control that there was an “opposite direction” business jet somewhere in the vicinity and cruising at 43,000 feet. Would we expedite our climb or maintain 41,000 feet. Rather than switch the reheats off then on again after an indeterminate time at an inefficient speed and altitude, we decided to “zoom” climb.

The kinetic or moving energy of an object is proportional to its speed squared. At Mach 1.5 the True airspeed (TAS) was 850 knots. There was a great deal of kinetic energy capable of being turned into potential energy – that is, height. The rate of climb quickly exceeded 4,000 feet per minute. So in two minutes we were at 45,000 feet and therefore safe from the business jet. However, the drop in IAS to less than 400 knots caused a loss of thrust; although well inside the flight envelope, we were too heavy to maintain 45,000 feet at constant speed, and the closer we came to  $V_{LA}$  (300 knots above 41,000 feet), the more rapidly the speed decayed. The only option was to descend. So down we went with full climb thrust through 43,000 feet for the second time in the day, keeping a sharp lookout for the business jet. In those days airliners had no collision avoidance system. Once we had convinced ourselves that there was no threat, we passed through 43,000 feet for the third time, climbing at  $V_{MO}$  where the intakes, engines and convergent divergent nozzles could perform their magic.

### A rapid climb

The other story occurred during the Iran–Iraq war. We had been given ATC clearance from Bahrain to London. Rather than take up the westerly track over Saudi Arabia to London, we had to fly due south until we had reached 35,000 feet. Saudi Arabia had withdrawn supersonic

overflying rights, so the first part of the route home, until Egypt, had to be flown subsonic. We discussed the merits of using reheat during the subsonic climb. The sooner we could turn, the better. At 15,000 feet and 400 knots IAS we were well inside the reheat “light up” envelope. We expected to use only about 5 minutes of the 15 minutes per flight limitation. On went the thrust and up we went. Concorde was one of the few aircraft in which one could enjoy the acceleration, and we did.

At 35,000 feet off went the reheats and the 90° turn to the right commenced. The only trouble was we were unable to maintain altitude and speed. With 25° angle of bank the load factor increases 10%. For fiddling little course corrections with minimal angles of bank, the speed would not be threatened; but a sustained 25° bank turn would have added about 17 tonnes to the lift requirement. We shed speed and altitude in portions that we hoped were unnoticeable. Then – before everything had gone completely astray, I rather think, although my memory fails me – we relit the in-board reheats. Eventually the aircraft became light enough to cope.

### Just in time

As a consequence another incident occurred on this flight. Fuel checks confirmed that we might have used more fuel than we should have. There would be 6,500 kilograms left. Once we were in range, I radioed ahead to Heathrow “approach”, to

tell them that we did not want to stack or suffer lengthy radar vectors. The weather was fine and 10L was the landing runway. This was before the reduction of magnetic variation had caused 10L to become 9L; it was and is the more northerly of the two east-facing runways at Heathrow.

The vectors were slightly longer than we had hoped and we had to reduce speed uncomfortably early. At the latter end of the supersonic cruise Concorde burned 15 kilograms of fuel per mile, at 250 knots IAS in level flight about 50 kilograms, and on final approach, descending on a 3° slope, 150 kilograms per mile. For a successful “go-around” and swift circuit, 2,500 kilograms would be required.

We were now down to about five tonnes. Before we could land, any preceding aircraft should have vacated the runway. However, the one ahead of us gave no sign of doing this expeditiously. Just the opposite; he lingered at the eastern end, mulling over which exit would suit him best. We were at 50 feet radio altimeter height. If we landed with him still anywhere on the runway we would be breaking the law even though we could easily stop in time. Landing appeared to be the better option than running dangerously low on fuel. So the Captain ordered “Tell the tower we will land whatever the case”. As he did so, the tower gave us landing clearance; at that moment we were a good two inches off the ground.

### Safely home

Concorde G-BOAD makes an uneventful landing at Heathrow.

*Photo: Aero Icarus / Wikimedia Commons*



# ENTERING THE USA

*Forty years ago, on 24 May 1976, Concorde began commercial flights to the United States. British Airways and Air France inaugurated their services simultaneously, with two flights to Washington, D.C. Our contributors recall the events of that day.*



## The inaugural flights

**Nigel Ferris describes the inaugural Concorde services to the USA – the start of Concorde’s unparalleled supersonic dominance of the Atlantic.**

Transatlantic Services to Washington DC, Dulles International Airport (code IAD) from London and Paris began with two Concorde – G-BOAC, for British Airways, with Brian Calvert as Captain, and F-BVFA for Air France, flown by Captain Pierre Dudal. Before landing at Washington Dulles International Airport, both aircraft simultaneously flew over the US capital and then made parallel approaches to Dulles Airport. Both aircraft touched down together; the British Concorde landed on runway 01L and the French Concorde on runway 01R. Special permission had been given by US Secretary of Transportation, William Coleman for these flights to take place.

That day, 24 May 1976, proved to be the starting point for the love affair that America maintained until Concorde’s withdrawal from service in 2003. They were entranced by her beauty and grace, and by the raw controlled power that enabled her to fly across the pond in 3½ hours. Businessmen and Company Executives could fly between the UK and USA and return the same day. These days, we have video conferencing and Skype links – but nothing can beat the personal touch of face to face meetings, which Concorde facilitated.

A video of the day is available here: <http://abcnews.go.com/Archives/video/24-1976-concorde-flights-13598354>

## Simultaneous arrival

The British and French Concorde come to a halt, nose to nose, with noses and visors lowered in salute.

*Photo: Image in Industry*

## The battle for America

**Concorde was intended to fly primarily to the United States – but it did not have an easy introduction to the country. Katie John looks briefly at the challenges that the British and French faced in winning acceptance for services to the USA. Table prepared by Nigel Ferris.**

The work of obtaining permission to fly to the USA had begun in February 1975, with British Airways and Air France writing to the Federal Aviation Authority (FAA) to request approval for scheduled Concorde flights. The aircraft then had to undergo rigorous evaluation of its possible environmental impact. In addition, Concorde faced hostility both from politicians in the US Congress – who maintained their opposition up to the day of the first flight – and from some of the American people, who feared that Concorde would be too noisy and

environmentally damaging for them to tolerate. However, on the day the first two Concorde services arrived (see previous page), thousands of people gathered at Washington Dulles airport to welcome the aircraft.

Despite this success, though, it took a further 18 months of strenuous campaigning by the two airlines before Concorde was granted permission to begin flights to New York. The table below shows the timeline of significant events marking the way to final acceptance of Concorde by the US authorities.

### Timeline

- |                         |  |
|-------------------------|--|
| <b>18 December 1975</b> | In Washington DC the US House of Representatives voted by 199 to 198 to put a six-month ban on Concorde landing in the USA. British Airways and Air France wanted to fly Concorde six times a day to John F Kennedy airport in New York and Dulles airport in Washington. Ohio Senator Clarence J. Brown said, concerning the ban, “I see no reason to oppose the SST (meaning Concorde) just because we were stupid enough to get out of the SST business ourselves”. |
| <b>4 February 1976</b>  | The US Secretary of Transportation, William Coleman, approved British Airways and Air France to operate 2 Concorde services each per day to New York and 1 Concorde service each per day to Washington for a trial period of 16 months.  |
| <b>11 March 1976</b>    | The Port Authority of New York and New Jersey banned Concorde from landing at its airports.  |
| <b>24 May 1976</b>      | Transatlantic services to Washington, D.C. began with two Concordes, one from British Airways and the other from Air France, landing at Washington Dulles International Airport, Washington, D.C.  |
| <b>19 October 1977</b>  | Concorde 201 (F-WTSP) made the first Concorde landing in New York from Toulouse for a series of proving flights.   |
| <b>22 November 1977</b> | After a long delay, due to protests over local noise, British Airways and Air France began services to New York from London and Paris.   |
| <b>21 November 1978</b> | After 1 year of Concorde service to New York, the FAA monitoring report found the Concorde noise to be in line with or less than they had predicted in an Environmental Impact Statement issued in November 1975. (In fact, she was quieter than the President’s own Boeing 747, Air Force One.)   |
| <b>9 January 1979</b>   | Concorde was awarded the US type certificate of airworthiness.   |



## A pioneering passenger

**Fred Finn is the world's most-travelled man – and he holds the Guinness World Record for his 718 flights on Concorde. Here he recalls his first ever Concorde flight – the return journey from Washington to London on 25 May 1976.**

I was on board for the first commercial flight from Dulles Airport Washington, D.C. back to London Heathrow. I was living in the USA at the time and was not familiar with Concorde. I was, therefore, excited and in great anticipation of the flight I was about to take.

### Love at first flight

Dulles Airport is one of those airports where the aircraft don't come to a gate at the terminal; once checking in is complete then you pass into the boarding lounge, which lowers and drives out to the aircraft. I got my first view of this sleek, long and very different-looking aircraft called Concorde. It had a wow factor straight away for me.

Although Concorde was narrow-bodied I was amazed at the length of the aircraft – just a few feet shorter than a 747. I was amazed that I could stand up my full 6 feet 2 inches without any problem. The announcements are of course unlike anything on a normal aircraft. Concorde is a supersonic marvel, and Brian Calvert the Captain was so proud to explain what was about to happen on this very special flight.

Engines were started and Concorde began to taxi, and as always there was the slight whiff of aviation fuel just to add to the already heady experience. The take-off was as different as riding in a Rolls Royce to riding in a McLaren F1 racing car – feeling the runway as Concorde accelerated with reheats on, the noise was different, the speed was special, the front of Concorde flexed as we took off. Cruising along the US coast until approaching the end of Long Island, I remember the announcement that the reheats would be lit two at a time to take Concorde from our current speed of Mach .98 through the sound barrier to Mach 1.71, then we would be in a cruise climb from 39,000 feet up to 60,000 feet; no bumps, no bangs, and the Dom Perignon sitting on my table never split a drop.

There was a great lunch; the food was always good on Concorde, and although not silver service, as in slower, more spacious aircraft, it was always served on the very best bone china tableware. This was all possible



### First flight souvenir

Fred Finn's souvenir luggage tag from his first flight: "Commemorating the first scheduled North Atlantic Concorde flight, 24/25 May 1976." The tag went on every flight with him.

*Photo: Fred Finn*

while we were flying at Mach 2, twice the speed of sound, faster than a rifle bullet.

All too soon we approached the Bristol Channel, and decelerated to subsonic speed and down to 39,000 feet to enter the UK flight path. We all had time to have a quick look into the cockpit and to realise just how different Concorde was, and to see the magic white reheat switches immediately to the rear of the throttles. We were told the visor and the nose would descend so that the pilot could see the runway. The vision was so good it's as if there was no screen at all.

The reverse thrust was applied; the incredibly powerful carbon brakes slowed Concorde down in a very short time. The gleaming bird came to rest at the gate and my first trip on Concorde was complete. I can tell you it was 'Love at First Flight' and the start of my 30-year love life with Concorde.

## Winning hearts and minds

**Gilly Pratt, former British Airways cabin crew member on Concorde, recalls the variety of ways in which Concorde connected with the United States – for business and pleasure, and even on British government service.**

It is amazing how the American people finally came to Concorde. I remember the outcry from them when they first learned that she was coming! It took a while, but in the end they were as horrified as we were when she was taken out of service.

### Special appearances

I was not part of the crew on the first flight; I didn't join the fleet until 1981. Nevertheless, I was on the crew of many inaugural flights that were chartered. On one occasion we were scheduled to fly to Denver in Colorado, but the local ranchers protested that the sound would make their cows abort. I don't know if they thought we would fly over their ranches at supersonic speed! In the end we flew to Colorado Springs, and bus-loads of spectators came from Denver and blocked all the roads surrounding the airport.

We were always given a huge welcome when we arrived at a new airport. One of the most memorable for me was Lexington, Kentucky – we were treated so well by their Tourist Board. The horse ranchers were not so fearful of their stock!

It was a gruelling day for the cabin crew as we were usually full. The route was usually supersonic to New York (approximately three and a half hours); from there we had to fly subsonic to our destination (usually three or

four hours). On arrival we usually had to give television interviews and meet other journalists and then wait for the local roads to clear before going to the hotel. It would be a very long day, and then we usually only had twelve hours off and then had to do the same trip but in reverse. Believe me, we were exhausted by the time we arrived back at Heathrow.

When I first joined the fleet the service terminated in Washington, but later it was linked with the Miami service. This was another long day, but the Washington – Miami part was only an hour and a half as we were able to fly supersonic over the ocean.

### Business and politics

Concorde played her part in the Falklands war by carrying top politicians to and from Washington. She was also chartered by a world-wide association of bankers to fly between Washington and London. We would all try desperately to swap the trip as most of the passengers had had sense-of-humour bypasses and it was very unpopular!

It took a while for the Americans to take Concorde to their hearts and it was not marketing that changed their minds – it was the sheer beauty of that wonderful aircraft. I am so proud to have had the privilege of working on her.

### Oshkosh air show, USA

A British Airways Concorde delights aviation enthusiasts at the EAA AirVenture show at Oshkosh, WI, in 1990.

Photo: D. Miller / Wikimedia Commons



# MY CONCORDE LIFE

*In our first issue, October 2015, contributing editor Nigel Ferris looked back over his lifetime with Concorde. Here, he shares further experiences of working with the aircraft, and describes his later work as a tour guide on Concorde at Filton after the fleet's retirement.*

## An aircraft is born

There were many memorable moments during my time working at BAC at Filton, in the main hangar where the aircraft were constructed. One such was for prototype 002, G-BSST ([seen here](#)), the day when all the major components had been delivered, put on the jig and joined up. Then came the operation to disconnect her from her mountings, lift on jacks (very carefully and with the utmost precision to avoid flexing) and mount on stands on the hangar floor.

We were told that the aircraft (in protective green covering – a bit Kermit-like) was going to be painted overnight. It was with a great deal of anticipation that we all trooped into work next morning, to be greeted by the wonderful sight of a gleaming, beautiful white aircraft sat there – looking like something totally out of this world. How could basically a collection of metals, plastics etc., an inanimate object (apologies, Concorde – you were more than that), inspire such wonder and passion? But it did, and has ever since. There was not a lot of work done in the offices that day, with everyone making excuses to go out and have a look. But I think the bosses did as well.

There also came the day when the first of the Olympus 593s were delivered – there they sat, next to the aircraft in the RR bay. I remember vividly walking up and down the length of the engine, and marvelling at the sight of that beautiful piece of engineering, which, when updated and developed to the 610 mark, would power Concorde to the superlatives she achieved.

## Retirement and after

Fast forward some years. Concorde was retired (prematurely) in 2003, after 27 years of service with BA and Air France. The last of the airframes, production number 216, registration G-BOAF, was returned to her birthplace of Filton (and the home of supersonic travel).



## Final touchdown

Concorde G-BOAF comes in to land for the last time at Filton, ready to begin a new life as a museum exhibit.

*Photo: Adrian Pingstone / Wikimedia Commons*

A visitor site was set up, and in 2005 I joined The Bristol Aero Collection as a tour guide.

I believe we offered visitors the best experience of Concorde. We would take twelve people at a time for a guided tour underneath (and if it was raining, we would say it was the best umbrella in the world!). I would try to explain the technical features in an understandable way, pointing out the various parts, engines, undercarriage, intakes, wing shape,

*“There was no such thing as a stupid question ...”*

etc. Visitors would always ask questions. One lady, pointing to the chines on the sides of the fuselage under the cockpit windows, asked what she thought was a stupid question – “Were they there to stand on to clean the windows?” My reply explained the reason, that they helped stability in yaw when she was landing at the ever-familiar high angle of attack. I also said there was no such thing as a stupid question, only a stupid answer! Another question was about the heated masts (due to the outside temperature being

well below freezing point) under the fuselage, designed to enable the exit of waste water from the galleys and toilets – the reply was “Oh, supersonic poo.”

After the underwing tour, visitors were taken up into the aircraft and sat in the first six rows, with a another talk about the cabin and service on board. They then had a few minutes each in the cockpit, standing right on the flight deck, and were briefly shown the controls, instruments, crew seats and responsibilities – usually with open-mouthed wonder in the ‘office’. A frequent comment was that it was very small – but then the crew were only there for 3.5–4.0 hours. The ‘hat in the gap’ was always a point of interest, showing the kinetic expansion of the airframe when heated up in supercruise. The effects could also be seen on the airframe exterior. For a while, some of the fairing covers on one of the port PFCUs had been removed. This exposed some of the hydraulic and fuel pipe runs, held in position to the airframe by mountings, with anti-wear rubber sleeves encompassing the pipes. It was clearly visible that there was a small shiny length of the pipe either side of the sleeve – this demonstrably showed that the airframe was expanding and contracting during a supersonic cycle, while the pipe stayed in its installed position.

Flying at 58–60,000 feet, we would say that passengers could look out of the windows and some 25,000 feet below them was a Jumbo jet appearing to be going backwards at 800 mph. (Concorde – 1350 mph, Jumbo – 550 mph.) There were so many things to say about Concorde that the tours could have gone on for hours. Indeed, I was often guilty of overrunning my time – and my boss would say that I would try to give a full pre-flight crew check list! I would babble on for ages, such was my enthusiasm and passion for Concorde. Sometimes, in between tours, I would take myself up into the cockpit and sit in the left hand seat with no-one else on board – something I’m sure very few people have ever had the pleasure and privilege of doing.

After my ground tours of AF, I would have to escort the visitors to the steps up into the aircraft for their inside tour. Whilst standing there, I would point out the sign on the inside of the intakes on the port

side engines, which read ‘Engineered To Be The Best – Concorde – Flew Above The Rest’. This was put there by some of the top engineers who worked on Concorde at Heathrow, and when I read it out, I would usually speak in an emotional, creaky voice. It seemed to me to encapsulate the whole Concorde story.

## The future for G-BOAF

It was a very sad occasion when Airbus decided to close the visitor site. True, Alpha Fox needed some very important deep maintenance and weather-proofing, and cost factors also came into the question. But I am sure the experience could have been restarted. However, now The Bristol Aero Collection Trust has secured funding from The Heritage Lottery and various businesses to construct a purpose-built hangar specifically for Alpha Fox on the north side of the (now closed) airfield, as well as refurbishing the two listed First World War hangars for a complete museum celebrating the involvement of Bristol in so many class-leading projects – trams, buses, rockets, engines, aircraft, guided missiles and so on – as well as getting young people interested in STEM (Science, Technology, Engineering and Maths), going on to lead development and progress in the future.

Concorde – a personal view and appreciation from one of millions who recognise her achievements – always with a hope that one day she may return to grace the skies again.

### Sleeping beauty

Alpha Fox sits quietly in the spot she has occupied since retirement. She is currently closed to visitors, but has been receiving maintenance (see Concorde Watch, p.14) and will be the centre-piece of a new museum, to open in 2017.

*Photo: Source unknown*



# SUCCESSORS TO CONCORDE

*Every few years, people in the aviation industry – and further afield – ask the question, “What’s next, after Concorde?” How can aviation build on Concorde’s achievements to create a faster, quieter, more efficient aircraft? Nigel Ferris looks here at three new concepts currently being developed.*

Mach 2 magazine is specifically published to celebrate the achievements of Concorde, and of the people who designed, built, maintained and flew in her, and to keep alive the memory for all devotees. We do, however, keep a watchful eye out for

a possible successor (but nothing could be better or have set such a high benchmark): i.e., a ‘Son of Concorde’. The most likely developments are going to be supersonic business jets (SSBJs), and there are three deserving special mention.

### Aerion AS2

The Aerion Corporation (<http://www.aerionsupersonic.com>) is a collaboration with Airbus, with a firm order for 20 Aerion AS2 aircraft from Flexjet.



### Spike S-512

Spike Aerospace (<http://www.spikeaerospace.com>) is also making progress with the S-512 concept aircraft, working with a global collaboration of aerospace partners and suppliers.



### Taking shape

Artists’ impressions of the Aerion AS2 (left), Spike S-512 (above), and Boom (below).  
Images: Aerion Corporation (left), Spike Aerospace (above), Boom Aerospace (below).

### Boom

Thirdly, a US start-up, Boom Aerospace, has partnered with The Spaceship Company, part of Virgin Atlantic, and Virgin have options on the first 10 aircraft. An unnamed European airline has also placed options for 15 aircraft. We do have some dialogue with Boom, and a link to their site is included here (<http://boom.aero>).





## CONCORDE WATCH

### Concorde G-BOAF

British production aircraft

**Location:** Filton, UK

**Reporter:** Paul Evans

**Date:** 13 May 2016

My name is Paul Evans and I have been involved with Concorde Alpha Foxtrot since 2005.

“Foxye” was the last Concorde built and in fact the last complete aircraft ever manufactured at Filton. I was part of the Sunday team at Concorde At Filton, who took great pride in showing this magnificent aircraft off to the general public, armed forces, ex crew, current Airbus engineers, etc.

Although Alpha Foxtrot is no longer open to the public, I, along with one of my former colleagues, Anthony Basi, have been assisting Graham Cahill at Heritage Concorde with various restoration projects for other aircraft on display in the UK.

I am currently involved with the BAC Trust (BACT) and am in the process of getting my old Sunday team back together in preparation for Alpha Foxtrot’s planned move into the new BACT museum, which is due to take place in January next year. We will then have 2–3 months preparing her for display, after which the public can see her in the state of the art museum at Filton, the birthplace and home of Concorde.

Since Concorde At Filton was closed down by Airbus, there seems to be a great misconception about Alpha Foxtrot being left to deteriorate outside, exposed to the elements. Whilst I agree that, in an ideal world, Alpha Foxtrot should have been left in the Brabazon Hangar after the decommissioning process back in November 2003 and displayed there until the BACT museum was ready, that didn’t hap-



#### Dedicated volunteers

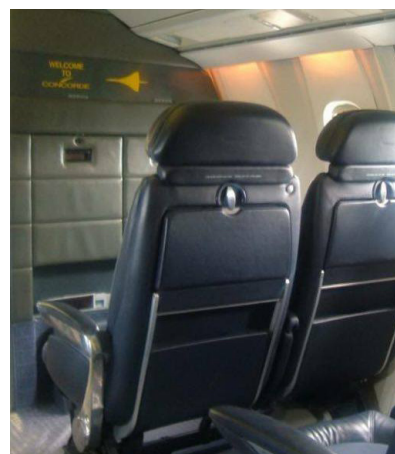
Members of the old Sunday team from Concorde At Filton, including Anthony Basi, Robert “Bob” White, Nigel Ferris (right), Andy Treweek (centre; white shirt and tie), Concorde author and ex First Officer Christopher Orlebar (second from right) and Paul Evans (centre; blue jacket).

*Photo: Paul Evans*

pen. What did happen was that a dedicated area was provided and financed by Airbus UK along with a weekly maintenance programme, again provided by Airbus UK.

As many in the Concorde community know, Alpha Foxtrot underwent a deep maintenance and restoration programme conducted by Airbus from November 2010 through to July 2011, at a cost of £1.8 million.

The purpose of this programme was to deal with minor corrosion issues which had arisen after several years of being exposed to the elements; also, various new parts of the aircraft fuselage were re-manufactured by Airbus whilst



#### Carefully treated

The leather seats in the cabin have been treated with preservative and then sealed.

*Photo: Paul Evans*



### Deep maintenance

These photographs show some of the areas that underwent repair and refurbishment work during the deep maintenance programme in 2014. Above left: the exposed powered flight control unit (PFCU) for the inboard elevon. Above right: one of the access areas for the hydraulic fluid tanks with the panel removed. Left: the flight deck, with mould-free visor and windshield.

*Photos: Paul Evans*

in direct consultation with BA, who of course still own the aircraft. During this process the Conran leather seats were treated with a special preservation cream and vacuum sealed, along with the seats on the flight deck. Upon completion of the work the aircraft's fuselage was sealed.

From July 2011 until present day the aircraft has still continued to receive weekly checks, again undertaken and financed by Airbus UK.

Two years ago, Alpha Foxtrot underwent another deep maintenance programme and deep clean, this time involving removing part of the visor to access the main windscreen in order to clean the screen and remove mould that had surfaced on parts of the frame structure.

Last month a group of representatives from NATO visited Filton and were given a tour of Alpha Foxtrot.

One of our volunteers conducted the flight deck tour and reconfirmed that the windscreen and visor are still mould free and clear and that the aircraft is in great shape.

There is now a dedicated member of the BACT who inspects Alpha Foxtrot on a weekly basis and liaises with Airbus.

Aside from the BA decals fading (there is a budget in place for a re-spray prior to her going into the new museum), she really is in great shape. I can assure all of you that when you visit new BACT museum you will be blown away, not just by the museum – which is going to be fantastic and will include many exhibits that chronicle the history of the Bristol Aero Company, including the Bristol Boxkite, Bristol Sports car, missiles, satellites, simulators, and Harrier Jump Jet – but also by the condition that Alpha Foxtrot is in, and wait until you see the plans we have for her!

I know I speak for all of my old Sunday crew – Nigel Ferris, Bob White, Anthony Basi, Andrew Strange, and Colin – that we cannot wait to get stuck into the work ahead and once again show off the baby of the fleet, the last Concorde built and the last one to fly: Concorde G-BOAF.

For information and updates on the progress of the new Aerospace Centre, please see the website: <http://www.bristolaero.org>

## Concorde G-BOAG

British production aircraft

**Location:** Museum of Flight, Seattle, USA

**Reporter:** Ted Huetter, Museum of Flight

**Date:** 14 May 2016

The Concorde has been positioned along the south side of the new Aviation Pavilion, where she will greet everyone entering the structure. The imposing and elegant nose adds a sculptural element to the experience that cannot be achieved using any other aircraft.

Last month the aircraft was cleaned, buffed and polished by an elite team of aircraft and auto detailers from around the U.S. They volunteer to come here every year to

polish and detail our Air Force One as a patriotic gesture, and then stay to do some more planes. This year was their first pass at the Concorde, and they plan to return next year to bring it back to next-to-new condition (apparently this kind of work must be done in stages).

We have also given the interior another good cleaning while we can reach every nook and cranny at our leisure. By June 25, when we open to the public, she will look better than

ever we have been able to present her before!

Further details from the museum can be seen here: <http://www.museumofflight.org/explore-the-museum/museum-galleries/Aviation-Pavilion>

### Under cover

Alpha Golf parked by the Boeing B-17 in the Museum's new Aviation Pavilion. Photo: Ted Huetter



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