

MACH 2

Concorde
magazine

The First of the Fleet
*G-BOAA – 50 years since
her maiden flight*

The secret to
supercruising
Concorde's air intakes

Concorde family day
Gathering at Brooklands Museum

Concorde Watch
News from Paris

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INTRODUCTION

This issue marks the 50th anniversary of Concorde 206: G-BOAA, or Alpha Alpha. This aircraft has her own place in Concorde history as the “first of the fleet” for British Airways (BA).

The first to be delivered to the airline, on 21 January 1976 she inaugurated scheduled passenger services for BA, then on 22 November 1977 she made the first scheduled passenger flight to New York. Mach 2 looks back at the achievements and historic moments associated with this aircraft, and traces her story up to the present day. In particular, Chief Concorde Pilot Mike Bannister recalls Alpha Alpha’s role as the highlight of a spectacular fly-past of airliners to mark the 50th anniversary of Heathrow Airport in 1996. We also hear from Concorde engineer Pete Comport about G-BOAA’s role as the first of the fleet to undergo maintenance checks, and we have an article from Kevin Jones on the air intake control system.

We end with a report from a gathering of the Concorde clan at Brooklands Museum on 24 October, to mark the 22nd anniversary of the end of scheduled services, and a Concorde Watch report from Paris.

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Cover: G-BOAA following re-assembly, being prepared for display at the National Museum of Flight, Scotland.
Photo © National Museums Scotland

THE FIRST OF THE FLEET

Fifty years ago, on 5 November 1975, Concorde 206 (G-BOAA) took to the air for the first time, from Filton. In this feature we look back over her lifetime up to the present day.

CONCORDE 206, G-BOAA (Alpha Alpha), could be described as “the first of the fleet”. Although her sister ship 204 (G-BOAC) is known as British Airways’ flagship, because of her registration “G-BOAC” (recalling the name of BA’s predecessor company, the British Overseas Airways Corporation – BOAC), Alpha Alpha was the first Concorde to be delivered to British Airways – and played a part in some significant occasions for the airline, Heathrow airport, and the nation.

Construction and career

The story of G-BOAA began in 1973, when parts of the airframe from Weybridge in the UK and Toulouse in France, together with many components from across Britain and France, arrived at Filton. Like her sisters, Alpha Alpha was assembled in the Brabazon hangar. Then, on 5 November 1975, she made her first flight, from Filton to Fairford. On that flight, though, she went supersonic and reached Mach 2 for the first time.

On 5 December 1975 Concorde received its British Certificate of Airworthiness – the green light for the start of passenger services. Alpha Alpha was the first Concorde to be delivered to British Airways, on 14 January 1976, while Alpha Charlie (G-BOAC) was being re-fitted for airline service.

Just a week later, Alpha Alpha’s career started in spectacular style, on 21 January, as she inaugurated Concorde passenger services with her Air France counterpart F-BVFA. (This event was featured in the Jan 2016 issue of Mach 2, and we will be returning to the events of that day in the Feb 2026 issue.) Captained by Norman Todd, with First Officer Brian Calvert and Flight Engineer John Lidiard, Alpha Alpha took off from Heathrow at 11.40 am. She arrived in Bahrain at 15:17 GMT, after a flight of just 3 hours and 37 minutes.

The next year, on 22 November 1977, Alpha Alpha – flown by Captain Brian Walpole, Captain Tony Meadows, Captain Leo Budd, and Senior Engineer Officer George Floyd – launched the Concorde services to New York (JFK), with her French counterpart F-BVFD.

The two aircraft would touch down together at JFK to mark what became the most prestigious and lucrative of all Concorde services, running until 24 October 2003.

Another high point occurred on 24 December 1985, when she formed part of the four-Concorde formation that performed a display flight off the coast of Cornwall, to celebrate 10 years of Concorde services. (See Mach 2, Christmas 2015, for further details of this awe-inspiring occasion.)

In April 1988 G-BOAA marked a milestone of a different kind, when she was the first British Concorde to undergo a Major check, having flown 12,000 hours and completed 3,500 supersonic cycles. BA ground engineer Pete



Construction of the airframe

Above: The forward fuselage of Concorde 206 (to become G-BOAA) during construction at Weybridge.

Right: The completed front fuselage for 206 (third from front) at Weybridge, ready to be transported to Filton for final assembly.

Photos © BAE Systems





Glorious day

G-BOAA (foreground) takes part in the spectacular four-Concorde flight on 24 December 1985, to mark 10 years of British Airways Concorde services. Photo: Adrian Meredith

Comport describes this work in his account on pp.12–13.

On 6 June 1990, G-BOAA, captained by W.D. “Jock” Lowe, had the honour of performing a formation flight with a Spitfire over the white cliffs of Dover, to commemorate the 50th anniversary of the Battle of Britain. (See Mach 2, May 2022.) Then, on 2 June 1996, commanded by Captain Mike Bannister, she performed a formation flight with the Red Arrows over Heathrow Airport, to commemorate the 50th anniversary of the airport’s opening. Captain Bannister recalls the events of that day in his article on pp.8–11.

An end and a beginning

The Concorde crash in Paris in July 2000 was a low point for both the British Airways and Air France fleets. On 15 August, Concorde’s Certificate of Airworthiness was withdrawn. Three days earlier, Alpha Alpha made her last ever flight – a return from JFK to Heathrow. There had been plans to return all of the British fleet to service once the Certificate of Airworthiness was restored in 2001, but as it transpired Alpha Alpha and her sister ship, Alpha Bravo, would never fly again.

For the last two years of Concorde services, Alpha Alpha was kept in a hangar and used as a source of spare parts for the active members of the fleet. Then, after scheduled services ended in October 2003, most of the aircraft were dispersed to museums.

G-BOAA would be sent to the Museum of Flight at East Fortune, just east of Edinburgh. Because she could not be flown there, in 2004 she was partially dismantled, then transported by road from Heathrow to a barge situated on the Thames. For many Concorde lovers this was a sombre occasion; people lined the streets to watch her leave the airport.

She was sailed down the Thames, past the Houses of Parliament, where she was shown to the public, then out to the North Sea. Brought ashore beside the nuclear power station at Torness, she was transported on a low loader along the A1 and over fields to the museum. There, over the following months, she would be carefully re-assembled and prepared for display. Paul Hazelwood, who worked at the museum, describes the restoration in his article on pp.14–15.

Alpha Alpha remains on display today. She has also appeared in films and on TV. She was used as a setting in the critically acclaimed 2018 film *The Wife*, in which the film crew used clever lighting to suggest that Alpha Alpha was flying from New York to Heathrow. The results can be seen here: https://www.youtube.com/watch?v=jKr8D_2Bgqk

More recently, she was visited by Scottish broadcaster Susan Calman in an episode of *Susan Calman’s Grand Day Out*, when Susan enjoyed a visit to the flight deck. Still a favourite at the museum, Alpha Alpha remains beloved by all who visit her.

Timeline: history of Concorde 206 (G-BOAA)

3 Mar 1974	First registered to British Aircraft Corporation as G-BOAA.
5 Nov 1975	Maiden flight, from Filton to Fairford.
14 Jan 1976	Delivered to British Airways at Heathrow.
21 Jan 1976	Inaugurates scheduled British Airways Concorde services. Captained by Norman Todd, with First Officer Brian Calvert and Flight Engineer John Lidiard, G-BOAA takes off from Heathrow at 11.40 am; at the same moment, French Concorde F-BVFA takes off from Paris–Charles de Gaulle. Alpha Alpha arrives in Bahrain at 15:17 GMT, after a flight of just 3 hours and 37 minutes.
22 Nov 1977	G-BOAA inaugurates the scheduled British Airways Concorde service to New York. Flown by Captain Brian Walpole, Captain Tony Meadows, Captain Leo Budd, and Senior Engineer Officer George Floyd, she is again accompanied by her French counterpart F-BVFA. The two aircraft touch down one after the other at JFK.
Apr 1988	G-BOAA is the first British Concorde to undergo a Major check, having flown 12,000 hours and completed 3,500 supersonic cycles
6 Jun 1990	G-BOAA performs a formation flight with a Spitfire over the white cliffs of Dover, to commemorate the 50th anniversary of the Battle of Britain.
2 Jun 1996	G-BOAA performs a formation flight with the Red Arrows over Heathrow Airport, to mark the 50th anniversary of the airport's opening.
12 Aug 2000	G-BOAA makes her final flight, from JFK to Heathrow. She has flown 22,768 hours 56 minutes, and completed 6,842 supersonic flights.
Nov 2001–Oct 2003	G-BOAA is kept in a hangar and used as a source of spares for the rest of the fleet, until she is allocated to the National Museum of Flight at East Fortune in Scotland.
Feb–Apr 2004	G-BOAA is partially dismantled for her final journey to the museum.
12 Apr 2004	G-BOAA is loaded on to a barge and sailed down the Thames, then via the North Sea to Scotland.
Nov 2004	Re-assembly of G-BOAA is completed.
2005–present	G-BOAA proves to be a highly popular exhibit at the museum.

Life in service

G-BOAA photographed during a charter flight over the southwest USA, late 1970s or early 1980s – just one of the activities that she carried out during her 24 years in service with British Airways.

Photo: NNehring / iStock



First encounters with Alpha Alpha

Fifty years ago, on 5 November 1975, Concorde G-BOAA made her maiden flight, from Filton to Fairford. British Aircraft Corporation (BAC) acoustic engineer Robin Crossan remembers her arrival, and BAC acoustic engineer Ken Alexander recalls his role on one of Alpha Alpha's test flights before delivery to Heathrow.

MY INVOLVEMENT with G-BOAA started on 5th November 1975 as I was set up to carry out noise recording of Concorde G-BBDG on the southern pan of Fairford airfield (roughly towards the entrance for the Royal International Air Tattoo). We had no idea that another Concorde was arriving that day, but I then heard an aircraft and noticed that Concorde 206,

G-BOAA, was joining the circuit from overhead. I whipped out my cine camera and filmed the landing; I also captured a slide shot of G-BOAA backtracking down the runway, as well as several shots of her being towed around the pan and into the hangar.

Robin Crossan



Arrival at Fairford

Left: G-BOAA just after arrival at Fairford, with Robin Crossan's equipment set up to record G-BBDG's take-off noise. Above: Taxiing back along the runway after landing. Photos: Robin Crossan



From testing to production

Above: G-BBDG (left) and G-BOAA (right). There are subtle differences between the two: G-BOAA has water deflectors on the undercarriage, unlike G-BBDG, and has a small black area visible on the leading edge of the wing near the fuselage, unlike G-BBDG. Photo: Robin Crossan

Preparing for departure

Left: G-BOAA (background) being readied for departure to Heathrow; pre-production aircraft G-AXDN is parked in the foreground. Photo: Robin Crossan

ON 6 JANUARY 1976, I was flying with G-BOAA; I assisted in rewinding some of the tapes containing the recordings of the noise measurements. We actually had two flights that day. The planned flight was no. 13, in the morning, when the photos on this page were taken. Flight 13 was cut short due to an engine warning light, I believe; we had to fly around to get rid of fuel before we could land. We had lunch while the aircraft was checked. After the all-clear we had flight 14 in the afternoon to carry out the original planned flight test.

The aircraft was almost full as it had to be an in-service representation. The take-off was a real experience; you were pushed back into your seat as the reheats kicked in. Then there was the noise abatement, which I was not prepared for as it felt as if the aircraft had stopped. There were several measurement points and I seem to remember having to go through Mach 1.7 more than once before accelerating to Mach 2. The only minor down-side of the flight was that they had

not fitted the Mach and speed displays in the cabin yet. We had to wait until the next day for the flight data to confirm maximum speed and altitude. This enabled me to purchase the Concorde M2+ tie which I still proudly have and wear occasionally.

I took some photos of AA on the apron by the flight test hangar and a few on board. I also have a certificate of the flight signed by Brian Trubshaw on my wall.

Ken Alexander

Data from flight 14

Duration: 3 hours 33 minutes
Supersonic flight time: 1 hour 38 minutes
Maximum altitude: 57,000 ft
Maximum speed: Mach 2.03



Preparation for flight

Above and below: G-BOAA being prepared for test flight 13 on the morning of 6 January 1976.

Photos: Ken Alexander

View from the cabin

Right: A photograph taken during the flight, as G-BOAA attained speeds up to Mach 2.

Photo: Ken Alexander



A celebration flight

One of the occasions in which G-BOAA was shown to dazzling effect was during the celebrations in 1996 to mark the 50th anniversary of the opening of Heathrow Airport. The final event was a flypast of many of the civil airliner types that had used the airport, finishing with Concorde G-BOAA and the Red Arrows. Alpha Alpha was flown by Captain Mike Bannister; in this interview with Mach 2 editor Katie John, he recalls the feat of organisation behind the stunning display.

KJ: I wanted to talk about the 50th anniversary fly-past for Heathrow, because I think a lot of people don't know about it – they know about the Golden Jubilee fly-past, but they don't know about the 1996 one with Alpha Alpha.

MB: There's a lot about Alpha Alpha that people don't know. It was the first BA Concorde to be delivered, the first flown in commercial service, and the first one flown in commercial service to New York. The aircraft was also left in New York after the accident in 2000; the flight back to Heathrow was her last ever flight. Then she was dismantled and shipped up to East Fortune, and that is where she is now.

KJ: Am I right in thinking that the Heathrow Airport fly-past was the only fly-past we have ever had of all civilian airliners?

MB: It wasn't all civilian airliners, because the Red Arrows were there. Originally the fly-past was going to be led by an [Armstrong Whitworth] Argosy, but unfortunately the Argosy had a minor accident shortly beforehand and couldn't participate. But there was a selection of aircraft that had used Heathrow – the fly-past kicked off with a de Havilland Dragon Rapide, then a Dove, then the Douglas family (DC3, 4, 5), then the Herald and a Viscount, and a Comet, and into the jets. So a Comet, the DC8, the 1-11, the Boeing family (737, 47, 57, 67), an MD-11 and an Airbus A340, and then us and the Reds.

Enduring icon

It is not certain whether G-BOAA was chosen specially for this fly-past, but she had featured in publicity for British Airways before, as in this photo montage created for an advertising campaign in 1977.

Image: Adrian Meredith



KJ: How long did it take to plan?

MB: A long time. This was the first Red Arrows fly-past I did with Concorde. I did three in all – the planning time was about six months for each of them. That includes all sorts of things – getting all the right permissions, both from the Civil Aviation Authority and the Air Traffic Control authorities; from the Reds' point of view, from the Air Force; then, from my point of view, getting the approval from the British Airways Board – I had to take the plan directly to the Board on a number of occasions to get the sign-off from the Chairman and the Chief Executive. Plus, from a technical delivery point of view, getting it all organised as to what we were going to do, when, and how.

The first thing I thought was “these guys [the Red Arrows] are the experts in this, so I'll do what I'm told”. The Reds know all about formation flying. I've done some – I used to fly an Islander for the Army parachute team, the Red Devils – so

I've done a fair amount of formation flying in a relatively small, slow aircraft, but nothing in a fast jet. I got the Reds and their leader at the time, John Rands, to come down to Bristol to fly the Concorde simulator, so they would understand the sort of things that we would be doing, and then I listened very intently to their briefing on what they would do when we talked about it in general terms and attended their briefings on the day.

We stationed the aircraft to Stansted for the launch, to come in over Heathrow; while we were at Stansted that gave me the opportunity to sit in on their pre-flight briefings.

KJ: Was there any reason why Alpha Alpha was chosen? Was it because she was the first BA aircraft, or was it just that she was available?

MB: I don't know the answer to that. It could have been that somebody thought that this was the first one that had ever flown in



A novel challenge

Not only was this flight Captain Mike Bannister's first formation flight with the Red Arrows; in addition, that particular Red Arrows team had no previous experience of flying with Concorde. *Photo: Craig S. Lucas*

commercial service, both to Bahrain and to New York, and the fly-past is celebrating 50 years of Heathrow, so this particular Concorde has got historical significance – I'd like to think that was the case, but, to be honest, I don't know.

KJ: So Alpha was stationed at Stansted – did you have to do any dress rehearsal flights, like you did for the Golden Jubilee flight in 2002?

MB: No, not for this one. It was all done in briefings and when the Reds came to the simulator. We couldn't really rehearse this one. It was possible to rehearse the Queen's Golden Jubilee fly-past because that was a totally military operation, whereas the others [the 1996 fly-past and the 1999 flight over Edinburgh for the state opening of the Scottish Parliament] were a combined military and civil operation.

You have to be mindful of the cost of doing this – in the Heathrow one there's a lot of costs to be borne by a lot of different individuals and organisations to provide the aircraft on the day, whereas in the Queen's Golden Jubilee flight all the costs were borne either by the Air Force

or by British Airways, and the decision-making process to do that is much simpler.

The Heathrow fly-past was also something different from the other two. The Edinburgh one for the state opening of the Scottish Parliament in 1999 was just Concorde and the Red Arrows, and then in the Queen's Golden Jubilee it was all military aircraft, all pretty much flying at the same speed. The big thing about the Heathrow fly-past was that the majority of the aircraft were flying at different speeds – so, for instance, the Rapide was at the front, doing maybe 120 knots, while we're at the back with the Reds, doing 280 knots. So the whole formation is concertina-ing as it moves. That was a big part of the co-ordination – to get the Rapide to arrive first at Heathrow, and then for there to be an interval for the Dove, then the same interval for the next one, and so on down the line, when they're all travelling at different speeds.

KJ: And, of course, you've got the slowest ones first!

MB: Absolutely. Everybody is catching everybody else up, apart

from us at the back. So that was interesting! It took quite a lot of work to make sure we could do that. That's what makes timings absolutely essential.

But it was huge fun. Particularly for me personally, because I live near Heathrow and so it was simple for my family and friends to come and find good vantage points to watch us flying over. I had some very good photographs of the fly-past taken by my wife. Our daughter, at the time, was only three years old, but Chris took Amy along, so there was a strong personal bit to it as well.

KJ: So where was the route? Presumably, you flew east from Stansted, and then came back...

MB: We came down the east side of London and then routed in over central London to get lined up. And of course, in that sense it was easier than the other two, because you could actually use the ILS [instrument landing system], which we did. So we established on the ILS for 27 Right and just flew the ILS down to 800 feet, then levelled off and flew through at 800 feet. So that bit was actually easier than it was for the other two, because the other two were completely visual operations.

KJ: What happened to Alpha afterwards? Did you return her to Stansted?

MB: No – it was the only time ever that I've flown a visual circuit at Heathrow! Not the sort of thing you expect to do at the world's leading international airport, and the busiest airport in the world, as it was at the time. We broke away from the Reds, who I think went to Northolt, then we flew a circuit and came in and landed. It was a clear day, so I flew a purely visual circuit to get back into the pattern.

KJ: You looped over London and then came back?



Flawless formation

The Red Arrows and Concorde create a perfect finale to the fly-past over the airport. It was judged best, for both operational and aesthetic purposes, for G-BOAA to lead and for the Red Arrows to formate on her.

Photo: PA Images / Alamy

MB: We went north, so we didn't go over much of London. We cut it in relatively tight so we didn't disturb too many people.

KJ: The airport was shut for about an hour to allow the fly-past?

MB: It might have been a little bit less than that, but of course that was all pre-planned and pre-notified, so all the operators knew that was going to happen.

The aircraft that were due to depart once it was all over were already out there on the taxiways, waiting for their departure clearance once we had landed after the fly-past, so there were a lot of aircraft who had the opportunity to watch the fly-past from a really good vantage point. I subsequently spoke to some of my colleagues in BA who

happened to be sitting in their aircraft waiting for departure clearance – they said they had a great view and pointed it out to their passengers on board that day, so that was rather fun too.

KJ: I've seen some fantastic footage of that flight – it was brilliant!

MB: There were three things that differentiated that fly-past from the other two. Firstly, I had never done it before, and none of that particular group of the Reds had ever done it before – the Reds had flown with Concorde before, but it was a different team and different pilots. Second was the nature of this close-up – you are flying a whole big formation that is concertina-ing all the time. Thirdly, it was right over central London, straight into a very

busy international airport, so that was an added level of co-ordination. Whereas the Queen's Golden Jubilee fly-past, which also took place over central London, was something that is done every year, for the Monarch's birthday fly-past, so all the procedures for that were established, and the Reds in particular have got a lot of experience of doing that.

That particular Red Arrows team at that time had no experience of flying with Concorde. Because it was the first time that anybody from that team had flown with Concorde, one of the things they did whilst they were at Stansted was to put a number of large Day-glo adhesive panels on the side of Concorde. These were large up close, but not so large that you could see them from the ground. The Reds put the panels at strategic points on the fuselage and engine nacelles and outer wings, to give the first member of the team off each wingtip the correct positioning guidance. Subsequent to that, on the other two occasions [1999

and 2002], that was not necessary because they'd got the experience by that time.

The other thing that we did was to have a long discussion about whether the Reds should formate on us or whether we should formate on the Reds. Previously, in early days, Concorde had formated on the Reds, with the Reds leading, but we collectively decided that the better way to do it, both aesthetically and operationally, was for Concorde to lead, with the Reds formating.

The other lovely thing for me was that subsequently, after we did the second one, for the state opening of the Scottish Parliament, I was fortunate enough to be invited by Simon Meade, who was the Reds' leader at the time, to go up to Scampton to the Red Arrows Open Day for families and friends, and fly sitting behind him in Red One for a full display! That was spectacular – it was about a 20-minute display. One of my most memorable aviation experiences ever.

KJ: It just seems so strange – like a vanished age. We've got people who are adults now who weren't even born when Concorde retired.

MB: There's not a single child in the world who has ever seen Concorde fly in real life. Anybody born on the day we did the last flight, November 26th 2003, is now coming up to 22 years old.

KJ: But there are so many people, still, who are so fascinated by the aeroplane – including very young people.

MB: One of the things I always delight in at Brooklands Museum, where we have Concorde G-BBDG as a very popular and busy exhibit, is seeing the groups of schoolchildren on board. We get about 20,000 schoolchildren on visits every year, the majority of whom are primary school age, and just seeing the look of amazement on their faces when they get off, to realise that all this

was done, for them, a very long time ago. For older children, early teenagers, you get that as well. I hope it's a bit of inspiration for some of them to realise that there are things that can be done if you persevere. I don't necessarily mean that it would guide them into aviation-related futures, but just that if you try hard and there is the will to do something, it can usually be achieved.

Film footage of this historic flight can be seen on YouTube here:

<https://www.youtube.com/watch?v=p6A82D70-4M>

Overflying the airport

G-BOAA and the Red Arrows overfly the centre of the airport, watched by thousands of crew members and passengers in other aircraft as well as people on the ground. In the background is the old air traffic control tower, originally designed by Sir Frederick Gibberd, which would be demolished in 2012.

Photo: PA Images / Alamy



The trail-blazer

As the first Concorde to enter service with British Airways, G-BOAA was the first of the fleet to undergo servicing. BA Concorde engineer Pete Comport describes the learning experience that Alpha Alpha provided for the maintenance team.

Whilst we all readily recognise the pre-production Concorde's trail-blazing journey in the development of supersonic flight technology safety and airworthiness in the world of commercial aviation, the leap of knowledge travelled by Alpha Alpha as she racked up supersonic hours and cycles has not often been acknowledged. Yet she was to the team who maintained the continued airworthiness of the fleet a "first" on many occasions.

She blazed the way in her role as the first to enter revenue service. She would reach those all-important milestones of the service check, Inter check 1, 2, 4, and major maintenance intervals first – which meant she was the first aircraft for airworthiness engineers, planners, and production engineers to test those all-important structural and systems inspections/test time estimates and planning estimates for downtime (albeit true that the detailed function tests completed as part of the pre-test flight testing had been completed years earlier at the birthplace of Concorde).

As each of Alpha Alpha's milestones passed, the data gathered by each engineer was being assessed. How was the aircraft faring? What was the best way to sequence or complete the many tasks needed? Was the downtime allocated accurate? Was the time anticipated for those inspections and tests correct? Were the spares and materials available for the identified defects? Did

Examining fuel tanks

An Inter check towards the end of G-BOAA's life in service; hatches have been opened on the wing to allow access to the interior of the wing.

Photo: Joseph Madden

the tooling and test equipment serve its purpose well? Did the docking needed for safe working suffice?

One of the first observations was that the service check took longer than the plan allowed; the intricacy of the tests and inspections, with a small flight deck with very limited access, meant that each of the engineering disciplines would have to work closely to avoid getting in each other's way. As time went by this would become even more of an issue. The one good thing about a service check was that as a rule it didn't require the aircraft to be jacked up, unlike all of the larger and more manpower-hungry "Heavy Maintenance" checks.

Inter check 1

Alpha Alpha's Inter 1 came and went at 12,000 hours flown. This would be the first time the bespoke docking would be used for real, and the first time that engineers would be in close proximity to an aircraft that was technically airborne whilst being on terra firma. Preparing and more importantly maintaining a safe working environment for up

to 35 engineers and maintenance workers whilst fuel, hydraulics, and flying controls were being exercised or pumped within a few inches of human flesh and bone, with some of the fuel tanks open, would mean that if you got it wrong the aircraft would bite you back. A simple self-test 2 of the air data computer would simulate 555 knots, 48,000 ft altitude, and Mach 2, which would send signals to numerous systems causing the flight control and secondary nozzle to move in a few seconds to the pre-determined positions should the hydraulics or pneumatics be powered up. Add to that the inevitable parts removed to keep the daily flight schedule alive and you have a Rubik cube puzzle of a job to make progress when you want to complete those tasks in that tiny flight deck.

One of the early lessons learnt was that as those 12,000 hours of flight go by, with the wings expanding and contracting as a result, the adiabatic heating effect and an outside ambient temperature in high minus values meant fuel would find its way out of any minute gap



created by the expansion of fuel tank joints; gravity did the rest! What wasn't so easy was anticipating how many of those tiny failures in the sealing inside the wing would appear after you had filled the tanks to test for leaks. With fuel tanks empty (remembering that fuel cooled the hydraulic fluid) this meant NO hydraulic power on the aircraft until fuel was available to the hydraulic fluid fuel heat exchanger, if you chose to use the onboard ground test hydraulic pump.

A few minor alterations were made to the docking after this first Inter. The tooling proved to be largely successful with just a few additions to fool the aircraft's air and ground sensors when the jacks were in use, plus some judicious wiring links to allow circuit completion when the main gears were removed. Downtime changed, not least because pumping of fuel around the aircraft's tanks to do the leak tests all took time, and this delayed jacking. Uplift of around 12 tonnes of fuel to check one tank at a time post rectification added more time.

Add three systems of 3,000 PSI hydraulic fluid coursing through pipes in close proximity (lethal to humans should any leak occur), and the capacity to fall from a significant height should safety rails be removed to allow the aircraft to "fly" whilst in the dock, and you'll get an idea of the safety protocols needed. All required safety look-outs in constant communications to be in place with the flight deck.

Major checks

Major checks would be another leap as much more of the aircraft would be dismantled to gain access to inspect the structure beneath those intakes, and the fuselage would be stripped to bare metal, along with each and every inspection panel and fairing and all of the flying controls removed.

Generally, the airframe benefited from the heat burning off any

condensation, with corrosion not so much of an issue other than the usual problems of moisture from fluids in the cabin, galleys and toilets attacking the metal. However, heat, cycling of cabin pressure, vast changes in aircraft structure temperature (-30° to $+100^{\circ}\text{C}$) and the inevitable effects of vibration took their toll especially in the intake and powerplant areas.

Flying control surface bearings suffered and were changed; modifications mitigated but were not a panacea for all those changes in temperature and high aerodynamic loads. Rigging tolerances were small, as such bearing wear tolerances were low to ensure ultra-low drag.

A combination of high hydraulic fluid temperature and 3,000 PSI operating pressure over time meant seals within hydraulic components were subjected to extreme conditions which led to changes in components, all identified during sustained system leak testing. A huge modification programme with improved seals was implemented to resolve this issue on the fleet, which increased both scheduled and unscheduled maintenance downtimes.

Estimates of how many hours of work were needed would be budgeted for; the costs of work resulting from all those detailed inspections of structure, airframe engine and the multiple systems wiring and components would be amended, generally upwards as airframe flight hours grew.

Alpha Alpha was the first of the fleet to undergo a major check. Again it was the guinea pig for adjusting the long-term plans for all the heavy checks. These plans were the milestones by which the whole flying schedule would be set; you can't run a world-class supersonic operation without understanding when each aircraft will need to be stood down to renew its Certificate of Airworthiness. Needless to say, the fuel tank leak rectification dictated the pace of progress on all



Radome removed

G-BOAA with the nose lowered and radome removed for access.

Photo: Joseph Madden

heavy maintenance visits, along with the supply of critical components such as engines and key hydraulic and flight control components.

Modification to the crown area became part of these major checks, along with extensive cold working – reworking of critical structural joints in the wing and fuselage. With strain gauge technology employed to ensure a few thousandths of an inch accuracy, this also dictated limits to the number of engineers allowed on the aircraft.

Generally, landing gear changes were scheduled during major checks, with a 3-month lead time for the return of the main landing gears. The one spare set of main gears was constantly swapping from aircraft to aircraft once the "overhaul never exceed" hours were reached. Rigging the main gears was a complex task with the geometry and tolerances critical, less so the nose gear.

The programme of checks would keep BA's Concorde operating safely for the 27 years of their time in service – thanks in large part to G-BOAA and her role as the first to undergo each stage of maintenance and enable the engineers to refine their skills and knowledge.

The move to Scotland

Following the end of Concorde passenger services, G-BOAA was moved up to Scotland to go on display at the National Museum of Flight at East Fortune. Paul Hazelwood, who worked with Alpha Alpha at the museum for nearly 20 years, recalls her arrival and her new role as a visitor attraction.

G-BOAA's first flight, 5th November 1975: I was 19 at the time and living in Southampton. I saw all of the Concorde fleet at Heathrow in the early 80s, with the exception of Alpha Fox. (I should get down to Bristol at some point!)

My life, like most people's, has had many twists and turns over the years, and I ended up working at the Museum of Flight in East Lothian for the summer season of 2002. It was a great place to work, but at the end of the season I was out of the door and unemployed. The museum, though, kept you on the books, and I was able to return for another season in 2003. This was when it was announced that the Concorde fleet was being retired.

Acquiring a Concorde

Behind the scenes our Director at the time, Gordon Rintoul, was working on a plan to bring one of the aircraft to Scotland. (There had been an idea to bring one of the development aircraft to the museum when they were retired and fly it in, which never came to fruition.) The museum's proposal met with approval from British Airways, and work

Preparing the space

Hangar 4 emptied of its previous exhibits, ready to accommodate G-BOAA. Note the modification to the ceiling, to allow space for the top of the tail.

Photo: Paul Hazelwood



started at the end of the summer season to make space for our new star exhibit: Concorde G-BOAA.

Alpha Alpha was to go into Hangar 4, which was the only hangar large enough to accommodate it. This meant that all of the exhibits had to be moved elsewhere within the museum – not an easy task. All of the hangars needed to be reorganised, as well as some of the other buildings.

Work begins

A plan was developed to move the aircraft and other exhibits at the museum, and this work started in November 2003. This was achieved despite the winter weather, and the hangar was emptied.

The structures inside the hangar needed some alterations to create offices, improved toilet facilities and a theatre to show the story of Concorde coming to the museum. The roof of the hangar had to be modified to clear the tail of the aircraft; as the hangar is a listed building, approval had to be granted and the parts of the existing roof removed and stored so that they can be replaced if Concorde is ever moved elsewhere.



Parts arriving

The engine nacelles arrive; these and other parts were sent to the museum in advance of the main airframe.

Photo: Paul Hazelwood

Moving the aircraft

The move of the aircraft is a story in itself. It was dismantled at Heathrow, and parts started to arrive at the museum in advance of the aircraft. These were carefully stored in the hangar ready for the team who would reassemble the aircraft. The fuselage was moved through London to the Thames and loaded onto a barge to make the trip up the east coast, to be unloaded at Torness, which is home to a nuclear power station. The aircraft was brought up the A1 at night and along a new section of road to a holding area before finally being brought across the fields on a metal track laid by the army for us.

The arrival of the Concorde at the museum was a big event for East Lothian. I was lucky to be there on the day, even though I was stood on the approach road checking tickets and allowing entry to invited guests. Everything went well, and after the speeches and press photos Concorde was moved into the hangar.

Re-assembly

It would be close to a year before Alpha Alpha would be open to the



Reaching the museum

G-BOAA on the low loader that brought her to the museum. The red door of hangar 4, her new home, is visible in the background.

Photo: Paul Hazelwood

public. Hangar 4 was turned into a workshop area with restricted access. We were able to get a sneak peek inside, though, before the work started. The aircraft had been stripped internally and was like a cargo carrier; I wish I had taken a photo of this.

The museum was open during the reconstruction and we were able to show visitors the work taking place through viewing holes in the wooden wall that had been constructed. Putting the aircraft back together was not the only aspect of getting her ready for display. The exhibition area had to be installed and the film show created. We needed a building for the shop, which ended up being a temporary building (still there), and the cafe had to be refurbished.

Most of this took place over the winter, when the museum was closed during the week.

Tours begin

Before AA opened to the public much had to be done. Staff had to be recruited and trained. We also needed a ticketing system which was able to sell tickets in 15-minute blocks, to allow people on board. It was decided that 15 people every 15 minutes could go on board using the new audio guides; I think it worked out at 375 people a day. All of the visitors were able to view the aircraft and exhibition, but only those with boarding passes got on board. This inevitably led to a few disgruntled visitors as we sold out every day for several weeks.

The level of interest in Concorde attracted many visitors who would not normally have been interested in an aviation museum. We had a guy who wanted to take photos of his models on the aircraft; these were not Airfix ones! People from all walks of life came to visit, which added to the interest at the time.

It was quite a learning curve dealing with the volume of visitors, which was probably three times that of previous years. We obviously had to limit the wear and tear on the aircraft and try to prevent people taking away souvenirs – not always successfully, sadly. The aircraft had been visitor-proofed; however, this didn't stop people trying to open the overhead lockers and various doors.

We did daily checks on the interior, and any maintenance was carried out by volunteers and our conservation staff. Tyres had to be

checked and inflated if required, and we were also still draining fuel out of the aircraft. To keep her looking good we tried to have an annual clean of the outside, which could only be done during the winter.

Further plans

Further development of the museum has taken place over the years, with hangars 2 and 3 refurbished and other buildings opened as exhibition areas. The initial surge of visitors in the first couple of years has settled down to a more manageable number, and Concorde is now accessible to all those who visit the museum.

There was a plan to build a new hangar just outside the main site, which would house Concorde and the other airliners. This sadly could not happen due to planning restrictions, and it remains to be seen what happens next.

Final thoughts

The arrival of Concorde started a busy period of investment and development at the National Museum of Flight and effectively gave me a job for close to 20 years. My time at the museum was generally a joy, albeit with a few frustrations – which you must expect in all occupations. I feel privileged to have been there.



Visitor attraction

G-BOAA has been on display since April 2005. She has attracted many thousands of visitors, including people who would not normally visit an aviation museum.

Photo: Anne Burgess / Wikimedia Commons (CC BY-SA 2.0)

The secret to supercruise

Some of the systems used on Concorde were found on no other airliner. Kevin Jones, one-time avionics workshop technician and latterly A and B (restricted) EASA licensed aircraft maintenance engineer, describes his work on these systems, starting in the 1970s, and particularly on the air intake control units (AICUs), which enabled Concorde to supercruise – fly at supersonic speed without reheats.

AN EX-APPRENTICE colleague of mine, Peter Comport (who was the British Airways Concorde Maintenance Manager), asked me if I could write an article about the Air Intake Control Unit (AICU).

Ground-breaking work

When I finished my apprenticeship with the British Overseas Airways Company (BOAC) in 1974, BOAC and British European Airways (BEA) had just merged to form British Airways. I was placed in the BOAC avionics electrical workshop in a building known as TBA (technical block A). Little did I know that in a few months' time I'd be asked if I would like to join the Concorde electronic component section.

This was an interesting time for me during the mid '70s. I attended several training courses learning about various Concorde systems and their electronic boxes or (as they later became known) Line Replaceable Units (LRUs). One of these training courses was at Filton, adjacent to the British Aircraft Corporation (BAC) Concorde production line, to learn about the Universal Test Equipment (UTE). The UTE was quite a large computerised testing station consisting of tall equipment rack cabinets and a test bench where the LRU under test would interface to the test rig. Interface patch modules determined the program to test the various major Concorde electronic LRUs. The AICU was one of these.

At the heart of the UTE was a Hewlett-Packard rack mounted computer. The electronic printed circuit boards within could be mounted

Technical block A (TBA)

Concordes G-BOAF, G-BOAG, and G-BOAC in the TBA hangar at Heathrow.

Photo: Baz Glenister



on extender cards, enabling fault-finding down to component level, assisted by the computer's analysis, with the LRU powered up on the test bench.

I was also lucky enough to attend a training course at Aero-spaciale's facility in Toulouse (now a major Airbus Industries complex); here I learned about the electrical system and propulsion system LRUs. Further courses were held in Paris at Messier Hispano's facility, where the anti-skid, carbon brake and nosewheel steering LRUs were on the agenda. A later additional modification to Concorde was the Flat Tyre Detection System, another LRU looked after in our workshop.

It was quite intricate to fault-find and change micro-electronic components within, using specialist de-soldering and soldering equipment, looking through a quite powerful microscope after having used the UTE or other relevant electronic test equipment; multi-meters, oscilloscopes and signal generators were essential to the task. We also did ground-breaking printed circuit board repair techniques that were ahead of the game compared to other electronic repairers, and I have it on good authority from a former

Civil Aviation Authority (CAA) surveyor that they were eventually included in the Civil Airworthiness Inspection Procedures. He did some of the BA workshop CAA audits and they took photographs of some of the techniques we used. I met him when he was the examiner for my Instrument License oral examination, where he remembered me.

Enabling supercruise

On to one of the major factors that made Concorde so successful (in my humble opinion): supercruise – a flight phase that no new aircraft now will probably ever achieve. This is the ability for Concorde to accelerate to cruising speed: say Mach 2.0. After passing the trans-sonic phase, Mach 0.9 to Mach 1.7, the engine reheat can be turned off and the throttles used normally to accelerate to cruising speed.

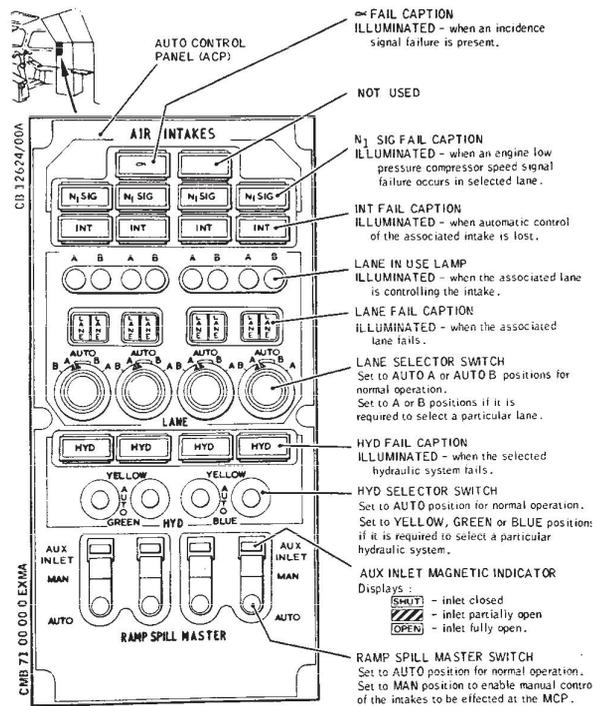
It's the clever design of the air intakes, with their internal, hydraulically operated, variable angle ramp doors, that enabled the air pressure at the front face of the four Olympus 593-610 engines to be lowered sufficiently that they breathe sub-sonic air at a much higher pressure. The intakes give the engines an 80:1 pressure advantage.

Diagram of air intake system controls

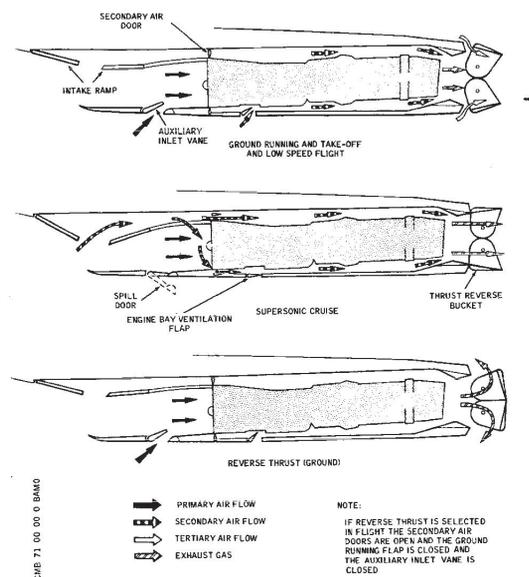
Right: This diagram shows the controls for the air intakes and the ramp spill doors on the flight engineer's panel. Image taken from the *Aérospatiale / BAe / BAC Concorde maintenance manual*

The four AICUs were the heart of the intake system. They worked in conjunction with the four Engine Control Units (ECUs) and two Nozzle Angle Scheduling Units (NASU 1 for engines 1 and 4 and NASU 2 for engines 2 and 3) and the Air Data System to get the optimum power from the four engines. The AICUs probably made the first use of an in-flight digital data bus for data signal transfer. (Many of the other LRUs I worked on had digital circuitry implemented using what electronic components were available at the time of Concorde's development: early microprocessors and microchip operational amplifier circuits.)

The AICUs and ECUs made use of a dual lane principle. The two lanes are designated A and B. Whichever lane is in control is monitored by the other, such that if the controlling lane fails the monitoring lane takes over in AUTO mode. The lanes could also be controlled at the flight engineer's panel, in MANUAL mode, if either lane developed a fault. On the Air Intake Control Panel (ACP), N1 is the revolutions per minute (rpm) of the Olympus engine's low-pressure compressor shaft. The top left warning light (Greek alpha symbol) is the angle of incidence of the aircraft; the AICUs needed this signal to determine the configuration of the ramp and spill doors. An example is on approach, with the aircraft at a high angle of attack and flying at a low air speed. The auxiliary vane in the spill door would be signalled by the AICU to open inwards so that the engines would receive undisturbed air, the front intake airflow being reduced because of the high angle of attack. Another example is when flying in supercruise at a low angle of incidence and at high speed; the AICU would modify the ramp door positions such that the shock wave produced is deflected out through the spill door, which is opened slightly ajar outwards.



Systems Management - Intake Sheet 1 of 3
Figure 022



Airflows
Figure 002

Diagram of air intake system operation

Above: These diagrams show the operation of the intake ramps, spill door, and thrust reverse buckets to direct air-flow around the engines at different phases of flight. Images taken from the *Aérospatiale / BAe / BAC Concorde maintenance manual*

A life with British Airways

I spent 15 years, after finishing my apprenticeship in 1975, in the BA avionic electrical section. In 1989 I transferred to aircraft maintenance and worked on both long-haul and short-haul aircraft. I worked on the last heavy major maintenance check at Heathrow: a Boeing 767-300. After that I moved to the ramp in Terminal 5 until my retirement, where I worked in cabin maintenance (mainly on in-flight entertainment systems) on long-haul aircraft - B747-400, B767, B777, B787 and A380.

All in all, I had a great time at BA. My only regret is that I didn't have many photographs. If only we had mobile phones then!

Kevin Jones

Concorde family reunion

On 24 October, marking the 22nd anniversary of the British Airways Concorde's retirement, Concorde First Officer John Tye arranged a reunion at Brooklands Museum for the Concorde "family" of flight crew, cabin crew, engineers and all who had worked with the aircraft over the years. Katie John reports on the day.

HAVING PUT IN months of work to organise the event, John was sadly unable to be there himself, but his wife Lynne held the fort in his absence, and First Officer Mark Jealous took on the role of Master of Ceremonies for the day.

Sharing recollections

The events started at 11.00am with a walk-through of Concorde G-BBDG. Being on board the aircraft sparked so many memories; people swapped recollections such as that of the 100-year-old passenger who remembered the Wright brothers' first flight; the jokes played on new cabin crew members (who would secretly be fitted with L plates); and the time Concorde landed at a French airport that was actually closed! The time on board Delta Golf was followed by a group photo for all the crew members, with flight crew ranged up the steps and cabin and ground crew clustered under the nose.

For the lunch, John had arranged a speech by Producer/Director Rick Gardner, who had televised some of the highlights of Concorde's early career. Already experienced filming aircraft at Farnborough and other air shows, in 1985 Rick spoke with Jock Lowe and John Hutchinson about the possibility of Concorde performing a fly-past with the Red Arrows and the QE2. This led not only to iconic images of Concorde and the Red Arrows overflying the ship at 1,500 feet (see Mach 2, Aug 2018) but also to a fly-past at Fairford in a "T" formation to mark Brian Trubshaw's retirement.

That autumn, Rick floated the idea to Jock Lowe, then BA's Concorde Director of Operations, for a 7-Concorde formation flight.



Concorde family gathering

A group photograph in front of Delta Golf, with the flight crew ranged up the steps and the cabin crew and other Concorde people gathered under the nose. *Photo: Franklyn Edwards*

This turned out not to be possible, but arrangements were made for a 4-Concorde flight on Christmas Eve 1985, to mark the 10-year anniversary of the start of Concorde passenger services in January 1976. (See Mach 2, Xmas 2015.) Adrian Meredith, following the Concorde in a Lear jet, took the photographs that still amaze Concorde enthusiasts today. Rick's video showed the Concorde forming a diamond and an echelon, then breaking from the echelon, and John Hutchinson giving an interview from the flight deck of Concorde 4.

Concorde, the Universe and everything

During the lunch I was seated next to Brian Irven, who had been Senior First Officer on Concorde from 1977 to 1990. He had a fund of stories about the people he had met on board, including Mother Theresa, the Dalai Lama, and Meryl Steep (who asked for his autograph!). He

also recalled landing at JFK on the 10th anniversary of the inaugural Concorde services; the airport staff tied a ribbon on to Concorde's nose, and Christopher Reeve – then best known as Superman – cut the ribbon in a special ceremony.

Brian had had a lifetime of working with Concorde – first as a design engineer in the drawing office at Tolworth, designing parts for the prototypes, then taking flying lessons and starting his flying career piloting VC10s for BOAC, and doing that for eight years before he joined British Airways and trained to fly Concorde. Even now, well into retirement, Brian is still challenging himself – he has been exploring the nature of the Universe, and he aims to do a PhD in physics so he can present his findings to the world.

The day ended with Delta Golf drooping her nose, with the Concorde family gathered around her. It had been a wonderful event – we were even lucky with the weather.



CONCORDE WATCH

Concorde F-BVFF French production aircraft

Location: Paris–Charles de Gaulle Airport, France

Reporter: Laurent Vialard **Date:** 27–31 October 2025

Concorde F-BVFF, at Paris Charles de Gaulle, was cleaned last week. The job lasted from Monday to Friday and was carried out by myself, Laurent Vialard, and two colleagues from the cleaning services company Vega, using a Kärcher pressure washer together with professional cleaning products.

At the same time, the energy company SPIE refurbished Fox-Fox's lighting system.

Further information about these companies can be found on their websites.

Vega: vegacs.fr/

SPIE: www.spie.com/en

Needing attention

Above right: Detail of F-BVFF at the start of the job, before cleaning has begun. *Photo: Laurent Vialard*

A week of work

Right and below right: the Vega team works on the aircraft in situ, from nose to tail, in all weathers.

Photo: Laurent Vialard

The final result

Below: F-BVFF in immaculate condition at the end of the week. *Photo: Laurent Vialard*

