

MACH 2

Concorde magazine



FEATURE

*One of a kind: Concorde 101
at 50 years*

Concorde watch

Latest news from Duxford

Issue 32
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INTRODUCTION

In this issue, we mark the 50th anniversary of the maiden flight by pre-production Concorde 101 (G-AXDN) – the third Concorde to fly. We look at the aircraft’s development and history, from construction and roll-out to her present existence at the Imperial War Museum, Duxford.

BA Concorde engineer John Dunlevy explores the features that made G-AXDN unique. Richard Harris recalls his involvement in preparing the aircraft for her maiden flight from Filton to Fairford. At the other end of the aircraft’s lifespan, Duxford Aviation Society’s David Norman recounts how 101 came to arrive at Duxford and describes her years as a museum exhibit.

Far from being a simple static display item, 101 is gradually being returned to the way she looked during her involvement in flight testing – with many systems, including the droop nose, re-activated once again.

To end, we bring the story up to the present day, with a report from Graham Cahill of Heritage Concorde on the ongoing restoration work at Duxford.

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Cover: Concorde G-AXDN (101) performs a display at Prestwick air show, Scotland, 1972.
Photo: Ronnie Macdonald / Flickr (CC BY-SA 2.0)

ONE OF A KIND

Each Concorde is unique – but British Concorde 101, registered as G-AXDN, is unlike any of the other development aircraft or those that went into airline service. In this feature we look at the unusual history and the future for this aeroplane.



IN 1969 THE FRENCH AND BRITISH prototype Concorde made their first flights – but it would be another seven years before the aircraft entered commercial service. During a rigorous programme of testing and design development, Concorde would undergo a transformation in form and capabilities. The stages of this metamorphosis could be seen in the forms of the pre-production aircraft: G-AXDN for the UK and F-WTSA for France.

Concorde G-AXDN (101) was already under construction when the prototypes took to the air. There were significant changes in comparison to the prototype – notably the all-glass visor replacing the metal visor of the prototypes. Yet in other respects the airframe and systems were still undergoing alterations and

The third Concorde

20 September 1971: Concorde 101 (G-AXDN), the third Concorde to be constructed, is rolled out at the British Aircraft Corporation factory in Filton. The aircraft would undergo 3 months of ground testing and further fitting out before making her first flight on 17 December, to the test centre at Fairford.

Photo © BAE SYSTEMS

refinements even as the aircraft embarked on her programme of test flying (see Mach 2, May 2021).

In this feature, we consider the characteristics that made 101 unique even among the Concorde fleet. We also look back at various stages of this aircraft's 50-year history; we hear from the men who worked on her in the earliest days, as well as from the volunteers who are maintaining her today and who are even restoring some of her systems to operational condition.

Flying display

Concorde 101 at the Farnborough air show, 1974.

Photo © Steve Fitzgerald



From prototype to pre-production

John Dunlevy, Concorde avionics engineer

Concorde's airframe and systems would undergo significant development in the seven years of test flying. BA Concorde engineer John Dunlevy looks at the most significant differences between the prototypes and the pre-production aircraft.

As the prototype Concorde, 001 and 002, were making their first test flights, two pre-production aircraft were already under construction: the first, designated 101 (and registered G-AXDN), being assembled at Filton and the second, 102 (F-WTSA), at Toulouse. Because the design and development work was still ongoing, differences would exist between these two "partner" aircraft.

101 and 102

Concorde 101 was an aircraft caught in the middle of design rushes and construction mayhem. Data gleaned from the prototypes' test flying programmes gave vast amounts of information as to what improvements/alterations could be made leading towards a final production version. The design and development drawing offices were in an overload condition. At the same time, new avionic technology was rapidly becoming available. As a result, construction of 101 had already commenced but its design would end up being frozen.

Aircraft 102, being constructed slightly later, would be longer in fuselage and would incorporate many more of the planned production features; there would also be minor system differences making 102 closer to the production standard. (At the time the production versions were planned to carry 128 passengers and be operated by a crew of three with six cabin attendants.)

Significant changes

There were many changes between the prototypes and pre-production versions – too many to list here. Instead, I will cover the most signifi-

Visor change

Concorde 101 (centre) with the two prototypes at Fairford, January 1972; the prototypes' metal visor is obviously different from 101's glass panels and remodelled nose. Photo: Richard Harris



Restricted view

The view through the prototype's visor was atrocious – just two tiny windows. Photo: John Dunlevy



cant ones that apply to both 101 and 102, many of which can also be seen in the later variants.

- **Glass visor** Advances in glass technology allow use of a glass-panelled visor – a dramatic improvement on the very poor visibility of the prototype mirror imaging system. The nose cone shape is changed to incorporate the new visor.
- **Forward fuselage** The emergency internal escape hatches as per the prototypes would be retained, but allowance would be made to incorporate a 9ft fuselage extension forward of the main wing root.



- **Flight deck** The navigator's station would be removed, as much improved equipment such as the Inertial Navigation System (INS) had arrived.
- **Ground power electrical connector** The connector, together with its heavy cable conduits, is removed from the nose leg (it was convenient but heavy and subjected to considerable flexing on gear retractions and extensions). It is now located in the forward lower fuselage.
- **Engine start** The heavy, unreliable gas turbine starters (GTS) fitted to the inboard engines of the prototypes are replaced with a conventional ground air start system consisting of ducting and air-driven starter motors. A cross-bleed system

Escape hatch inside cabin

The hatch in 101's cabin floor. It was designed to be operated even if the aircraft was travelling supersonically. Photo: Katie John

is incorporated, which allows adjacent engines to be started. On the prototypes, failure of a GTS would have made cross-feed impossible.

● **Intake controls** Although the pre-production aircraft are built to operate with the analogue system as per the prototypes, the digital system then in development would become available in time to be incorporated into 101. (See Mach 2, May 2021.) Aircraft 102, however, would retain the analogue system throughout his working life.

● **Engines** Near-production standard engines are fitted, although 101 retains the prototype exhaust and internal reverser clam shells. Aircraft 102 differs here again by having the production-standard exhaust/reversers installed.

● **Windows** The size is reduced to increase the strength of the fuselage and to prevent any extreme cabin pressure loss in case of failures.



Thrust reverser

One of the internal “clam shells” on 101, displayed in the closed position.
Photo: Katie John

● **Wing** The shape is changed for improved aerodynamics and also to give extra fuel capacity.

● **Undercarriage** The main legs are increased in height, which changes the sitting attitude of the aircraft; the pronounced nose-up attitude of the prototypes is noticeably reduced.

● **Rear pressure bulkhead** The submarine-type bulkhead and ventral access steps of the prototypes are gone; the bulkhead is now incorporated within double frames forward of the aft fuel tank. A vapour seal is added to prevent any leakage or

vapour entering the cabin. Space for a rear cargo hold is now possible.

● **Hydraulics** Reservoirs and accumulators are repositioned within the aft lower fuselage (originally located behind the pressure bulkhead of the prototypes).

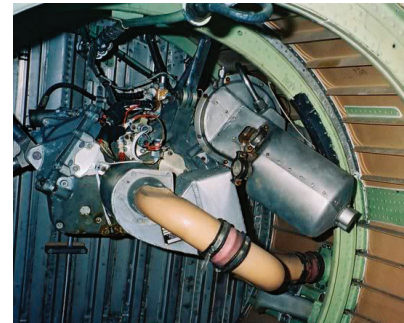
● **Emergency devices** A mono fuel emergency power unit (MEPU) is installed within the tail cone assembly. This consists of a 7-gallon tank (containing basically rocket fuel) and decomposition chamber; ignition and combustion would power two hydraulic pumps. The MEPU would not be incorporated in final production versions due to major safety concerns; an air-driven hydrant would be the final install.

● **Assists (speed brakes and braking parachute)** The speed brakes are gone but the parachute remains. By



contrast, 102 would have the new production version tail assembly.

● **Tail** The titanium tail skid is retained on 101, while 102 would have the production-standard boom tail.



MEPU in position

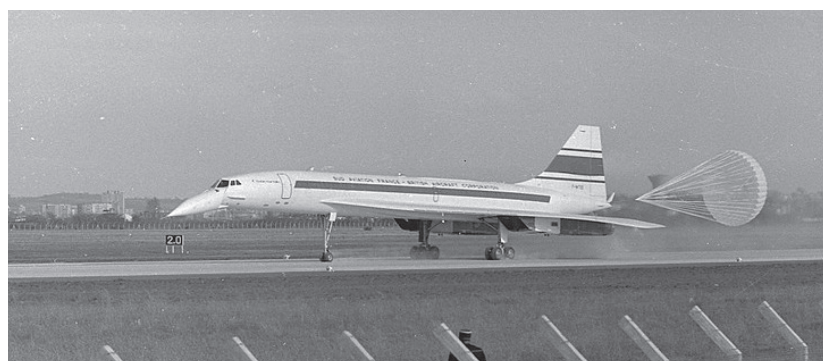
The MEPU seen in situ, installed in the tail cone of the aircraft.
Photo: John Dunlevy



Tail skid replacement

Left: the tail skid on 101.
Photo: Katie John

Above: the tail bumper on 102.
Photo: Mathieu Marquer / Wikimedia Commons (CC BY-SA 2.0)



Braking assistance

French prototype Concorde 001 (F-WTSS) deploys the brake parachute on landing after his first flight in 1969. Pre-production Concorde 101 would also have a brake parachute (see p.10), but Concorde 102 would not.

Photo: Fonds André Clos, Toulouse / Wikimedia Commons (CC BY-SA 4.0)

Further improvements

Some cosmetic improvement ideas continue within the cabins as time goes on, such as the design of the hat racks, galleys, waste water disposal and toilets. These changes would be incorporated into the next two aircraft off the two production lines. Those aircraft, the French 201

(F-WTSB) and the British 202 (G-BBDG), would closely resemble the production variants.

A fleet of individuals

Summing up, there was never a “production standard” as such. Instead, there were slight variations to different aircraft during build, with

modifications continuing throughout their working lives.

As a result, the Concorde aircraft were all individuals. A number behaved themselves constantly and were favourites. Others, however, were occasionally put on the naughty step and could be left back in the hangar for another day!

Comparing the pre-production aircraft



Top: Concorde 101

The nose and visor are similar to those of the final production aircraft, and the main legs are longer than those of the prototype, but 101 still retains the short prototype tail.

Photo: Alistair Bridges

Above: Concorde 102

The French pre-production aircraft (with British Airways livery on one side). It looks much more like the production aircraft, especially with the lengthened rear fuselage.

Photo: Athis Aviation Musée Delta, Orly

Happy 50th anniversary, 101

Richard Harris, Electrical Test Engineer, British Aircraft Corporation

With the impending 50th Anniversary of Concorde 101's first flight from Filton in a few weeks' time, Richard Harris reflects on his own association with the aircraft, beginning with his introduction to her at Filton in January 1971.

FOR THE LAST TWO YEARS of my engineering apprenticeship at Filton I joined what in those days was called Sales and Service for my career training, working under Walter Gibb, the retired Chief Test Pilot. As a Trainee Service Engineer, I already had experience of the Britannia and BAC 1-11; as new aircraft were being developed, it was quite usual for Service Engineers to be seconded out to other departments, to develop their product knowledge and familiarity.

First encounter with 101

When the British prototype, 002, was taking shape I was seconded to production on build, focusing mainly on electrical power generation and distribution. After 002's first flight in April 1969 I joined Flight Test/Test Services at Fairford as an Electrical Test Engineer.

With 101 taking shape at Filton, I was seconded back there to work on her. I was employed with Test Services in the Fuel Quantity Indication (FQI) and Centre of Gravity (C of G) Systems Group on the fuel tank probe and flight deck gauging part of the system. Other members of the same team had been testing load limit and fuel transfer; we were then brought together as an integrated team to qualify all the electronics associated with the total fuel system management.

Just to gain an insight into the extent of testing necessary, Concorde has 13 fuel tanks (numbered 1-11!) divided into three groups: main and engine feed tanks, and forward and rear trim tanks. The tanks have several purposes: to provide fuel feed to the engines, to manage



Preparation for maiden flight

Concorde 101 at Filton, being prepared for her first flight. The turning circle by the railway crossing was used as a dispersal point.

Photo: Richard Harris

the position of the aircraft's C of G, and also to act as a heat sink for the aircraft structure as well as the air conditioning and hydraulic systems. In addition to providing engine fuel feed, the fuel tanks also contain components for tank ventilation and pressurisation, fuel pumps, and load limit control together with refuel and defuel management. There is an excellent article in the June 2017 issue of Mach 2 magazine, describing the operation of the aircraft's fuel system and authored by Nigel Ferris.

Fuel system checks

The majority of the FQI system components were provided by Inter-technique in France. Most of the fuel probes and their associated wiring were now installed in the aircraft tanks. Our initial task was to check that the now wired-in tank probes each gave their correct (expected) outputs, using a Wayne Kerr Bridge.

The next task, following testing of each of the many tank probes, was to connect the probes to the aircraft wiring and feed into the FQI man-

agement racked control units, which had to be calibrated – then onwards to feed the tank fuel gauges on the flight engineer's management panel.

Once everything had been checked out electronically, then each of the tanks was filled in turn with calibrated quantities of fuel to compare with the results indicated by the aircraft's system.

Just to underline that "home life" continued during all this work, I took a couple of weeks' leave in May for the birth of the first of our sons!

The shuttle to Fairford

Once full systems test and integration had been completed and the aircraft moved into the "Function" phase, to test flying control and landing gear functioning, a number of us then returned to Fairford – both to resume work on 002 and to prepare for the arrival of 101.

By this time the British Aircraft Corporation (BAC) had acquired a Douglas DC3 Dakota, G-AMPO, which had been fully refurbished by Field Aviation at their Midlands



Shuttle service

Above: G-AMPO, the DC3 Dakota that ferried staff between Filton and Fairford, making four flights a day.

Right: 101 in the detuners at Filton during ground runs, prior to taxi runs and first flight; taken from G-AMPO on a 7.30am flight to Fairford.

Photos: Richard Harris



base. This aircraft became part of the Filton Communications aircraft fleet, with a regular daily schedule between Filton and Fairford. There were two return services each morning, the first leaving at 7.30am; a return flight at lunchtime; and two return flights again in the evening.

Until the arrival of G-AMPO, staff who had not relocated to Fairford used to travel in daily on several Wessex coaches, which left the Assembly Hall each morning at 7.30am. The coach journey to Fairford in those days took approximately 75 minutes, but the schedule for the Dakota reduced that to 30 minutes – greatly preferable.

Travelling in the Dakota had its moments, though. The first flight of the day was always a bit miserable as the aircraft was cold and the crew needed to sit on the end of the taxiway doing pre-flight run-ups and other checks. By the time we started the take-off roll, many passengers would be dozing or asleep.

On the first flight one morning, however – just after getting airborne, and still over the Filton runway – we hit a flock of seagulls just after take-off! There was a bang, the aircraft shuddered, and the cabin was full of wind and feathers.

I realised that the bird must have come through one of the two pilots' windscreens; the chances were that it would have done serious damage to one of them on the way through.

Jumping up, not knowing what to expect, I found it was the right-hand screen that had shattered – but the pilot had been reaching down to raise the undercarriage and the bird had gone right over his head and through into the cabin.

After helping the pilots to pull on their goggles whilst they called a Mayday to the Tower, I returned to my seat. All the passengers had blood stains down their faces and shirts, and feathers in their hair. The remains of the bird had travelled the length of the cabin, hit the rear bulkhead and looked very sorry for itself on the floor.

We landed without further incident, with an escort of fire engines, and we were taken back to Flight Ops. The downside was that the 8.30am Wessex Coach had yet to leave, and so it was rerouted to pick us all up for our journey to Fairford.

An enduring friendship

Within the FQI group at Fairford, I was teamed with Chris Morton, who had not long come to Filton from the Fleet Air Arm; during that year we developed an excellent working relationship and friendship.

Chris then became a specialist test engineer on the digital intake control system; he carried out many hours of ground and flight testing, mainly on 101, a lot of which was done in Tangier and Casablanca (see Mach 2, May 2021). As an intake specialist, he was seconded to us for the hot trials, route-proving, and first scheduled flights to Bahrain.

Our friendship has lasted now for just over 50 years. In October 2021 we took the chance to reprise the photo below, taken originally in 1976 on one of our flights to Bahrain (see Mach 2, February 2021), and this time on G-BOAF.



Chris Morton (left) with Richard Harris (right): then and now

On display at Duxford

David Norman, Accreditation Manager, Duxford Aviation Society

In August 1977 Concorde 101 made her final flight, to the Imperial War Museum at Duxford. She has been on display at the museum ever since, under the care of the Duxford Aviation Society. David Norman looks at the aircraft's years as a museum exhibit, and her astonishing return to a semi-live condition.



On the airfield

Concorde 101 on display outside the “Superhangar”. The aircraft was moved outside in 2005 while the new AirSpace hangar was being built. Photo: kitmasterbloke / Wikimedia Commons (CC BY-SA 2.0)

WHEN THE DUXFORD AVIATION SOCIETY (DAS) was formed in 1975, Duxford airfield was very different from the leading aviation museum it is today. Much of the airfield was being farmed and only a few of the buildings were usable, there having been little maintenance since the departure of the Royal Air Force in 1961.

DAS's predecessor, the East Anglian Aviation Society, had been formed in 1969 by a group of military aviation enthusiasts; they had done much work on the site to make the hangars and control tower serviceable and improve security. The Imperial War Museum (IWM) arrived in 1971, initially to store surplus large exhibits in one of the hangars, but later to develop its own aircraft collection at Duxford.

Bid for a Concorde

DAS was leased Comet 4 G-APDB in 1974 by Dan Air – and there being no museum, national or private, devoted to civil aviation, they decided to build up a collection of British airliners. Bristol Britannia G-AOVT arrived in 1975, and the oldest surviving Vickers Viscount, G-ALWF, the following year. The British Airliner Collection, as it is now known, has since expanded to

13 aircraft and is the most complete collection of post-war British airliners in existence.

An iconic Concorde would be the jewel in the crown of any such collection. The first two built in Britain, G-BSST (002) and G-AXDN (101), were nearing the end of their test programmes, and several museums had expressed an interest in taking them. DAS invited Lord Beswick, then Minister of State at the Department of Industry, to Duxford, where with DAS founder-member Mike Donelan he inspected the Comet 4 and saw the restoration and conservation work being done by DAS volunteers – the ability to maintain the aircraft was a major consideration in deciding where the Concorde could go. It must have created the right impression, as on 29 October 1975, Lord Beswick announced in the House of Lords that the Department of Industry would donate Concorde 002 to the Science Museum and 101 to DAS.

On 13 February 1976 a Treasury Minute was published stating:

“The Department of Industry has taken the opportunity, now that the prototype and pre-production aircraft have ceased to have any useful part to play in the Concorde

development programme, to seek appropriate sites with the right aviation or scientific associations where these historic aircraft will be preserved and available for viewing by the general public. Having considered all the possibilities put to the Department it is proposed to transfer to the Science Museum, free of charge, the Concorde prototype 002. It is also proposed to transfer free of charge to the Duxford Aviation Society the Concorde pre-production aircraft 01.” (Due to an anomaly in the Concorde numbering system, Concorde 101 is sometimes referred to as “01”; see p.14.)

Runway issues

Public access was an important requirement. In 1976 the IWM had acquired the permanent use of the Duxford hangars and airfield apron as display areas and begun opening the site to visitors on a regular basis, so all of the conditions were met. However, spirits were dampened when Brian Trubshaw, Chief Concorde Test Pilot for the British Aircraft Corporation (BAC), came to Duxford to inspect the runway and judged that it was unfit for landing Concorde. It had received little maintenance since the RAF's departure 15 years previously – and, as Duxford had been a fighter station, he questioned if it could take Concorde's 90-ton landing weight.

At a cost to DAS of several thousand pounds, a test weigher came from RAF Cardington, and after two weeks of testing the runway was declared capable of bearing the weight. It then needed jointing and cleaning to bring it up to Civil Aviation Authority (CAA) standards. A contractor was unaffordable, so a group of DAS volunteers (along with wives and children) spent several weekends on the runway de-weeding, raking out and repairing the joints. Finally, after a CAA inspection, it was passed fit for use. While all this was happening, construction of the new M11 motorway was in full swing and fast approaching Duxford, where it would involve cutting off about a quarter of the runway. Time was running out.

Preparing 101

At Filton, however, Concorde 101 was not yet ready to come to Duxford. It had been stored minus its engines, so they needed reinstallation, and to reduce the landing weight much of the 12 tons of test equipment on board had to be removed. Filton was busy completing production aircraft for delivery to British Airways, so preparing 101 to fly had low priority.

Eventually the work was done, but there was another delay when an engine failed during testing by Rolls-Royce, and one had to be borrowed from Concorde 202 (G-BBDG, the aircraft now at Brooklands), which was due to depart for the Middle East on 27 August as part of the test programme.

When the aircraft was finally returned to flight, one last issue remained: a Concorde had never before landed on such a short runway. Brian Trubshaw and John Cochrane, the pilots who were to fly 101 to Duxford, therefore carried out trial landings to show that it was possible to stop the aircraft within markers placed on the Filton runway 6,000 feet apart, the length available at Duxford. In the event, 101 was able



Touchdown at Duxford, 20 August 1977

Test pilot Brian Trubshaw brings 101 in perfectly. Note the deployment of the brake parachute – and the hay bales freshly cut from the airfield!

Photo source: unknown

to stop in less than 5,000 feet, but during the tests three of the eight main wheel brake cooling fans burnt out. As only a few days now remained before the M11 construction there was no time to repair them, and it was decided to go ahead with the cooling fans inoperable. In any case the borrowed engine was urgently needed back on G-BBDG. Motorway construction was getting ever closer; contractors' plant had even begun to appear on the airfield, so it was "now or never".

At last, on Saturday 20 August 1977, Concorde 101 left Filton shortly after 10 am on its last flight, arriving overhead Duxford about an hour later. A team of BAC engineers had arrived to receive the aircraft and take the borrowed engine back to Filton. They also brought with them eight spare main wheels in case any of the tyres had blown their thermal plugs and deflated due to the inoperable cooling fans.

After a low pass at Cambridge Airport (where the later-pattern nose and visor, first fitted to 101, had been designed and built by Marshall Aerospace), the aircraft returned to Duxford to make a perfect landing, using brakes, reverse thrust and brake parachute to bring it to a halt in just over half the runway

length. Perhaps, on reflection, it is just as well that DAS was offered one of the prototypes, as only they had brake parachutes! After allowing wheels and tyres to cool (none had deflated), 101 was turned on to the relatively narrow taxiway, with co-pilot John Cochrane hanging out of the flight deck window to ensure it did not stray on to the grass.

When the aircraft finally came to a halt, a large crowd had gathered, with radio and TV waiting to interview the crew. The biggest set of stairs available, however, were much too short to reach the exit door, so some steps were hastily found, and the crew made rather undignified



A step too far?

L-R, in orange overalls: John Allen (Observer), Brian Trubshaw (pilot), John Cochrane (co-pilot), Alan Heywood (flight engineer, at the base of the precipitous steps).

Photo: Mike Donelan



Removal of the engines

An engine is lowered out of the engine bay for transport. Photo © DAS

exits to cheers from the crowd. Duxford finally had its Concorde – and just two days later the motorway contractors began cutting 1,200 feet off the eastern end of the runway: a close call!

The four engines were removed and returned to Filton – the engine now exhibited with the aircraft at Duxford is an earlier type of Olympus 593, as fitted to the prototypes. Most of the fuel was also drained off, but some was distributed around the tanks to balance the aircraft after the removal of the engines. The Filton team then departed.

Display and promotion

By 1977, Concorde was in airline service and had an unprecedented image of glamour and luxury, but the only ones that the British public could board without an expensive flight ticket were 002 at Yeovilton and 101 at Duxford. 002 had a full complement of test gear to display, but 101 had arrived with an empty rear cabin – most of its test equipment had been left at Filton and was eventually, and sadly, scrapped.

Considerable work was needed to prepare the interior for visitors. Over the following years the floor was carpeted, fluorescent lighting was installed, and 16 pairs of (non-Concorde) passenger seats were installed in the rear part of the cabin to give visitors an impression of what an airline Concorde looked like. These were later replaced with genuine Concorde seats when BA carried out a cabin refit on its aircraft. Display cabinets contained

photographs and other Concorde memorabilia. The absence of suitable front and rear stairs was solved through the generosity of a local engineering company, Acrow Ltd, who designed and built a pair of very sturdy stairs that it presented to DAS and which are still in service today. Concorde 101 finally opened to the public in March 1978.

The arrival of Concorde led to an immediate increase in the number of visitors to Duxford. Commercial companies also wanted to promote their products and services by association with this technological icon; the writer remembers being filmed in about 1980, clad in the obligatory white coat, “taking a sample for analysis” from 101’s engine nacelle to promote the latest product of his then employer, a local scientific instrument company.

The 1980s saw no less than seven more aircraft arrive to join the British Airliner Collection, three of which needed complete rebuilds, so for a while for a while most work on Concorde was limited to care and maintenance. 1983 was, however,

Movie role

March 1983: 101 in her film role as a bomber, with a “cruise missile” being towed into position for “loading”. Photo © DAS



The Big Pull

September 1983: The young volunteers from Rotaract tow 101 (together with her tow truck) along the runway for a fund-raising event. Photo © DAS



a busy year for 101. Concorde appealed to the film industry, and 101 appeared in several movies, perhaps the best known being the James Bond movie *Never Say Never Again*, in which it masqueraded as a B1 supersonic bomber. Concorde was chosen because it had a similar engine nacelle arrangement to the B1, and because the Americans would not let them use the real thing, which was then still on the “secret” list. Brief scenes showed dummy “cruise missiles” being prepared for loading into the “bomber” and later being loaded into a real bomb bay – actually that of the IWM’s Avro Vulcan. The film company even wanted to paint 101 in military camouflage – but this was a step too far!

On another occasion, teams of young volunteers from Rotaract (an affiliate of Rotary, formerly the Rotary Club) pulled 101 six times along the runway to raise funds to help disabled people. As the aircraft’s brakes were not working, a Sentinel aircraft tractor (with brakes) was attached to the aircraft’s

tow bar with its engine running but in neutral gear. So, in addition to pulling Concorde, the teams had to pull the Sentinel as well!

Protecting the aircraft

One of the challenges of collecting large aircraft, as any aviation museum knows, is protecting them from the elements. Permanent covered accommodation is hugely expensive, and the alternative, continuously battling corrosion and regular repainting, has been likened to painting the Forth Bridge.

While Concorde 101 is now safely housed in Duxford's AirSpace building, it had stood outside for over 20 years, only moving permanently under cover in November 1998. The aircraft has been completely repainted twice, in 1983 and 1991. In 1983, before Duxford's "Superhangar" was built, no hangar at Duxford was large enough to admit Concorde – or at least its tail, at over 40 feet high – so another temporarily vacant hangar was used, with 101's tail protruding and painted when the British weather allowed. Some of the original markings were not replaced, but there is now a plan to restore them as they would have looked during 101's test career.

Also in 1983, a puddle appeared on the tarmac under the aircraft, and it was found that the fuel left in the tanks to balance the aircraft after the removal of the engines had begun to leak. A local oil company came to pump out the fuel. After testing, this was found suitable for sale as heating oil – so someone in Cambridgeshire has used genuine Concorde JP4 fuel in their boiler! Concrete blocks had to be placed in the forward baggage hold to restore the balance.

A new lease of life

Concorde 101 has been a major visitor attraction at Duxford since its arrival and remains so to this day. A recent survey showed that at least



A tight squeeze

Even the largest hangar on the airfield was not big enough for 101; here she is uncomfortably wedged into a hangar for a repaint in November 1983.

Photo © DAS



Freshened up

July 1991: Test pilot Brian Trubshaw waves from 101's window as the aircraft is wheeled out after another repaint.

Photo © DAS

60 per cent of all visitors to Duxford walk through the aircraft, which is open to visitors every day IWM Duxford is open. Conservatively this means over 200,000 a year or at least 7 million since the aircraft arrived at Duxford. Social events and celebratory dinners are often held in AirSpace and a tour of Concorde is usually on the menu.

The next major chapter in the 101 story followed a fortuitous visit to Duxford by the Heritage Concorde group, who had come to Duxford as visitors in late 2012 and happened to meet the then Chair-

man of DAS, David Garside, on board the aircraft.

DAS was looking to improve the Concorde visitor experience, by then getting a bit tired, and Heritage Concorde's proposal to restore some of the aircraft's systems to life seemed to offer exciting possibilities. It is fair to say that its realisation has been an unqualified success.

The first step was to restore the flight deck electrics and instrument lighting. Next came the reactivation of the droop nose, using a hydraulic power pack donated by Hydraulics Online Ltd – 101 drooped and



Return to light

Flight deck instruments lit up after the “Return to Light” restoration project by Heritage Concorde.

Photo © DAS

raised its nose under cockpit control on 12 August 2014, the first time any Concorde had done so in the UK since 2003, and the first time for 101 since 1977. Especially remarkable was that after some solidified hydraulic fluid had been cleaned out, the hydraulic system worked – with no leaks – having been almost completely inactive for nearly 40 years.

The droop nose is now demonstrated to the public on a regular basis. Other enhancements have included the activation, using electric motors, of the air intake ramps, spill doors, thrust reversers and landing lights for demonstrations, and the installation of a very realistic, loud, and to some rather alarming audio of a full Concorde engine start. Heritage Concorde are continuing to work on the aircraft, and DAS



Aft cabin today

Replicas of the original flight test equipment have been installed, such as the zonal units for processing data.

Photo © DAS

can only thank them for their great work and commitment, and for the generous support of Brooklands Museum, who loaned components and provided invaluable support.

As mentioned above, in the early days attempts had been made to give visitors an impression of an airline Concorde by installing some passenger seats in the rear cabin. This was only partly successful, as visitors could still see the miles of orange test wiring in the “luggage racks” and all the test equipment in the forward cabin. In any case, there were now airline Concordes in several UK museums. It was therefore decided to revamp the cabin to show how the aircraft would have looked during its test career and explain its unique contribution to the Concorde development programme.

With help from Heritage Concorde a replica of the “Ice Station” used to monitor aircraft icing – one of 101’s tasks had been to evaluate the de-icing system – was built by DAS volunteers. The seats originally used by the test crews were found in a container at Duxford, re-upholstered, and installed in their original positions in the rear cabin. Replicas of the zonal units used to process the test data, which had all been removed before 101 came to Duxford, were also built. Outside, a wall of information explains some of the issues that had to be solved to make supersonic passenger flight a reality. Visitors unable to go inside the aircraft can enjoy a virtual tour of 101 by scanning a QR code on their mobile telephones.

The Coronavirus pandemic has severely limited the footfall at Duxford and restricted work on the aircraft. With things returning to normal, however, it is hoped that DAS will be able to suitably celebrate the 50th anniversary of 101’s first flight in December 1971.

This story is not ended, as Concorde 101 will surely thrill visitors to Duxford for many years to come. It could not have been written, however, without the efforts of all the DAS volunteers that have cared for the aircraft for the last 45 years, and more recently the work of Graham Cahill, John Dunlevy and the Heritage Concorde team. The writer is grateful for the copious notes made over the years by the late Ken Pettit, DAS member and devoted Concorde enthusiast; for the reminiscences of other DAS members, especially founder member Mike Donelan; and for Carla Butler’s help with enhancing some of the older photographs.

Project Salute

August 2014: at the culmination of Heritage Concorde’s restoration work, 101 droops her nose and visor for the first time in 37 years.

Photo © DAS



Timeline: history of Concorde 101 (G-AXDN)

20 Sep 1971	Roll-out of Concorde 101 at the British Aircraft Corporation (BAC) factory, Filton, for the start of ground testing.
17 Dec 1971	Maiden flight from Filton to RAF Fairford, flown by BAC Chief Test Pilot Brian Trubshaw, with co-pilot John Cochrane.
12 Feb 1972	First supersonic flight; limited to Mach 1.5 as aircraft is still fitted with fixed engine air intakes.
10 Aug 1972	101 returns to Filton for modifications. These include fitting of the new digitally controlled air intakes, as well as the modified wing leading edges, and the new Olympus 593 Mk 602 engines.
15 Mar 1973	Aircraft returns to Fairford to begin the test flight programme. This would run from Jan 1974 to Mar 1975 (see Mach 2, May 2021).
15 May 1975	End of test flight programme; 101 put into storage at Fairford.
21 Jan 1977	Test centre at Fairford closes; 101 flown back to Filton for storage.
August 1977	Aircraft prepared for delivery flight to Duxford.
18 Aug 1977	Tests are carried out at Filton to ensure that 101 can safely land and come to a halt on the 6,000-ft runway at Duxford.
20 Aug 1977	Final flight of Concorde 101, with Brian Trubshaw as pilot and John Cochrane as co-pilot; arrival at Duxford.
March 1978	Aircraft is put on public display at Imperial War Museum, Duxford.
Mar 1983	101 is used in the Bond film <i>Never Say Never Again</i> (see p.11).
Sep 1983	Aircraft is used in a “sponsored pull” to raise money for charity.
Nov 1998	Concorde is moved under cover in Hangar 1 at Duxford.
2008	101 goes on display at the new AirSpace hangar.
Late 2012	Members of Heritage Concorde visit Duxford and enter discussions with Duxford Aviation Society (DAS) about restoring movement to Concorde’s nose and reactivating the cockpit lights.
22 Nov 2013	101’s cockpit lights are switched on for the first time in 37 years.
12 Aug 2014	101 lowers and raises the nose and visor – the first British Concorde to perform these moves since the British Airways fleet’s retirement in 2003.
17 Dec 2021	Celebration to be held at Duxford, with Concorde pilots and engineers, DAS members, and Heritage Concorde, to mark 50th anniversary of Concorde 101’s first flight.

Pre-production serial numbers

When the Concorde production run was planned in the 1960s, there was to be one prototype each for France and the UK, one pre-production aircraft each, then the production aircraft.

- The production aircraft for the airlines would be numbered 1, 2, 3, 4, and so on.
- The pre-production aircraft would be numbered 01 and 02, the “0” signifying that these were the stage before the production aircraft.
- The prototypes would be 001 and 002 – “00” signifying 2 stages before the production run.

A problem arose, however, when the manufacturers started to use computers for tracking parts for specific aircraft. The computer system needed all the numbers to be 3 digits. The serial numbers for the prototypes were fine as they were, but the others would have to be altered.

The solution was to change the pre-production serial numbers to 101 and 102, and the numbers for the production aircraft to 201, 202, and so on. This resulted in the official serial numbers that the aircraft bear today.

CONCORDE WATCH

Concorde G-AXDN British pre-production aircraft

Location: Imperial War Museum, Duxford, UK
Reporter: Graham Cahill **Date:** 2 November 2021

Heritage Concorde visited Duxford to work on G-AXDN on 21 September and 2 November 2021. The team was James Cullingham, Peter Ugle, John Dunlevy and myself.

Duxford Aviation Society (DAS) have always been extremely supportive of both our work and our group so it is always a pleasure to work on my personal favourite Concorde.

Nose mechanism

We are in the process of updating the hydraulic power pack that powers the nose on G-AXDN. Hydraulics Online Limited have completed the upgrade of the power pack – sterling work as usual.



The nature of the task

G-AXDN seen here before the start of the current work. The wires leading from the hydraulic power pack are clearly visible, trailing under the aircraft's fuselage. The new hydraulic power pack should operate without any trailing wires.

Photo: Katie John

As things have progressed with nose moves in the UK we have fine-tuned and improved the way this is done. Duxford's G-AXDN (101) was the first aircraft in the UK to have a moving nose since 2003. Because this was the first time we had completed the task, the set-up was basic. The power pack will now include a low oil sensor and high temperature cut-off, and we have reduced the size of the tank capacity.

Other changes are the configuration of the power pack from vertical to horizontal. We are removing the ugly pipes that go to the ground from XDN, and the pump will now sit in the nose leg gear (NLG) bay on a nicely constructed shelf. This means that all green systems forward of the NLG leg are active (obviously we have disconnected the gear retraction system). The benefit of this is that we can activate the NLG doors so DAS can show what is inside, and also to allow access for servicing the power pack. This work is ongoing.

Upgrading the hydraulic power pack

The visits have gone as follows:

1 Wiring and safety systems John and I completed wiring and safety systems for the hydraulic power pack control. This will enable DAS to complete a nose move without two team members if required. We have added safety systems for pressure release, oil temperature and oil level; this will bring Duxford up to the standard of the Concordes at Brooklands, Filton and Manchester.

2 NLG door The NLG door gear was repaired and tested. Considering this system has not been used for 44 years, it went extremely well. James and Peter have had to manufacture some bespoke fittings for this test Concorde and they have done a great job. We found some dry M2V but this issue was quickly solved as we have come across it before at Duxford and other locations.

3 Upgrade of power pack The hydraulic power pack was removed from Duxford and returned to Hydraulics Online Limited for upgrade. The company also changed the configuration of the pack for horizontal operation, so that it would fit properly in its new location inside the NLG bay.



Hydraulics Online

Graham Cahill receives the upgraded hydraulic power pack from Mark Tonks, Director of Hydraulics Online. Photo: Heritage Concorde

Working inside the bay

Right: The nose leg gear bay open while the work takes place. Far right: James Cullingham works late on repairing the hydraulic system for the nose leg door gear.

Photos: Heritage Concorde



4 Re-installation of power pack On completion of the upgrade we have installed the power pack inside the NLG bay on a custom-made shelf, which DAS made from scratch.

5 Nose tests We performed several nose tests and the nose performed as expected.

Further work

Future visits will include further investigation of the ground service lights, fine-tuning of the new hydraulic pump and further work on the NLG door system, which requires some small hydraulic work.



Information and donations

Please remember that all your donations support this work and the work on G-BOAC, as well as some of the work on G-BBDG. For details on how to donate, please visit the web page here:

<https://paypal.me/Heritageconcorde?locale.x=>

For further information on G-AXDN at Duxford, please see the DAS site:

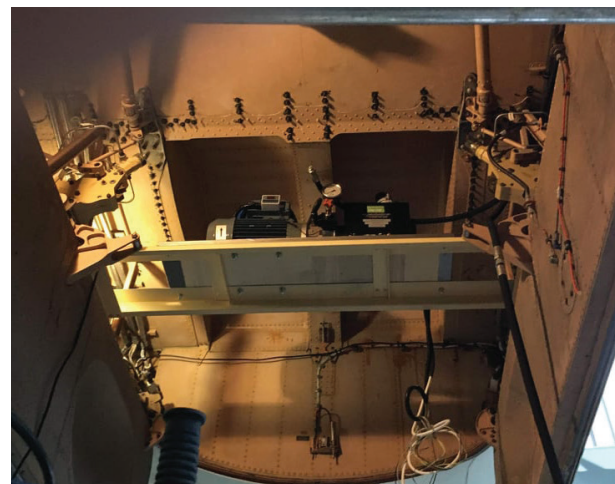
<https://www.duxfordaviationsociety.org>

For details on the work of Heritage Concorde, please see their website:

<https://www.heritageconcorde.com>

For information on Hydraulics Online and their work with Concorde, please see:

<https://hydrauliconline.com/concorde-home/>



New hydraulic power pack

Top: The power pack in place on its shelf.

Above: The view of the pack from the ground.

Photos: Heritage Concorde