

# MACH 2

Concorde magazine



ANNIVERSARY  
ISSUE

*Concorde Delta Golf:  
10 years at Brooklands*

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# INTRODUCTION

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*In this issue, we have great pleasure in featuring the recent work carried out at Brooklands Museum to bring Concorde G-BBDG (Delta Golf) back to life. We look back over the history of this unique aircraft, from her construction in the early 1970s and her work as a production test aircraft, to the years during which she was quietly stored at Filton, and then her relocation back to Brooklands, the site where her British components were first built.*

*We end with an account of Delta Golf's new life as a visitor attraction at Brooklands. James Cullingham, who led the project to reactivate the nose, tells the remarkable story of this work. Concorde Operations Manager Jenny Tye presents the visitor experiences on offer today. Finally, we feature the celebrations for the 10th anniversary of Delta Golf's inauguration as a Brooklands exhibit, and the activation of the nose by VIP guest Jodie Kidd. We hope you enjoy the re-telling of this extraordinary and inspiring achievement.*

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# THE LIVES OF DELTA GOLF

*The existence of Concorde G-BBDG (construction number 202) has spanned almost the whole of the Concorde fleet's history. On the following pages we re-trace each episode of Delta Golf's existence, from the start of construction through to her amazing return to life today.*

Construction work on this aircraft began in 1970, less than a year after the first flights of the prototypes. Delta Golf made her maiden flight on 13 February 1974, and for the next seven years she carried out an extensive programme of test flights for certification and then to test in-service modifications. She made her final flight back to Filton on 24 December 1981, having achieved 633 flights totalling 1,282 hours and 9 minutes in the air.

The aircraft was retired to Filton, and was taken over by British Airways to be used as a source of spare parts for the Concorde aircraft that had entered airline service. Over the years she had major parts removed, such as the tail fin and the droop nose.

With the retirement of the Concorde fleets in 2003, however, Delta Golf was resurrected and prepared for a new life as a museum

exhibit. In October 2003 British Airways confirmed that this aircraft would be donated to Brooklands Museum. In early 2004 she was dismantled at Filton and moved to Brooklands. During 2005 and 2006, a team from Air Salvage International carried out structural reconstruction, while a dedicated team of volunteers did the remaining work of rebuilding and then repainting the aircraft.

Delta Golf was opened to the public by HRH Prince Michael of Kent on 26 July 2006. For ten years she has been a highly popular visitor attraction as well as being used as a set for films and documentaries. Most recently, on 26 July this year, Brooklands Museum celebrated the 10th anniversary of Delta Golf's inauguration as a museum exhibit. We wish many happy years ahead for both the aircraft and the team who maintain her.

## **Rebirth of an icon**

G-BBDG in January 2006. The aircraft was re-assembled by a team of more than 100 experts and volunteers. *Photo: James Cullingham*



## The early years

*Concorde 202, registered G-BBDG (and known as Delta Golf), holds a significant place in the history of the British fleet. As a “production test” aircraft, Delta Golf was used to test all the elements that would come together to produce the whole Concorde service – from supersonic test flights to route proving, crew training, and carrying full loads of passengers.*

### Taking shape

Construction of the British parts of Concorde 202 – the nose, forward fuselage, and tail section – began in early 1970. In late 1971 the completed parts were then transported to Filton, to be joined with the central section and the wing parts, which had been built by the French in Toulouse. During 1972 the wiring and instruments were fitted.

By August 1973 the aircraft was complete. Concorde 202 was registered as G-BBDG, to the British Aircraft Corporation, in Weybridge. In December of that year she was rolled out.



### Constructing the tail

The tail section and tailfin for 202 under construction at Weybridge (above).

*Photo: Brooklands Museum archive*

### Preparing for transport

The completed front fuselage for 202 is loaded for transport to Filton (right).

*Photo: Brooklands Museum archive*

### Final assembly

The parts of Concorde 202 are gradually brought together (opposite).

*Photo: Brooklands Museum archive*







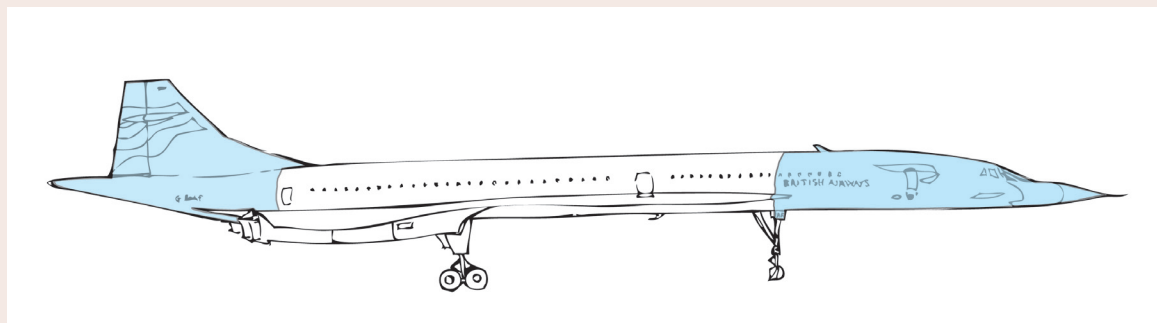
## Distribution of labour

As set out in the Franco-British agreement of 1962, the work of designing and building Concorde was shared out equally between Britain and France. Regarding the airframe, the British built the forward fuselage, including the nose and visor; the tail, including the fin and rudder; and the air intake system. The French built the wings and the central part of the fuselage, as well as the landing gear. The British and French components were brought together for final assembly at two sites: Filton in the UK, which produced the British Concorde; and Toulouse in France, for the French ones.

### Built at Brooklands

The nose, forward fuselage, and tail with tail fin were built at Weybridge; these areas are shown in blue on the diagram.

Artwork: Katie John



## A career in flight

Delta Golf's maiden flight took place on 13 February 1974. Pilots Brian Trubshaw and Peter Baker took the aircraft from Filton to Fairford. The journey included 12 minutes of supersonic flight, reaching Mach 1.4 and 42,000 ft.

Two weeks later Brian Trubshaw took G-BBDG on her first flight abroad, to Toulouse. Together with French chief test pilot André Turcat, Trubshaw carried out an exercise comparing the aircraft's performance with that of her French partner, F-WTSB (201); the British pilot flew F-WTSB (201), while Commander Turcat flew G-BBDG.

Other "firsts" for Delta Golf included the first flight at Mach 2, on 10 April, and the first visit to London Heathrow on 6 July (this being the first time any production Concorde had visited the airport). In addition, in August 1974 Delta Golf became the first Concorde to carry a full complement of 100 passengers at Mach 2.

During 1974 and 1975 DG was used for an extensive series of flights to test systems and performance in various atmospheric conditions, and to establish Concorde's compatibility with airport runways and handling procedures. Procedures included measuring take-off and landing noise in Casablanca and Madrid, hot-weather trials in Kuwait, and runway response tests in Singapore.

The aircraft was also taken to Tehran and the Gulf states for demonstration flights to help generate

sales, and performed a demonstration flight at Fairford for British MPs and trade union leaders. In addition, she was used for training the very first batch of British Airways pilots and flight engineers.

The test flights eventually helped Concorde to earn its French and British Certificates of Airworthiness in late 1975. Even after the Concorde fleets had entered service, Delta Golf continued flying, to test performance-enhancing modifications to the air intakes, control surfaces, and tailfin leading edge.

### Engine run

G-BBDG seen here undergoing a test in the Concorde engine detuners at Heathrow, 23 September 1975. Photo: Brooklands Museum archives







### **Maiden flight**

Delta Golf comes in to land at Fairford at the end of her first flight, 13 February 1974.

*Photo: Brooklands Museum archive*

### **The flight of the makers**

*One of the demonstration flights by G-BBDG was performed on 3 August 1974, for a group of 40 shop stewards from Filton, Weybridge, and Hurn – major British sites involved in the manufacture of Concorde.*

This passenger flight is described in the diaries of Tony Benn, then UK Secretary of State for Industry: “Some of the shop stewards had never flown before, even one of them who had been in the aircraft industry for thirty-seven years. Another had gone to confession last night, and another had made his will. It was astonishing that in the aircraft industry, nobody had thought of asking them to fly.” However, it seems that the passengers enjoyed the flight. As Benn recalled, at Mach 2.02 “Somebody made a threepenny bit stand up on his table in front of him. We just behaved like people on a coach trip to Weston-Super-Mare or Southend, taking photographs and talking.” In his view, “It was an unforgettable day.”  
*Quotes from The Benn Diaries: 1940-1990, Arrow Books 1996, pp.297-298.*

### **Testing the limits**

*Doug Newton, safety equipment supervisor and cabin crew supervisor, recounts his experiences of some hair-raising flights in Delta Golf.*

Whilst in Bahrain we had a flight at 300 feet and 300 knots over the desert; this was, I believe, to monitor engine response. We were then asked to do a flypast of Doha airport. As we approached, Doha air traffic control requested that we increase height – so we passed through at all of 400 feet...

On another occasion, we took a load of company passengers on a test flight over the English Channel. This involved dropping down to 2,000 feet and climbing to 15,000 feet several times to check engine response for Rolls Royce. My task was to have ‘honk’ bags at the ready. Luckily, not one was called for. One lady gripped my hand so tight that she left finger nail marks on my wrist for ages afterwards – BUT she was determined to fly. Just another day in the office for us, but with plenty of excited chat by the ‘pax’.

On one trip to Casablanca for test flights, we took some VIP passengers. One was Douglas Bader. I had a chat with him on board and was proud to shake his hand as he said, in an unassuming way, ‘From one Douglas to another, thanks for looking after me’.



### **Hot-weather work**

Delta Golf during her tour of the Gulf states in 1974. After a stop in Tehran, the aircraft visited Bahrain, Kuwait, Doha, Abu Dhabi, Dubai, and Muscat. The work during this visit comprised both test flights in hot conditions and demonstration flights to help generate sales.

*Photo: Brooklands Museum archive*

### **G-BBDG in flight**

An air-to-air shot of Delta Golf during a test flight in the 1970s.

*Photo: Brooklands Museum archive*



## **Storage at Filton**

Delta Golf made her last flight on 24 December 1981. The flight from Filton and back again was flown by Peter Baker and Roy Radford, with John Lidiard as Flight Engineer.

The aircraft was then stored in the Brabazon hangar and kept in a semi-serviceable state in case she was needed for further test flights or development work. No such work was required, however, so in 1982 she was stood down.

### **Stripped down**

Delta Golf towards the end of her time at Filton. The aircraft has had the tail fin removed and is standing on dummy undercarriage. The nose and visor were removed to be fitted to Concorde G-BOAF.

*Photo: Brooklands Museum archive*



In April 1984 British Airways bought the aircraft, for use as a major source of spare parts. In 1988, Delta Golf was moved into a purpose-built hangar, having first had her tail fin removed.

During the 1990s British Airways considered the possibility of using Delta Golf for airline service, but this idea was rejected due to the cost. In 1995, the aircraft had the droop nose swapped with that of Concorde G-BOAF, whose nose

had been damaged during a handling incident at Heathrow.

By the end of the century Delta Golf had had the landing gear, engines, and various other major components removed, and was looking much the worse for this treatment. Even so, the aircraft was pressed into service one last time, after the 9/11 terrorist attack, for trial fittings of the new strengthened cockpit doors now required for the BA and Air France fleets.



## A new start

*With the retirement of the British and French Concorde fleets in 2003, G-BBDG was resurrected for a new phase of existence as a museum exhibit. From being completely dismantled at Filton, Delta Golf has been fully re-assembled and restored to become a hugely popular visitor display at Brooklands.*

British Airways formally offered the aircraft to the Brooklands Museum Trust on 30 October 2003. During early 2004, G-BBDG was dismantled by Air Salvage International (ASI) and was moved, piece by piece, from Filton to Weybridge.

Over the next year and a half, ASI re-assembled the aircraft and

set her back on her own landing gear. A team of more than 100 volunteers, supported by ex-Concorde engineers and students from the University of Surrey, completed the restoration, re-fitting, and re-painting work. Many of the components that had been removed during Delta Golf's life in storage were taken

from Concorde G-BOAB (the last Concorde remaining at Heathrow) and fitted to Delta Golf to make her fully fitted for display.

Finally, after more than two years of hard work, Concorde G-BBDG was officially opened for visitors by HRH Prince Michael of Kent on 26 July 2006.



### The move to Brooklands

The forward section of the fuselage in transit along the M4 (left); the central section arrives at Brooklands (above).

*Photos: Brooklands Museum archive*

### Re-building work

Re-assembly of the aircraft was carried out by Air Salvage International. Their work was begun in March 2005 and was completed by the end of the year, at which point the volunteers took over to finish the re-building. Here, ASI are attaching the starboard wing to the fuselage.

*Photo: Brooklands Museum*





### Essential tasks

Shown here are just two of the tasks carried out by the team of volunteers. Above, the aircraft fuselage is masked for application of the original British Airways "Négus" livery. Right, two volunteers wash the tail.

*Photos: Mark Redgwell*

### The volunteers' work

From the day Delta Golf arrived at Brooklands, the team of volunteers led by Gordon Roxburgh have played a vital part in restoring the aircraft to the superb condition in which we see her today. They received expert assistance from former Concorde engineers as well as from students at the University of Surrey. These dedicated people have carried out much of the restoration work, including re-painting the aircraft and fitting out the flight deck and the cabin.

Since the official opening in 2006, the volunteers have been as busy as ever with maintaining and cleaning Delta Golf. Finally, and most recently, they have now managed to re-activate the aircraft's lighting and nose mechanism, as project leader James Cullingham describes opposite.





## Re-activating the nose

*James Cullingham, volunteer at Brooklands Museum*

As said in an earlier article, G-BBDG was a source of spares for the fleet while Concorde was in service, so many of the parts had been removed. Thankfully most of the fuselage nose hydraulics were different enough that this part was still complete. The nose fairing itself, having come from Concorde 216 (G-BOAF) after that aircraft suffered a hangar accident, was missing all the pipework as well as having a wiring loom that was different enough to cause compatibility issues with 'DG's production test wiring.

### The programme of work

Starting in 2012, the first work involved generating a brand new wiring diagram based on pin-to-pin continuity testing. We have a copy of 202's wiring diagrams, but as she was a development aircraft subsequent modifications mean the wiring diagrams we have for her are not 100% correct. Once a new diagram had been created, a number of modifications to her wiring were made to restore correct operation.

During 2014 we lowered first the visor, then the whole fairing later on in the year, using the screw jacks and support crane. During this time we also took all the hydraulic components apart for cleaning and testing.

### The volunteers

The team who brought G-BBDG back to life, shown here on 7 May. Left to right: Ross Kelway, Dave Ricot, James Cullingham, Mark Redgwell, Richard Walker, Gordon Roxburgh, Neil Walker, Mike Warren.

*Photo:*

*James Cullingham*

### Mechanical lowering

The nose and visor were first lowered mechanically in 2014, using a crane.

*Photo: Mark Redgwell*

Other work during 2014 and 2015 was the restoration of some additional circuitry so that we could control the 28V power as well as control the pump from the original electrical and hydraulic switches on the flight engineer's panel.

In addition, volunteer Dave Ricot had to manufacture about two dozen parts, including bushes, faceplates and hydraulic pipe caps, which we simply didn't have.

Late 2015 and early 2016 involved cleaning out the pipework, which contained original 35-year-old M2V, some of which had dried out and crystallised. We then started to rebuild the nose fairing hydraulics, starting with the pipework to enable the visor part of the system. May 2016 saw the first hydraulic system test using a hydraulic hand pump. This allowed us to operate the visor using the cockpit switch for the first time since 1981.



In late May we re-fitted the pair of 12.5 degree jacks with which DG had flown for most of her career. (DG was originally fitted with 17.5 degree jacks – identical to those of G-AXDN – for her first 27 flights.) Early June saw the arrival of the 3kW 2900 PSI hydraulic pump from Hydraulics Online, and the first full system test. A number of issues were identified and were corrected over the following weeks, the majority being the adjustment of uplocks, guide rails and microswitches.

Late June saw the first operation of DG's nose with no faults. The final piece of the puzzle was to manufacture the missing indication panel, which was fitted in mid-July.



## Delta Golf today

*After years of dedicated work by experts and volunteers, Concorde G-BBDG is now the centrepiece of the aviation displays at Brooklands Museum. Here, Jenny Tye, Concorde Operations Manager, describes the visitor experience, which includes opportunities to “fly” the British Concorde simulator.*

Tuesday 26 July 2016 marked the 10th anniversary of Concorde 202, G-BBDG, being opened to the public at Brooklands Museum in Weybridge. She has welcomed nearly 400,000 visitors through her cabins over the ten-year period, and continues to stir the imagination and evoke fond memories by showing people just what it was like to fly on board the world’s most iconic passenger aircraft. Her sole purpose nowadays is to ‘Keep the Concorde Dream Alive’.

As well as being one of the premier exhibits at Brooklands Museum, she also hosts many events, including Champagne Days hosted by Chief Concorde Pilot, Captain Mike Bannister, Afternoon Teas and even Wedding Ceremonies on board. But what of Delta Golf’s past – what was her story, and why was she made?

### Early history

Concorde G-BBDG was designed as one of the first production standard aircraft, following on from the prototype and pre-production airframes. Alongside her French sister, Concorde 201, she carried out



the bulk of the flying necessary for the final certification of the entire fleet (see pp.6–8).

Although never entering commercial service with British Airways, in 1974 she was the first of the supersonic fleet to carry 100 passengers at twice the speed of sound. This was done with employees and representatives of the British Aircraft Corporation to test the air conditioning systems on board.

Sadly, Delta Golf’s flying days ended with her final flight into Filton on Christmas Eve of 1981. She was kept in a serviceable condition for several years, in case of develop-

### On display

Delta Golf stands ready to receive a fresh group of visitors.

*Photo: Alan Wilson / Wikimedia Commons*

ment modifications or any necessary test flights. During 1984, British Airways acquired G-BBDG and used her as a source for spare parts to keep the serviceable fleet in the air. This included her droop nose, which was removed and fitted to G-BOAF’s airframe after her nose was damaged!

Brooklands Museum was offered Delta Golf in 2003. The Brooklands site was once used to manufacture 30% of both British and French Concorde components and parts. This included the 90 miles of wiring necessary in every aircraft, the nose and tail sections and part of the main fuselage.

### The visitor experience

Visitors to the Museum can ‘fly’ on Delta Golf during a 35-minute virtual flight, which includes an exhibition in the rear cabin telling the story of the aircraft and the restoration project. Additionally, the

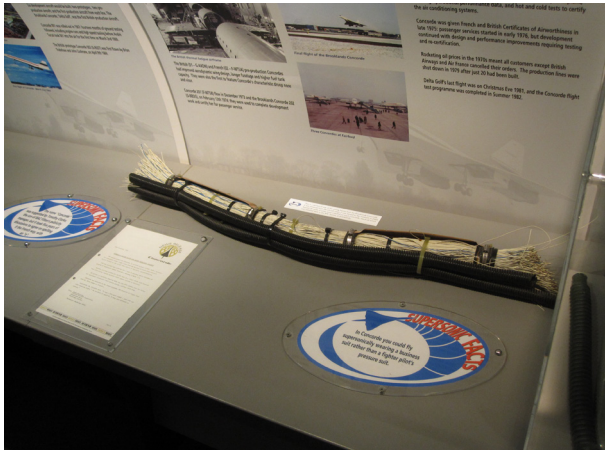


### Front cabin

The front cabin has been fitted out with the seats and decor that Concorde used in passenger service in the 1980s. Seating from the 1970s and the 2001 refit are also on display.

*Photo: Kurkoe / Wikimedia Commons*





### On-board exhibition

The rear cabin houses a display showing the history of G-BBDG and illustrating the structural and other features of the aircraft. Here, a section of the wiring is on display.

*Photo: William M / Wikimedia Commons*

front cabin is configured just as it would have been on a British Airways Concorde flight, complete with seatbelt signs, Mach monitors, and ambient British Airways music! As the aircraft powers up, you feel the rumble in your seats, accompanied by a real-time commentary from Captain Mike Bannister as he prepares for take-off. The tour is run by a dedicated army of volunteer Concorde Stewards, without whom we would not be able to offer the tours. Their passion for the aircraft is delivered in every tour throughout the day, and both young and old leave the aircraft feeling that they truly have flown on the edge of space, faster than a rifle bullet.

### Flying the simulator

Not only is Brooklands Museum home to Concorde G-BBDG, but it also houses the world's only working Concorde simulator. The Concorde simulator was used to train all British Airways flight crew, and to practise emergency procedures that would be impossible or too dangerous to act out in a real aircraft. There were only two ever constructed: a British and a French model.

### Try for yourself

Brooklands Museum offers visitors the chance to have a "flying lesson" in the simulator, under instruction from a Concorde pilot. For details, see the museum website.

*Photo: Brooklands Museum*

Once the fleet retired in 2003, the Concorde simulator was decommissioned, and it was subsequently loaned to Brooklands Museum in 2004. She was delivered in two halves, with all her electrical wiring and ducting chopped in half. Her software was destroyed and she was left in a sorry state. Once again, due to a team of knowledgeable volunteers, work began on restoring the simulator for exhibition at the Museum.

In 2009, the Concorde simulator was opened to the public, and she now operates a demo cycle throughout the day for visitors to see. Additionally, she is used for special Concorde events, where one can fly the simulator alongside a Concorde pilot.

For more information on simulator packages and other events that are available at Brooklands Museum, please visit the Brooklands Concorde website:

<http://www.brooklandsconcorde.com>



## REACHING A MILESTONE

*On 26 July 2016 Brooklands Museum marked the 10th anniversary of the inauguration of Concorde G-BBDG as an exhibit. We end by looking back on this historic day for the museum, and Mach 2 contributing editor Nigel Ferris gives an account of the events.*

### Guests arrive

Guests and visitors included former Concorde pilots, flight engineers and ground engineers, and cabin crew, and representatives of Heritage Concorde and the forthcoming aviation museum at Filton.

*Photo: Nigel Ferris*

Katie and I were very pleased to receive invitations from Jenny Tye, Concorde Operations Manager at Brooklands Museum, to their 10th anniversary event. This was to celebrate 10 years since the aircraft, G-BBDG, was officially opened by HRH Prince Michael of Kent to the general public. DG had been at Filton since her last flight in December 1981. She was disassembled and transported by road in 2004, and over the next two years the dedicated team began restoring her, with many parts coming from G-BOAB at Heathrow. She now takes her place among all the other Concorde on display around the world, and rightly so. Many thousands of visitors have passed through her gleaming fuselage, and marvelled at the complexity of the technology (and beauty) which placed Concorde as the aviation icon of all time.

### Lowering of the nose

We were treated to a champagne reception from 11.00am, and then at 12.00pm special

guest Jodie Kidd operated the control on the flight deck which lowered the visor and nose – accompanied by cameras, videos, clapping and admiration from all present. This was the first time the nose had operated since her last flight, and serves as a fitting tribute to the hard work, dedication and love that the Brooklands team had put into her. Everybody wanted to walk up the steps, peer into the flight deck, walk through the cabin – and I don't think anybody was disappointed.

Lunch (a superb meal) followed at 1.00pm, with two ex-Royal Air Force pilots as guest speakers – Vulcan pilot John Tye (no relation to Jenny, apparently), and Geoff Brindle, who flew the Lightning and the Phantom. These speakers treated us to many fascinating stories (and hair-raising escapades) from their times in The Royal Air Force.

Then there was an auction – the lot being bid for was a fantastic holiday to Kenya, worth some £8,000. This was donated by Fred Finn, Guinness World record holder for the most





### VIP guest

Jodie Kidd (right) waves from the side window of the flight deck. Under the guidance of James Cullingham, team leader for the nose activation project, Jodie lowered the nose and visor.

*Photo: Graham Cahill*

### Preparing for the move

Jodie Kidd (below left) looks from the flight deck window while former BA Chief Concorde pilot Mike Bannister and Concorde Operations Manager Jenny Tye give introductory speeches.

*Photo: Katie John*

### Lights and action

The landing lights and wing root strobes were switched on as well as the nose being active.

*Photo: Katie John*



flights in Concorde, and the world's most travelled man – a truly generous offer. The auction was conducted by Jodie Kidd, and the final figure raised was £3,600. The event was attended by many ex-Concorde pilots, engineers, and technicians, along with many members of the general public. And of course all the stewards and volunteers, all of whom were so eager to talk and explain about Concorde, relate experiences, and generally show their enthusiasm.

We must at this point make mention of Jenny Tye and her team who had put in weeks (months?) of planning to make the event the success it was, and congratulate her. Katie and I felt it was a great honour to be included, and would like to thank Jenny personally through this piece. Everybody received a personal

certificate recording their attendance – a very nice and final touch, making us feel welcome.

### Brooklands Museum

We would urge everybody to try and visit – a fantastic day out for young and old alike. Brooklands – the world's first purpose-built motor racing circuit, where many world records were set, constructed at Weybridge, Surrey in 1907 – was more than a great sporting arena. It was the birthplace of British motorsport and aviation, home of Concorde, and the site of many engineering and technological achievements throughout eight decades of the 20th century. Part of the old runway still exists and is visible as you drive in.

The Museum displays a wide range of motoring and aviation exhibits related to

Brooklands, ranging from giant racing cars, motorcycles and bicycles, aircraft engines to an unparalleled collection of Hawker and Vickers/BAC-built aircraft, including the Second World War Wellington Bomber, Viking, Varsity, Viscount, Vanguard, VC10, BAC One-Eleven, and the only Concorde with public access in south-east England.

Brooklands is a must visit venue – not only for all the exhibits, but to serve as an inspiration to the youth of today to appreciate the efforts put in by talented designers and engineers in over one hundred years. Hopefully, the young people will believe they can do the same, and contribute to science and engineering in years to come.



### Gathering of the crew

Former Concorde pilots and engineers pose with Jodie Kidd under Delta Golf's droop snoot. The flight crew members present included Peter Baker (not seen in this photo), who had flown the first and last flights with G-BBDG, and John Lidiard (seen here second from left), who had been the Flight Engineer on more than 60 flights with DG, including her final return to Filton.

*Photo: Nigel Ferris*

### Further information

To find out more about Brooklands Museum, the Concorde exhibit, and special visitor experiences, please visit the Brooklands Concorde website:

<http://www.brooklandsconcorde.co.uk>