CANADA AVIATION MUSEUM AIRCRAFT

CANADAIR CL-600 / 601 / 604 CHALLENGER
SERIAL 1003 / 3991, REGISTRATION C-GCGT

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Introduction

Setting the bar high is always a risky venture in the sinusoidal up and down world of aerospace, and Canadair Limited in Montreal literally risked it all in the late 1970s with its challenging, advanced design and manufacture of the world’s first wide-bodied business jet – the aptly named Canadair Challenger.

Canadair, a virtual fledgling in the world of aerospace achievements compared to the larger and more famous contemporaries south of the border, had to try harder to make itself recognized as a force to be reckoned with in aircraft design and manufacturing. Therefore, the young research and development staff of engineers, prevalent in the early 1950s through to the 1980s, was constantly tasked to come up with novel proposals, studies and product ideas to fill a competitive niche in a current or a future market. Hoping that one of these schemes would prove to be the harbinger of fame and respect in the aviation manufacturing community, numerous designs, from jets, trainers, maritime reconnaissance aircraft, and drones to military and civilian passenger transports of all shapes and sizes, flowed onto drafting tables at a prodigious rate. Unfortunately, the company’s nationality, periodic government ownership and location above the 49th parallel kept it from competing fairly for the huge United States Air Force military aviation contracts, something that was perceived to be sorely needed to survive in the burgeoning post-war aviation market.

Canadair Limited in Montreal, one of the largest companies in the Canadian aircraft industry, was acquired from the Canadian Government by the Electric Boat Company of Groton, Connecticut, in January 1947. The Electric Boat Company also owned Convair, the acronym for the merged Consolidated Aircraft and Vultee Aircraft Corporations. These organizations formed the nucleus of what was to become known, in 1952 as the General Dynamics Corporation. With a virtual foot in the door, due to its parent company's close military contacts, Canadair soon emerged as General Dynamics’ most active and profitable division. Canadair earned a good reputation, mainly as a licensed manufacturer of other design bureau’s aircraft, albeit oftentimes, producing more refined and improved versions of these products.

Canadair, the largest manufacturer of aircraft in Canada, was the Canadian subsidiary of the General Dynamics Corporation from 1947 until the Canadian Government bought it back as a Government-owned concern on 5 January 1976.

This is the Canadair Limited history with respect to their early business and executive aircraft designs, leading up to the conception, design and manufacture of the three CL-600 Challenger pre-production aircraft. The complete chronology of the Canada Aviation Museum’s artifact, the third pre-production Challenger test aircraft registered as C-GCGT, is fully detailed, emphasizing its varied ground and flight test history as the Canadair, and later, the Bombardier CL-600, CL-601, CL-604, Regional Jet and Active Control Technology (ACT) testbeds.

Cover Photo Caption:
The third and last flying pre-production Canadair CL-600 Challenger test aircraft, C-GCGT, on its debut flight in its final guise as the Bombardier Aerospace ACT testbed.
Canadair’s Aircraft Conversion Programmes
Some of the first projects, on which Canadair subsisted, were the refurbishment of war surplus military transport aircraft that were flooding the market and, in time, turning them into passenger or executive company transports. Notable amongst these early conversions were a few examples of Beech 45s and Lockheed 18 Lodestar’s for the T. Eaton Company and The British American Oil Company. To accommodate the conversion and overhaul business, Canadair, located at Cartierville Airport near Montreal, leased the former Noorduyn Aircraft Limited plant, also located at Cartierville Airport and it became known as the Canadair Conversion Plant, then later, as Canadair’s Plant 2 facility.

C-47 Conversion Project
Later, in a fortunate turn of events, Canadair acquired all of the Douglas C-47-type jigs, tooling and spares that had been virtually discarded by Douglas at war’s end. This provided Canadair with a huge opportunistic leap into the field of used, reconditioned aircraft, as they converted a multitude of war weary C-47s, C-49s, C-53s and ex-RAF Dakotas, into pristine, almost as good as new, DC-3s for the burgeoning commercial aircraft market. A few corporations purchased some of the refurbished DC-3s for use as executive transports, having interiors configured with all the amenities of the corporate lifestyle. Canadair also became the sole source and provider of the huge inventory of spare parts, which they provided at low cost to DC-3 customers to support their aircraft worldwide for years to come.

The C-47 conversion project began in 1945 under the Canadair model number CL-0. The newly devised model number prefix “CL-” (for Canadair Limited) had already been in use by this time. It was decided, however, CL-0 would precede an older project number, CL-1, which had been assigned to the PBY Canso amphibian aircraft, a production programme inherited from Canadian Vickers in 1944. At one point, during the summer of 1946, more than forty aircraft were undergoing conversion simultaneously on an assembly line basis. The C-47 / DC-3 major overhaul and conversion programme was completed in 1947, with Canadair having converted up to approximately 425 C-47-type military aircraft to DC-3 passenger and executive transports.
Canadair retained one of the C-47/DC-3 conversions as their own, first, corporate executive transport. Built originally as a C-47A for the USAAF (42-93060), this aircraft then served with the RCAF as a Dakota Mk. III (KG526). Following another conversion it became "civilianized" and went to TCA (CF-TED). Acquired by Canadair Limited in July 1946, and re-registered as CF-DXU, it was initially painted in an overall dark blue, then later on, redone in lighter house colours with script "Canadair Limited" markings. This executive workhorse went on to serve for more than 20 years with the company.

C-5 Canadair Five

The seventy-first and last of the famed Canadair North Stars to be built, was a one-off VIP transport conversion for the Royal Canadian Air Force (RCAF). It was a replacement aircraft for one, CF-TEL, that had been loaned to Trans-Canada Air Lines (TCA) and that had been lost in a crash in 1948. Built in 1950, this specially modified version, designated simply the C-5 and formally called the Canadair Five, it incorporated a luxurious interior outfitted with all the amenities of home and office – divans/beds, fully equipped galley, washroom, desks, swivel chairs, table lamps and of course ashtrays. While it retained the graceful lines of the North Star it had one noticeable change. This was the replacement of the four tremendously noisy Rolls Royce Merlins with quieter Pratt & Whitney R-2800, Double Wasp, radial engines. Bearing RCAF serial number 17524 (renumbered 10000 in 1951), it had its first flight on 15 May 1950 crewed by Canadair’s A.J. (Al) Lilly and William (Bill) Longhurst. It was taken on strength by the RCAF on 20 July 1950 and served as the premier VIP transport with No. 412 Squadron until June 1966.
Canadair Executive Aircraft Design History

Many of the proposed, new passenger transport designs, that came from the Canadair engineering mindset, catered mainly to the larger military market. If purchased by the military they would have a greater chance of being adapted for sales, at lower prices, in the civilian market. Some of these design proposals for propeller and jet driven aircraft were also marketed as corporate executive and business-types, and a few made it to the mock-up stage and, in some cases, metal was cut for proposed contracts. A few of the Canadair models that reached an advanced study, drawing or hardware stage for a business/executive transport aircraft included the CL-60/CL-42, CL-41, CL-53, CL-69 and CL-95.

CL-60/CL-42 Trainer/Executive Passenger Transport

In 1951, the United States Air Force (USAF) issued a specification for a twin piston-engine, high performance, utility trainer transport, for aircrew navigational training, capable of accommodating 12–14 passengers. Canadair, partnered with Beech Aircraft, along with other aviation firms in the running, was invited to submit a proposal based on the specifications. The Canadair/Beech submission eventually ranked the highest and won the design competition. The new Canadair model CL-60 was the co-operative design proposal to be designated as the T-36 in USAF service. The aircraft design had an overall length of 16.07 m (52 ft 9 in.), height of 6.71 m (22 ft), and a wing span of 21.18 m (69 ft 6 in). It was intended to be powered by two Pratt & Whitney R-2800-CB17 radial engines, providing the capability of achieving a speed of 400 knots (740 km/h / 460 mph) at an altitude of 6,100 m (20,000 ft).

With the US military contract order for 227 shipsets of aircraft components, metal was cut and three sets of outer wings, tail cones, empennage and rear fuselage were manufactured at Canadair and shipped to Beech beginning in 1952 for final assembly. However, with the assembly of the prototype aircraft well advanced, the T-36 project was terminated in June 1953 when all such foreign military contracts were cancelled, as the Eisenhower administration came to power and made across the board spending cuts. Only a full-scale mockup, in natural metal with USAF markings, was ever completed at the Beech facilities.

By January 1954, the CL-60/T-36 design was seen to be readily adaptable into the civilian model CL-42, for use as a high performance executive transport, capable of carrying 10 to 12 passengers and a crew of two. Detailed examination of the CL-60 design data and wind tunnel results showed that, while it fulfilled all of the military requirements, the design made it somewhat unsuitable for the civil market without a great deal of modifications. The fate of the CL-42 civilian executive version followed that of its predecessor when it was proved too expensive to be put into production.
CL-41 Business Executive Transport

Canadair undertook a somewhat risky move in mid-1955 to design and manufacture a side-by-side seating \textit{ab initio} jet trainer to replace the venerable \textit{Harvard} in the pilot training role for the RCAF, even though there had been no initial interest by the military in such a Canadian made concept. It was felt that this design showed promise and Canadair decided to proceed to construct two prototype aircraft under the assigned Canadair model number CL-41. A full-scale engineering mockup, in pseudo military markings, was constructed in 1957, and this was later modified and repainted to represent a potential civilian CL-41 variant. This civilian version, with the interior adaptable to seat four, was suggested for use as a convenient and practical means of high-speed transportation for important officials and business executives. Nothing ever came of this proposal. However, the CL-41 jet trainer design progressed and Canadair soon received contracts for the production of 190 examples of this aircraft as the CL-41A/CT-114, \textit{Tutor} trainer for the RCAF, and 20 CL-41G \textit{Tebuan} light attack versions, destined for the Royal Malaysian Air Force.

CL-53 Business Jet Transport

The CL-53 preliminary design proposal was conceived in 1956 in anticipation of a possible USAF requirement for a crew readiness trainer and small jet transport. The design concept was also readily adaptable for a small business jet type of transport. The basic CL-53 design would utilize many of the major components and tooling from the F-86 \textit{Sabre} aircraft, which was still being manufactured at the time by Canadair as the famed CL-13 model series. The aim of this was to benefit from proven operational serviceability of these components and to reduce costs and aircraft developmental lead-time. Parts commonality between the CL-13 and CL-53 included the complete wings, the horizontal “all-flying” tailplane, landing gear, the hydraulics and some electrical systems. The aircraft would seat seven and was to be powered by three 8.90 kN (2,000-pound) thrust Rolls Royce RB-108 or Fairchild J83 jet engines. Two engines were to be mounted on the outside rear fuselage in nacelles and one enclosed in the rear fuselage. The intakes for the interior engine were to be located on the sides of the rear fuselage and incorporated doors that could be closed when the engine was not in use to improve cruise performance. All three engines would be equipped with thrust reversers. This concept remained only in the preliminary design phase.
CL-69 Business and Utility Executive Transport

A truly interesting concept, the CL-69 was by no means a pretty airplane. This business and executive transport configuration, either land or water based, was designed in June 1958 as a twin engine turboprop, high cantilever wing, monoplane with somewhat short takeoff and landing (STOL) performance. For the amphibious operations, a separate boat-like hull equipped with stub wings and retractable, tricycle-type wheeled gear could be readily attached underneath the main fuselage. This 600 shaft-horsepower, twin-engine aircraft, would employ both engines for takeoff and then could convert to single engine operation for the cruise portion of flight, capable of achieving a maximum speed of 296 knots (547 km/h / 340 mph). It would seem that the side-by-side engine grouping, mounted immediately above the cockpit and cabin, might have caused some discomfort to the passengers and crew. A choice of a single pusher propeller, or two contra-rotating pusher propellers, driven by common driveshafts, was made available. Seating capacity was to be seven passengers and a crew of two. It had a length of 12.19 m (40 ft), a height of 4.87 m (16 ft) with a 15.24 m (50 ft) wing span, and weight of 3,628.8 kg (8,000 lbs). Like many of its contemporaries, it did not proceed beyond a study phase.

CL-95 Turboprop Executive Aircraft

The CL-95, a May 1961 design study, encompassed four main variations of a twin-engine turboprop, T-tailed, executive and business type aircraft. The different designs envisioned either a circular or elliptical shaped fuselage cross section, high or low wing arrangement, and multiple configurations of engine mounting, with the tractor or pusher propellers mounted below, within or above the wing. Power was to be provided by dual Canadian Pratt & Whitney PT6-A turboshaft engines, rated at 500 shaft-horsepower as the preferred choice, with two Continental T-72s slated as alternatives. The preferred pusher propeller and high wing arrangement had some advantages, most notably more propulsive efficiency than the tractor type, and placing the annoying propeller noise behind the main cabin. This arrangement also provided forward, unobstructed aircraft access by passengers with engines running. The dual main gear could be retracted rearward into the unpressurized tail cone, instead of into the engine nacelles. It was to have a fuselage length of 13.56 m (44 ft 6 in), height of 3.50 m (11 ft 6 in) and wing span of 13.56 m (44 ft 6 in). This variant of the CL-95 would be capable of carrying 6 to 8 passengers and a crew of two, with a gross weight of 4,080 kg (9,000 lbs) over a 1,850 km (1,160 miles) distance at 260 knots (482 km/h / 300 mph). Once again, there was no further progress beyond the study phase, but with each successive design, tradition and valuable design experience was gained for future reference.
Canadair Challenger 600 Design History

Before his name became synonymous with the premiere line of small, yet elite, private business jets, William (Bill) Lear first ventured into the business aircraft field in 1954, by converting a series of Lockheed 18 Lodestars into private and very luxurious executive transports. Combining his family name with Lockheed’s penchant for naming their aircraft with a galactic theme, the Lear conversions became known as the Learstar, with at least one example, (s/n N16L), having the name emblazoned in script above the cabin window line. The Learstar conversions were such a success, that the name would much later be resurrected for a potentially promising, new, large business jet aircraft design that Bill Lear had in the back of his mind.

In the decades of the 1950s and 1960s, Canadair had seriously studied the business aircraft sector, looking for ways in which the company might participate in one of aviation’s fastest growing markets. Towards the end of 1975, the opportunity arose for Canadair to form an association with the famed designer and creator of the Learjet, with a view to developing Lear’s concept (circa 1974) of a new business jet proposal, the Garrett AiResearch TFE731-1 turbofan-powered LearStar 600.

Canadair LearStar 600

Although the Lear name, and his reputation as a prodigious inventor, was world renowned, he had not amassed the wealth necessary to launch, on his own, another completely new aircraft design. Also, his small manufacturing facility, then located in Reno, Nevada, lacked the space and capability to perform such a task. Financial backing was essential to his endeavor, however, with the aviation recession in full swing during the mid-1970s, he could not find anyone in the American aviation community who would risk taking on the final design, engineering and fabrication of his new business jet that he called, again, the LearStar.

Spearheaded by company President Fred Kearns and Executive Vice-President Harry Halton, Canadair decided to join forces with Lear to complete his new venture. Lear had a somewhat steadfast idea of what he wanted built, however, over the course of many meetings, his design was seen to be impracticable and not far-reaching enough to corner a niche in the civil aircraft market. Methodically, Canadair changed the design to such an extent that it became, virtually an innovative, wide-bodied airframe incorporating new supercritical wing technology, new avionics, and new engines, to be constructed to tough new certification standards. It appeared, at times hauntingly familiar, that the lessons of Avro’s failed CF-105 Arrow interceptor project, some twenty years earlier, had not been learned as Canadair struggled with the monumental tasks of designing, building and selling the new LearStar design.
In April 1976, Canadair acquired the worldwide, exclusive rights to develop, market and manufacture Lear's original LearStar 600 business jet. The initial aircraft design was offered in three variants – the primary high-speed (Mach 0.85), non-stop long range 7,240 km (4,500 miles) executive version that could seat 14 passengers, or a commuter airline version that could carry up to 30 passengers in a 2-1 seating arrangement. In an air freight role, the aircraft would be capable of accommodating nine containers with 3,400 kg (7,500 lbs) of cargo loaded via the front combo cargo/passenger entry door. By August, the initial design configuration was decided upon, pending the results of extensive wind tunnel testing.
Initial wind tunnel tests were conducted at the National Aeronautical Establishment (NAE), Ottawa, transonic wind tunnel on a 1/25-scale model, with preliminary investigations concerning the high-speed aerodynamic performance of the aircraft’s configuration and the possible benefits of employing fuselage area ruling. Such tests continued throughout the follow-on Challenger development programme.

With firm orders and deposits in-hand for 53 aircraft, the programme was officially committed to launch on 29 October 1976, with the full backing of the Federal Government. The long-range, executive configuration of the aircraft design was proving most attractive, particularly to large international companies, with the cargo configuration following close behind.

Due to many disagreements on the way the project was moving away from his original design, Bill Lear was slowly phased out of the design process and his LearStar 600 was renamed the Challenger 600 in March 1977. One of the major design changes was the incorporation of a T-tail empennage, due to the impractical location of the horizontal tail in the path of the engine exhaust, as originally envisioned.

The first launch customer, FedEx, with an order for 25 aircraft, requested that a wide upward opening dual entry/cargo door be designed to suit its cargo handling requirements. They also dictated that power was to be supplied by Avco Lycoming ALF-502D, high by-pass turbofan engines, due to problems they had apparently encountered with General Electric CF34 engines on some of their other aircraft. On the latter point, Canadair concurred, with the view that ‘the customer is always right’, without investigating the Avco Lycoming engine’s use in the civil market, upgrade possibility or the ability to supply these engines to other than its primary US military customers. This did not bode well for the Challenger production line. Bothersome Lycoming engine performance and delivery troubles would continually plague the original CL-600 programme.

![The Canadair Challenger 600 full-scale wooden engineering mockup highlights the upward opening, combo separable cargo and passenger door configuration, originally designed for FedEx, the primary launch customer’s requirements. A four-piece windshield has by now been adopted. This mockup began taking shape in August 1976 as the Learstar 600 forward fuselage mockup, complete with only a single main entry door, and the original two-piece wrap-around windshield.](image-url)
With over 70 firm orders on the books by the spring of 1977, Canadair undertook the construction of three pre-production CL-600 Challenger test aircraft, plus ground-based, full-scale static and fatigue test airframes, and related component test rigs to fully wring out the design.

Due to the sudden deregulation of the air cargo industry in the United States, FedEx bowed out of their contract quickly with aircraft configured for their specific use already on the assembly line. Canadair removed the large cargo doors from these aircraft, but retained the single upward opening design on them, and they were sold rapidly to other eager customers awaiting their turn in the long queue.

A full-scale Marketing Mockup of the Challenger fuselage, with fully integrated cockpit, made its first public appearance at the 1977 Paris Air Show before going on to tour throughout Europe. An extensive North American tour followed, with all of this high profile visibility helping to add greatly to the number of aircraft being ordered. By the end of 1977, 106 Challengers had been sold with 116 orders confirmed just prior to the rollout of the first aircraft – a first in commercial aviation history at the time.

Full airframe structural testing, conducted by Canadair’s Experimental Department, began on the Challenger Static Test Article (production line airframe No. 3) in February 1979. Operational test cycling of the Fatigue Test Article (production line airframe No. 5) was started in December 1979, with a test schedule calling for a final goal to complete 72,638 simulated flight hours by February 1985. These tests formed a critical part of the aircraft’s certification programme and simulated the flights of an actual Challenger as a customer might operate it over its lifetime, which is assumed to be, for engineering purposes, 30,000 flight hours.

Due to programme delays and lack of suitable weather conditions for much of the year, the critical flight test and new aircraft certification programme could not be performed in due course at any Canadian test range. In conjunction with Flight Services Inc. (FSI) in California, a newly constructed hangar facility, called Canadair Services Limited, was established in 1977 at the Mojave Kern County Airport. This choice location was selected for its abundance of military and civilian flight test ranges nearby with near year-round superb flight testing weather conditions. By early March 1978, the first prototype CL-600 Challenger aircraft (c/n 1001) was taking shape and the assembly of the subsequent test aircraft was well underway in a typical production line setup.

### Original Canadair CL-600 Challenger Aircraft Performance Data

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CL-600 Challenger Pre-Production Test Aircraft

Serial 1001 C-GCGR-X

The first of the CL-600 Challenger pre-production prototypes was destined to be used for initial control handling qualities and performance flight-tests. Following an unofficial rollout for PR photos on 23 May, the grand formal rollout of this daring, new, state of the art business jet took place on 25 May 1978 at the Canadair St. Laurent plant, only 19 months after go-ahead.

Subsequent to its 50-minute inaugural flight starting at 9:26 a.m. on 8 November 1978, from the Cartierville Airport facilities, C-GCGR-X returned to the air after lunch for another, unprecedented and equally successful, 45-minute flight. By the end of that first week, the aircraft had racked up an additional seven flights, accumulating more than 9 hours of flight time with no recorded problems.

Attended by dignitaries, politicians and Canadair employees, the Canadair Challenger, the first business aircraft in production with a wide-body fuselage, was rolled out of preflight on 25 May 1978. Unfortunately, Bill Lear did not live long enough to see this incarnation of his original concept realized. However, as a concession to the brilliant designer, Canadair paid, for a time, a commission to his estate for every Challenger sold.

Challenger 1001 C-GCGR-X, with the crew of pilot Doug Adkins and Norm Ronasen at the controls, smoothly and quietly lifts off for the first time from Cartierville’s Runway 28. During the 50-minute flight, the first prototype climbed to 2,896 m (9,500 ft) and Adkins carried out a series of handing maneuvers, commenting after the flight that this was “The best airplane the company has ever built”.

Canadair’s chase Tutor C-GVQX, with airbrakes fully open, is tucked in tight to the Challenger prototype, banking to the north over Canadair’s Plant 2 during an early test flight.
For the first series of Canadair-based, ground and flight-tests, C-GCGR-X was initially equipped with two 29.80 kN (6,700 lbf) thrust Avco-Lycoming ALF-502H turbofans, installed due to the unavailability of the production standard 33.36 kN (7,500 lbf) thrust AFL-502L versions. The AFL-502L engines were eventually installed, along with reduced span elevators, following the arrival of the aircraft at Mojave in early 1979. A successful first flight with the new engines was accomplished on 14 March. However, in late 1979, two separate engine shutdown-events with this aircraft were a harbinger of things to come with the civil Lycoming powerplants.

Meanwhile, back home, the gross weight of the Challenger had grown to 15,650 kg (34,500 lbs) from the planned 14,740 kg (32,500 lbs) with further increases foreseeable. An intensive aircraft weight reduction programme was started at Canadair, using innovative manufacturing techniques, and a range of new lightweight composite materials were certified for installation, many appearing for the first time on a production aircraft.

The Challenger was the first aircraft to be certified to the new US Federal Aviation Regulation (FAR) 25 standards. No prior aircraft had to undergo the rigorous testing for certification that the Challenger was required to do, and some controversy resulted with regards to the manner of tests being conducted and their results, particularly the stall tests, in which aircraft 1001 was heavily involved.

In 1979 pre-production aircraft 1001 and 1002 performed a joint PR flight near their Mojave, California, test base. Challenger One, nearest the camera, sports photo tracking and calibration markings on the fuselage and tail.

While performing a series of mandated stall tests on its 353rd test flight, the first Canadair CL-600 Challenger crashed on 3 April 1980, near Mojave, fatally injuring renowned former CEPE and well liked Canadair test pilot Norm Ronaassen. The two other crewmembers successfully egressed and parachuted to safety. This aircraft had completed some 578 flight hours at the time of the accident.
Serial 1002 C-GCGS-X
The second pre-production Challenger was the systems test aircraft, used to evaluate all of the basic operating onboard systems and to conduct the all-weather testing. Crewed by pilot Doug Adkins, co-pilot Dave Gollings and flight test observer Jim Martin, Challenger 1002 entered the flight test programme at Canadair, performing its first flight on 17 March 1979. The routine 1.6-hour premier test flight was uneventful, as was the subsequent flight the next day for 1.8 hours. The aircraft initially sported a smart, revised company 3-stripe styling, with the civil experimental registration in small letters on the engine shrouds. Mounted to the nose, was the standard instrumentation data boom and, at the rear of the aircraft, a spin recovery parachute was installed.

Aircraft 1002 joined sister ship 1001 briefly in Mojave, before returning to Canadair in early May to be prepared for participation in the upcoming Paris Air Show. With the tail chute assembly removed, a large red Canadian maple leaf was added to the top of the tail and a larger italicized civil registration reapplied on the nacelles. The aircraft, piloted by Doug Adkins, departed Canadair and flew to Le Bourget in 7 hours 22 minutes. Just days before, Adkins had put 1002 through its paces at Cartierville in a rehearsal for the Paris performance, and simply awed everyone who happened to be outside and witnessed the event. It was no wonder that this performance earned it “star of the show” by the press at Paris.

Shortly after returning from Paris, the aircraft resumed its certification flight tests at the Mojave facilities, contributing a good deal by performing much of the stalls in the test programme.

Challenger 1002 cruises enroute to the Paris Air Show on 5 June 1979, just two months after its first flight. It is seen with the show I.D. number 110 on the main door. Piloted by Doug Adkins with co-pilot Dave Gollings and flight test engineer Bill Greening, the second prototype flew from Montreal to Paris non-stop, performed six demo flights and returned to Montreal 13 days later. Quite an accomplishment for such a new aircraft.

Upon completion of its test-flight duties for Canadair, aircraft 1002 went on to serve with the CAF as the sole CX-144 variant. It bore the serial 144612 along with its civil experimental registration for a time. This was the first Challenger to be retired from service and was eventually preserved and put on display at Air Command Heritage Park in Winnipeg, Manitoba, on 29 April 1993.

The second CL-600 Challenger marked another significant milestone in its flight test career by recording the 300th flight by Challenger aircraft in October 1979. Following its highly successful flight test career of nearly 1000 flights, the aircraft was put up for sale to the Department of National Defence and officially taken on strength by the Canadian Armed Forces (CAF) as a CC-144A on 29 February 1988. Being a former civilian test aircraft, it had little in common with the other military Challengers in the fleet, and was eventually assigned to perform varied test duties at the Aeronautical and Experimental Test Establishment (AETE) at Canadian Forces Base Cold Lake, Alberta. There, it acquired a matte grey finish and was redesignated as a CX-144A. This was only the second CAF aircraft to receive the ‘CX’ designation; the other, also Canadair designed and built – was the CX-84 V/STOL tilt-wing.
Serial 1003 C-GCGT-X

The aircraft on display in the Canada Aviation Museum is the third pre-production prototype Challenger aircraft model CL-600-2B12, also known as the “Frankenplane” due to the multitude of modifications incorporated to the aircraft over its lifetime. This was the first Canadair Challenger aircraft to be formally retired and preserved within a museum setting; the second Challenger pre-production aircraft was retired previously in 1993, but as an outdoor static display exposed to the harsh elements.

Unlike its two sister ships, there was no ‘formal’ or even an ‘informal’ rollout of this aircraft in the early part of 1979. It didn’t even have a token company paint or identification scheme, and remained in basic bare metal with minimal markings throughout most of its testing career. This, the final of the pre-production series aircraft, was home based at Canadair in Montreal, and tasked to perform the wing and tail loads survey tests, fuel system certification, all-weather certification testing, thrust reverser testing and standing water engine ingestion tests. It was also equipped with the Avco-Lycoming ALF-502L turbofans, with operational thrust reversers.

The interior incorporated a myriad of company-designated ‘experimental-orange’ painted racks, filled with test equipment, controls and monitors, an Aircraft Data Acquisition System (ADAS), a main passenger door emergency egress system, a water ballast transfer system, and a rear baggage door egress system, all common to a sophisticated test aircraft. Various flight test monitoring instruments, switches and gauges were also installed in the cockpit apart from the standard flight accoutrements.

The first flight of Challenger 1003, sporting Canadian civil experimental registration C-GCGT-X, occurred on 14 July 1979, flown by Canadair Chief Test Pilot Doug Adkins, Co-Pilot Dave Gollings and Flight Test Observer Ian McDonald. This flight, which lasted for some 35 minutes, reached an altitude of 4,570 m (15,000 ft) before being terminated earlier than planned due to a pressurization system failure and high engine fuel temperatures.
Bearing only small experimental aircraft registration markings on the rear fuselage, the unpainted third pre-production Challenger takes off on its first flight from the Canadair facilities at Cartierville Airport.

If it were not for the visible experimental registration, this could be mistaken for an ordinary ‘green’ Challenger just off the production line on an acceptance test flight.

The varied surface finishes, materials and overall clean lines of the Challenger 600 are clearly evident in this photo of C-GCGT-X on an early test flight in August 1979.

Standard flight tests to wring out the aircraft, preparatory to the start of its participation in the Challenger Type Approval programme, continued through 1979 at the Canadair facilities. The fuel system underwent further evaluation and engine nacelle anti-icing measures were assessed. By mid-October, aircraft 1003 had racked up 5 flights for a total of 10.4 hours. Shortly thereafter, a series of specific air and ground-based tests commenced with the aircraft. The first of these was the wings flight loads survey, which were conducted in mid-November, confirming results obtained from earlier wind tunnel testing. Later in January 1980, the aircraft was placed in a structural test rig in order to calibrate the instrumentation that had been installed for upcoming inflight tail loads tests.
Ground operations in bad weather is a concern to any aircraft operator, particularly with respect to the takeoff from a runway that may have standing water in puddles from a heavy rainfall. At takeoff speeds, if water is thrown up from the nosewheel into the engine intakes in sufficient quantities, it may extinguish the combustion process, ruining the whole day! Due to the high aft placement of the engines on the Challenger, this was foreseen not to be a problem. However, to alleviate the anxieties of Department of Transport (DoT) officials, Canadair conducted a series of simulated takeoff runs in heavy rain by taxiing aircraft 1003 through a shallow water filled trough at its Plant 2 facility. From taxiing speed of about 35 knots (64 km/h / 40 mph) up to the speed of rotation (VR), between 117 and 122 knots (217 and 225 km/h / 135 and 140 mph), the amount of ingested water was shown to be negligible.

When each of the three pre-production test aircraft and subsequent operational aircraft were completed, they were each equipped with an engine thrust reversing system. The thrust reversal system is used to slow the aircraft down during the high-speed portion of the landing run, thereby helping to reduce the wear and tear on the brakes. However, until fully ground and air tested, the thrust reversers on these aircraft were not permitted to be used and, therefore, were fastened shut. When reverse thrust is applied on the Lycoming equipped Challengers, the engine fan airflow is redirected via a series of cascade vanes forward over the nacelles, thereby slowing the aircraft. Due to a spate of airline accidents attributed to the deployment of thrust reversers while the aircraft were still flying, safety interlock systems, preventing thrust reversal operation in flight, were incorporated to preclude the occurrence of such events.

Flight tests of the integrity of the safety interlocks were conducted during the Challenger test programme, including checks that simulated the failure of these interlocks, permitting the deployment of one thrust reverser while in flight. The Challenger was easily controlled during this extreme flight condition.
Due to the possibility of the Lycoming engines ingesting foreign object debris, commonly known as FOD, such as small stones from the reverse thrust airflow during the landing run, a short series of ground runs were performed at Canadair. In one of the final home-based tasks for the third pre-production Challenger, the aircraft was to help clear the thrust reversers for operational use by the fleet by investigating possible FOD ingestion, and at what speeds this might occur. In a prelude to the performance of these ground-based tests, the aircraft received a special paint scheme. The complete rear of the under fuselage, along the engine pylon line from the engine intake to the tail cone, the lower half of the engine nacelles and pylons, and the upper surface of the inboard flaps were painted flat black. The rest of the aircraft remained basically unmarked with the exception of the civil registration, serial number and the company / aircraft appellation.

Challenger 1003 is seen here in the pre-flight area at Canadair’s Plant 2 facility in early 1981 with the matte black paint scheme applied to the aft fuselage and the upper surface of the drooped inboard flaps. The aircraft is being prepped for one of the ground-based engine thrust reverser FOD tests.

Along the lines of the previously performed water ingestion tests conducted at Plant 2, test aircraft 1003 was run at various speeds through an 18 m (60-foot) long bed of white chalk particles that had been spread over one end of the main Cartierville runway. Chalk sticks, cut into small pieces, were used, because they could be ingested without causing any internal damage to the engines. When reverse thrust was applied any re-ingested chalk particles would be expelled and any traces of impingement would bear witness on the flat black painted surfaces of the aircraft.
With its Cartierville-based testing completed for the time being, the aircraft was ferried on its 90th flight to Mojave, California on 25 March 1981, for additional thrust reverser operational evaluations at the Canadair Flight Services test base. Four additional flights were conducted, and then testing of this aircraft as a CL-600 Lycoming powered model was concluded on 8 April 1981. Prototype 1003 now entered a major modification programme to convert it to the Challenger CL-601 General Electric powered prototype.

From the beginning of the Challenger flight test programme, concerns with the quality, reliability and performance of the Avco Lycoming ALF-502 turbofan engines were apparent. This engine was initially engineered as a low-cost derivative of the core of T55 turbine engine used on some American military helicopters. As a private venture, these engines were installed in the prototype Northrop A-9A attack aircraft, but this aircraft lost out in a fly-off competition to the Fairchild A-10A. Another failed effort had the engines being chosen for the Dassault Falcon 30, only to have that programme cancelled. Launch customer FedEx had specified that it wanted these engines for its aircraft and Canadair obliged, although preferring the more powerful and reliable General Electric CF34, which was not as close to certification as was the ALF-502. Canadair had no option but to constantly revise delivery schedules and hope that no orders would be lost due to engine delivery delays and technical problems. And problems did arise. Some of the Lycoming engines exhibited a fuel consumption at a rate higher than expected, thereby decreasing the promised range, multiple failures occurred in the accessory gear boxes, and numerous compressor stalls happened at altitudes above 10,973 m (36,000 ft).

The engine deficiencies were a thorn in Canadair's side, yet they persevered with Avco Lycoming in trying to resolve these issues. These ongoing problems continued into the initial Challenger production run and, because the US military had priority on deliveries of these engines, they were often not available for the next Challenger to be completed for delivery. A stopgap measure had the Challengers being flown to completion centers in the States, whereupon the engines were removed and trucked back to Canadair towards installation on the next aircraft scheduled for delivery. With a continued threat of cancelled orders hanging over their heads, Canadair offered customers a choice of installing extra fuel tanks or new winglets, which offered improved range and low-speed handling performance, at no extra cost, but with additional weight penalties.

With late engine deliveries mounting, and associated decreased range and payload capabilities in the basic Challenger, Canadair explored the international marketplace and realized that there was a requirement for a business aircraft with even greater range and cabin area than that of the standard Challenger. On 3 July 1979, Canadair officially announced that they would be marketing a new, stretched, longer-range version of the Challenger to be known as the Challenger E (for Extended), later to be called the Challenger 610. The engines envisioned for this new version were to be new, fuel-efficient, General Electric CF34-1A turbofans.

Go-ahead for production of the Challenger E was officially given in March 1980, along with an announcement that another version of the basic Challenger would be made available to customers, also powered by the same General Electric engines. A choice of engines had long been the accepted norm for commercial aircraft and now the Challenger became the first business jet to offer that same choice to its customers. Orders soon rolled in for these new variants, but by the summer of 1981, it was shown that the Challenger 610 would be too heavy for the new engines. By August, further development of the 610 was postponed with many of the orders converted to the new GE powered Challenger. This alternate variant of the basic Challenger was assigned the model number CL-601, and aircraft 1003 was slated to become the prototype.
The conversion of the pre-production Challenger CL-600 1003 to become the prototype CL-601 aircraft required the installation of a completely new rear fuselage design to accommodate the heavier and more powerful 38.48 kN (8,650 lbf) thrust General Electric CF34-1A engines and pylons. The new engine nacelles were designed and built by LTV, Rockwell International redesigned the rear fuselage structure and Canadair fabricated it in their Plant 1 facilities.

At Mojave, the fuselage of Challenger 1003 was split in two during July 1981, with the forward section seen here supported on jack stands being prepared to receive the new CL-601 rear fuselage assembly coming soon from Montreal.

On 22 October 1981, an ex-RAF Short Belfast transport of HeavyLift cargo arrived at Canadair's Plant 1 to take the first completed CL-601 rear fuselage assembly to the Mojave test facilities.

The new CL-601 rear fuselage assembly is finally attached to the forward fuselage of aircraft 1003 at the Canadair Services Limited hangar in Mojave. The rudder and tailcone would soon follow suit.
Following the installation of the new CL-601 rear fuselage onto Challenger 1003, additional flight test systems were installed onto the aircraft. Like its sister test ships, an anti-spin parachute system was installed at the reinforced tail, as well as under-floor ballast to simulate the weight of two additional fuselage fuel tanks, which would be standard equipment on the upcoming production CL-601 aircraft.

Due to the numerous major modifications to the aircraft, Canadair gave this ‘new’ prototype the serial number 3991. However, the original serial number, 1003, was retained on the official aircraft documentation, including the Transport Canada flight permit. By early 1982, Canadair decided to install four-foot-long winglets onto 1001/3991 as part of the certification process for both Challenger versions.

Shortly thereafter the new CL-601 prototype was rolled out and it embarked on a series of ground tests at the Mojave facilities to verify that all the newly installed systems and assemblies worked as planned before attempting a first flight.

The maiden flight of this prototype CL-601 Challenger 1003/3991, piloted by Canadair’s Doug Adkins and Jamie Sutherland, took place from the Mojave Airport on 10 April 1982, five days ahead of the preplanned schedule. The first flight lasted for 45 minutes, reaching an altitude of 5,182 m (17,000 ft) and a top speed of 250 knots (463 km/h / 288 mph) with no problems encountered. A second flight, three days later, of 2.3 hours duration reached an altitude of 10,973 m (36,000 ft) and a maximum speed of Mach 0.75. The aircraft then entered an aggressive certification programme as the primary aircraft for stability and control, handling and performance scheduled to complete certification with the new engines and winglets within 12 months.

Initial engine handling throughout the full speed range was performed. Planned stall tests began in July, following the successful completion of the flight flutter tests, the most critical part of any flight test programme. Flights up to altitudes of 14,508.5 m (47,600 ft), speeds of Mach 0.94, and two, four-hour cruise flights had also been accomplished during the hot summer months. The extra weight of the installed winglets on the airplane was literally outweighed by the benefits of improved range performance, higher aileron effectiveness and better low-speed handling.
The prototype Challenger 601, serial 3991, is seen cruising on its first flight with the high desert backdrop of Mojave Airport. Atop the vertical fin at the aft end is the orange-painted housing for the trailing static cord used for air data measurements.

Shot from Clay Lacy’s Learjet, the first CL-601 is here trailed by Canadair’s Tutor chase aircraft. In order to remain on chase duty for the longer duration test flights, the Tutor carried two long-range fuel tanks on the two under-fuselage pylons.

Eventually the CL-601 test programme was supplemented by the introduction of the first production example of the Challenger 601, aircraft 3001, arriving at the Mojave facilities in September 1982, following its official rollout ceremonies at Canadair in Montreal.

Transport Canada Type Approval was granted on 25 February 1983, with restrictions remaining on the use of thrust reversers and wing anti-icing systems. Challenger 1003/3991 continued test flying to demonstrate compliance and to obtain approval for use of these systems. Following that, it then returned home to Montreal on 20 August 1983, in order to continue CL-601 post-certification testing. Some of the tests conducted during September included a new series of water and chalk ingestion investigations for the General Electric CF34 engines and thrust reversers. To aid in the visual and photographic examinations, the LH engine nacelle was painted flat black and the RH nacelle was painted white.

In 1984, a new and interesting task befell Challenger 1003/3991. Transport Canada had a requirement to operate their new CL-601 ILS calibration aircraft from remote northern Canadian Arctic gravel runways. Operations from gravel runways required special protective measures to be taken to preclude excessive damage to the aircraft’s underbelly and control surfaces and, more critical, to absolutely prevent foreign objects thrown up by the landing gear from entering and damaging the engines.

Other aircraft operating out of rough northern regions, had protection kits tested and adapted for their use, but none had yet been tested for Challenger rough field operations. To avoid damaging a customer’s new aircraft in a potentially destructive test programme, Canadair offered up one of its test aircraft for the task - the aircraft that had previously performed the roughly similar water ingestion and chalk FOD tests seemed particularly well suited.

Aircraft 1003/3991 was readily configured with a modified gravel runway protection kit, which included nose and main landing gear debris deflectors, lower fuselage and lower flap surface debris protection and a debris protection coating on the lower fuselage antennae. For added mobility on these rough surfaces, larger, lower pressure tires were installed.
Looking after the best interests of its test team personnel, the test site chosen was, of course, not in the
great White North but in Lake Havasu City in Arizona during October and November 1984. Another
reason for the choice of test location was that this airfield was on a spit of land jutting out into the
Colorado River and, that in addition to a gravel runway, it also had a paved runway. The gravel runway
was not in the best of shape and had rocks on it the size of a fist and greater. Before testing was allowed
to commence, the test team walked the length of the runway, throwing off the larger rocks. A cautionary
series of high-speed taxi runs were first conducted, to assess visually the deflected debris pattern. Fine
mesh protective screens had been installed over the engine inlets. Once it was determined that the spray
pattern was within predicted norms, the tests flights were performed with the inlet screens removed.

Not at all looking like a typical runway, Challenger
1003/3991 barrels along the gravel and scrub with a dust
cloud following close behind. In this October 1984 test
run, engine inlet protective screens were installed for
the initial testing to protect the engines from possible
debris ingestion. These screens were later discarded,
after it became evident that the landing gear debris
deflectors were doing their intended job.

This close-up shot from November 1984 clearly shows
the landing gear debris deflectors in action. Most of the
gravel and dust is being kept down and under the
fuselage and wing areas. Rocks and larger debris can be
seen flying up to the aircraft belly and, for proof, the
lower surface of the aircraft on display in the Canada
Aviation Museum still exhibits some evidence of the
rock strikes.

Leaving a huge dust cloud behind to settle over Lake Havasu City in the background, the prototype CL-601 takes off. All of
the landing gear deflectors are clearly visible and the engine inlet protective screens have been removed from the aircraft.
The rough field landings, in particular, subjected the aircraft to extra abuse. On average, a new set of
main-wheel tires lasted four maximum braking, performance landings before they had to be replaced,
because of cuts and missing chunks of rubber. The whole exercise was a testament to the ruggedness of
the Challenger design. Later that same year, additional, similar tests were performed on the dry lakebed
at nearby Edwards Air Force Base, to evaluate the capability of the aircraft, equipped with gravel kit and
low-pressure tires, to operate from low load bearing surfaces.

These warm weather locales had been too good to be true for the test team and, sure enough, Arctic
gravel runway performance tests were then conducted at Kuujjuaq (Fort Chimo), in northern Quebec. Still
with the ‘cold’ theme, the aircraft was next ferried to Punta Arenas in Southern Chile to conduct cold
weather engine relight testing.

Over the next several years, the aircraft was used to support improvements and enhancements for the
Challenger CL-601 programme, including cruise performance, evaluation of the GE CF34 engine
modifications, auto-pilot improvements and auxiliary power unit (APU) operation. During this period,
Canadair Limited underwent some improvements and enhancements of its own.

Canadair was not left unscathed by the trials, troubles and tribulations of launching the new Challenger
business jet in the era of one of the greatest downturns to hit the aviation industry. It had persevered to
the point that the Challenger was finally coming onto its own, was outperforming its competition, and
profitability was starting to return to the company. However, economically and politically, the damage had
been done and on 18 August 1986, the Federal Government disposed of Canadair in a much-publicized
sale to Bombardier Inc. of Montreal. Bombardier seeing this purchase as a positive move towards
expanding its expertise in the aviation industry, and trying to get away from the image of being just a
maker of snowmobiles and trains, soon thereafter acquired Short Brothers of Ireland. Now on a roll,
Bombardier also picked up Bill Lear’s famed Learjet Corp. based in Wichita, Kansas, in June 1990 and
finally completed its aviation foursome by purchasing struggling de Havilland Canada in March 1992.

The next aircraft iteration of Challenger 1003/3991 came in November 1989, when it was used to conduct
development testing in support of the upcoming, and revolutionary Canadair Regional Jet (RJ)
programme. On the original Challenger 600 test programme, roll control spoilers were part of the design,
but their use turned out to be problematic and the system was de-activated. The spoileron system on
1003/3991 was re-activated, and the aircraft was used to develop the aileron to spoileron schedule for the
new Regional Jet. Additionally, the aircraft was used to gather baseline flight control data for the RJ
Head-Up Display (HUD) system, and conducted development testing on the RJ APU. New, more powerful
General Electric CF34-3A engines, the same as those specified for use on the CL-601-3A and Regional
Jet, were installed on 1003/3991 to conduct ongoing RJ engine development tests. For the first flight of
the Canadair Regional Jet, 7001, on 10 May 1991, this Challenger was used as the safety/photo chase
plane and later followed the relocation of the RJ flight test operations to the Learjet facilities in Wichita.

By mid-1993, Bombardier announced the next generation Challenger aircraft, the CL-604, and, in due
course, further testing would be required from old reliable 1003/3991. The aircraft was ferried back to
Bombardier’s Dorval plant on 13 July 1993 for partial conversion to a CL-604 standard. Essentially, no
changes were made to the cockpit and aircraft systems. Modifications to this aircraft included heavier
main landing gear, larger wheels, improved braking system and tires, and a larger wheel to fuselage
underbelly fairing. Solid ballast was placed in the tail to simulate the weight of the production CL-604 tail
fuel tanks. These modifications helped to raise the maximum take-off weight to 21,863 kg (48,200 lbs), a
far cry from the original design target weight for the CL-600 of 14,742 kg (32,500 lbs).
The first flight of aircraft 1003/3991 in its CL-604 configuration, occurred from Montreal’s Dorval Airport on 8 June 1994, crewed by pilots Doug Adkins and Bruce Robinson, with Jim Brown as the Flight Test Engineer. The actual first prototype of the CL-604, aircraft 5991, had its premier flight, also from Dorval on 18 September 1994. Aircraft 1003/3991 was ferried to Bombardier’s Flight Test Center in Wichita and was put to work immediately on development and certification testing, concentrating primarily on stability and control, and handling and performance of the CL-604. The certification trials, performed by the two 604 test aircraft, resulted in Transport Canada Type Certification being granted in September 1995. The Challenger 604 prototype, aircraft 5991, was later specially painted and utilized as the company demonstrator aircraft, until it crashed and burned during a takeoff at Wichita in October 2000. Meanwhile, aircraft 1003/3991 continued with post-certification testing for the CL-604 programme until the beginning of 1997, when it became time for the aircraft to morph into its next form.

In-flight simulators, aircraft that can be operated as other types or to proof new design concepts via computer generated visual and motion systems, have been around since the early 1950s. Uses for such specialized aircraft range from basic research and development work to dynamic pilot training and evaluations for yet to be built aircraft. Some are used for a short period, relevant to the research necessary to complete a specific design or training task, while others endure for years, adopting different guises for new simulation programmes. Two of the most successful of the latter type were Calspan’s NC-131H, Total In-Flight Simulator (TIFS) and NT-33A variable stability airplane, each one serving for more than 40 years with the military and various civilian agencies.

Canadair’s participation in the simulator field had been limited to sub-contract work for Canadian Aviation Electronics (CAE) in the design and construction of F-104 Starfighter Flight Simulators for the RCAF and the German Air Force in 1960. Later, a practical, fixed-base cockpit simulator was designed and built to refine and test design characteristics, and for training numerous pilots for the somewhat successful CL-84 tilt-wing V/STOL aircraft programme from 1963 into the mid-1970s.

In 1997, Bombardier authorized an Advance Design Project called the CL-450 to study Active Control Technology (ACT), investigating fly-by-wire (FBW) and side-stick control expertise for its future aircraft design programmes, most notably the planned BRJ-X (later to be known as the CSeries), a proposed 105 to 120-seat regional twinjet. Aircraft 1003/3991 once again was chosen to be modified, this time as the ACT Flight Test Demonstrator aircraft. The modifications were performed at Bombardier’s Defence Services Division (DSD), located at Mirabel International Airport, northwest of Montreal.

In the late 1990s, aircraft 1003/3991 arrived at Bombardier’s DSD facility for its conversion to the new ACT testbed. The hand-painted “Queen Of The Fleet” nose art was proudly emblazoned on the side of the cockpit since 1995 of this, the oldest flying Challenger aircraft.

This photo, from May 1999, was taken following the completion of the first phase of ACT modifications at Mirabel. The aircraft was being ferried to the Bombardier Completion Center at Dorval by the crew of Doug Adkins, Jeff Kirdeikis and Jacques Thibaudeau for painting in ACT markings. Doug Adkins, seen at far left, was Canadair / Bombardier’s most experienced and longest serving test pilot. Officially retired as Chief Test Pilot in May 1996, he continued to fly the initial ACT flight-tests and, in the end, had flown over 900 flights for more than 1,600 hours in this aircraft alone!
A developmental fly-by-wire system was installed, along with an active sidestick controller in the co-pilot position. The left-hand safety pilot position retained the conventional flight control mechanical systems for safety and back-up purposes. The fly-by-wire system was integrated with a new experimental heads-up primary flight display screen on the right side at the forward cockpit window location. The aircraft could be flown with the co-pilot’s hand-wheel, which could be removed on the ground or in flight for dedicated FBW testing using just the sidestick controller.

The Lear Siegler, sidestick control box installation, as seen mounted in C-GCGT. The sidestick controller was not an innovation for aircraft use. One of the first uses of such a device was in the North American Aviation’s JF-107A (s/n 55-5120) Century Series fighter in early 1958 for the development and support of the North American experimental X-15 rocket plane control system. The first practical application of the sidestick controller on a production military aircraft was when it was selected for use with the General Dynamics F-16 Fighting Falcon. Other military and commercial aircraft applications soon followed.

The console mounted computer-generated indicator panel and the window head-up outside display screen are seen here during a ground simulation run.

The new 1003/3991 first took to the air, still unpainted but with the “Queen Of The Fleet” nose art, as the Bombardier Aerospace ACT Demonstrator C-GCGT on 28 May 1999, flown by pilots Doug Adkins and Jacques Thibaudeau, with Jeff Kirdeikis as the flight test engineer. Functional tests of the aircraft’s systems were performed to verify all worked as designed, following the extended modification downtime, and the aircraft was then ferried to Bombardier’s Dorval facility for painting. This workhorse test aircraft finally acquired a real overall paint and markings scheme, designed by Bombardier’s Graphics department, this time ‘round highlighting the “ACT” mission on the fuselage sides. In its new guise, resplendent 1003/3991 was returned to Mirabel for the final phase of ACT modifications preparatory to the start of flight tests.

The ACT flight-test programme, based out of Mirabel, then began in earnest starting in February 2000 with the great majority of flights being flown by Doug Adkins. During the ACT programme, extensive simulation was performed before numerous iterations of FBW control laws were evaluated on the aircraft.
The first flight of the ACT demonstrator in its new paint scheme went well, but was not without incident. That thin black curving line above the cockpit was actually the exterior seal from the LHS cockpit window, peeling away. No damage resulted and it was replaced prior to the next flight. The flamboyant white, red and black paint scheme made this aircraft one of the prettiest of the test fleet. The aircraft retained the anti-spin chute assembly at the rear and the test data instrumentation boom at the nose. The Bombardier Aerospace and sprocket logo branding were newly applied to the tail.

By the end of the ACT programme in March 2004, FBW system stability margins had been defined, “Up and Away” handling qualities had been assessed, flight envelope protection had been evaluated, and a take-off and landing phase was successfully completed. The goals of the programme had been achieved with much data gathered and knowledge gained towards designing a future FBW controlled aircraft.

The decision to finally retire Challenger 1003/3991 from further flight test duties was made by Bombardier Aerospace in December 2005. The aircraft’s systems were becoming increasingly difficult to keep serviceable, mainly due to the low utilization rate typical of a test aircraft, and these had not been updated since the aircraft was first built 27 years earlier. Additionally, some major structural inspections were coming due and these would be expensive and all for naught, if the aircraft was no longer required for test or development work.

It was deemed apropos for Bombardier to donate this significant aircraft to the Canada Aviation Museum (CAvM) in Rockcliffe, Ottawa, to reside alongside their numerous other renowned Canadair-produced aircraft and aviation-related products.

Pre-production Challenger 1003/3991 had accomplished the following in its various incarnations:
- As a CL-600: 94 Flights and 174 Hours.
- As a CL-601: 884 Flights and 1,624 Hours.
- As a CL-604: 220 Flights and 333 Hours.
- As the ACT: 150 Flights and approximately 275 Hours.
The Museum’s Challenger Aircraft

Piloted by Bombardier’s Senior Experimental Test Pilot Chuck Ellis, Jacques Thibaudeau as Co-Pilot, and Supervisor of Flight Test Operations Jim Brown as the Flight Test Engineer, Challenger 1003/3991 arrived at Rockcliffe Airport from Montreal at 11:00 a.m. on 7 February 2006.

A single, clean configuration flypast of the Museum was performed, followed by a rather fast landing and quick stop (the last use of the more capable CL-604 brakes and tires) on the short Rockcliffe runway.

Braking hard with spoilers and thrust reversers deployed for the final time, Challenger 1003/3991 begins to slow down following a hot landing on snowy Runway 27 at the Rockcliffe Airport, adjacent to the Canada Aviation Museum, Ottawa. (CAvM Photo)

The flight crew had flown the aircraft from the Bombardier Flight Test Center in Wichita, Kansas, to the Bombardier facilities at Dorval Airport a few days prior to offload onboard experimental test equipment no longer necessary for use on this aircraft. Some of the removed test equipment would be required for the new Challenger 605 prototype flight test aircraft, serial 5701, which had just performed its premiere flight on 22 January. This was the first of the Challenger 600 aircraft series in which 1003/3991 did not participate in some kind of test role.

Officials and friends on hand in Ottawa, included Anthony P. Smythe, CAvM Director General and Marc Ducharme, CAvM Chief of Operations, who braved the frigid February cold and winds to greet the new acquisition and Bombardier flight crew. As well, test pilot compatriots Tim Leslie and Robert Erdos of the NRC’s Institute for Aerospace Research (IAR) arrived via helicopter to view the official handover.
Still utilizing the original design upward opening main door, the “Frankenplane” offloaded its flight test crew via the old boarding ladder for the final time at the Canada Aviation Museum, Ottawa. (CAvM Photo)

While a second reconfiguration of the main museum display area in the year was taking place, C-GCGT was stored for the next seven months in the newly opened Storage Hangar of the Museum. It resided next to other famous Canadair-built predecessors – the giant CL-28 Argus anti-submarine, maritime patrol aircraft, three of the unique CL-227 VTOL Remotely Piloted Vehicles (RPV), the PBY-5A Canso and, the object of a major restoration effort, the sole remaining example of the C-54GM/DC-4M1 North Star of the RCAF.

The ACT painted Challenger is seen here on 12 September 2006, rolled out from the Museum’s new storage hangar behind, from where it had been stored, protected from the elements since its arrival in February. (Bill Upton Photo)

This view shows the ACT Challenger with the backdrop of the main museum hangar just prior to being rolled in, awaiting a major rearrangement of the exhibit islands within for its final placement on permanent display. (Bill Upton Photo)

Finally, on 19 September 2006, the ACT Challenger was slowly and methodically maneuvered around existing exhibits and displays into the main Museum. It took awhile for many of the displaced aircraft to be returned to their original positions but within the week C-GCGT was officially put on permanent display to the public, another in the proud, ever-growing collection of Canadair-built aircraft, missiles, drones and hardware at the Canada Aviation Museum.
New “Queen of the Fleet” titling with the signatures of the last flight crew who delivered the aircraft from the Bombardier Wichita facilities are displayed on the side window roundout. (Bill Upton Photo)

The former test configuration of this aircraft is evident here, showing the left side reinforced tail cone doubler plates, and the experimental-orange painted, spin recovery chute attachment fixture at the rear. (Bill Upton Photo)

The ACT cockpit was returned to its “standard” experimental configuration prior to its delivery to the museum. (CAvM Photo)

Some of the multitude of experimental-orange painted, test instrumentation racks and equipment onboard the aircraft. The fold down crew jump seat is seen behind the cockpit bulkhead. (CAvM Photo)

Freshly cleaned and polished, Challenger C-GCGT was displayed in front of the Museum’s newly constructed Library, Archives and Administration entrance, from September 2006 to December 2008. (Bill Upton Photo)
Total Build of Challenger 600 Series Aircraft Models

**CL-600** full-scale static and fatigue test articles 2

**CL-600** (c/n 1001 to 1085) 85
(Including the 3 pre-production test aircraft)

**CL-601** (c/n 3991[CL-600 c/n 1003] plus 3001 to 3066) 67

**CL-601-3A/-3R** (c/n 5001 to 5194) 194

**CL-604** (c/n 5991[ex-CL-601-3R c/n 5143] plus 5301 to 5666) 366

**CL-605** (c/n 5701 to 5712) 12
(up to end of 2006)
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