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From the Left Hand Seat



As I sit writing these words in my small office in deepest, darkest Derbyshire it is with very mixed emotions.

The summer airshow season is well and truly underway here in the UK so it's been a very busy period for the team here at the magazine. Between us we've been attending events across the UK and spent significant amounts of time sheltering from, variously, heavy rain and scorching sun!

For many of us (myself included) it is the thought of these not-so-lazy days on airfields that sees us through the cold winter months. The social scene that we enjoy during the 'season' allows us to catch up with old friends who we perhaps only see infrequently during the rest of the year. For me, the enjoyment of catching up with these friends is just as important (perhaps more so) than the actual watching of aeroplanes.

Friendship

This year's Royal International Air Tattoo at RAF Fairford in mid-July was a great example. Not only did it allow me to see friends from across the globe, it also presented us with a very rare opportunity to take a 'Team Jets' photograph!

The image, which graces these pages, shows Richard Freail, Jamie Ewan, Rebecca Gibbs and myself (although I'm clearly the only one who received the 'uniform' memo that day!) and I smile every time I look at it. Without these friends – for they are friends who I'm honoured to also call colleagues – I could not do the job that I love so much.

We enjoyed a packed weekend at RIAT and met up with countless readers and friends – enthusiasts and pilots alike. Rebecca and I then decamped to London where we attended the opening of the Guild of Aviation Artists' annual exhibition on The Mall and met up with yet more comrades from the aviation industry.

Farewells

Just two weeks later we were firmly brought down to earth when news began to filter through of a terrible accident.

Regular readers will doubtless know that this magazine has been firm friends of the Heritage Aircraft Trust and their Gnat Display Team for many years. Like my 'colleagues turned friends', the Gnat team members crossed the line from being magazine 'contacts' to becoming friends. We work together, we socialise together and now we mourn together.

It was with heavy hearts that we learned of the loss of Gnat G-TIMM during an air display at the CarFest North show at Oulton Park on August 1. It soon became apparent that TIMM's pilot, Kev Whyman, had perished in the accident and many tears were shed.

Within minutes we also received news of a separate accident in which pilot, friend and occasional *Jets* contributor Dan Griffith had been injured after the engine of the Spitfire he was flying failed shortly after take-off.

With time, Dan will be fine but as these words are written, just a few short days after the accidents, my colleagues, friends and I remain numb. We send our heartfelt condolences to everybody affected by this tragic weekend.

Moving On

Luckily one 'farewell' we are marking this month comes after some good news. Andy Hill, our erstwhile designer for more than two years, has been promoted within the AT Graphics design agency and will no longer be designing our pages.

I've thoroughly enjoyed working with Andy and have appreciated both his relaxed 'can do' attitude and his unflappable personality. We wish Andy well for the future and thank

him for everything he has done to make this magazine what it is today.

New members

Of course Andy's departure from 'Team *Jets*' leaves a sizeable hole and we are pleased to welcome Becky Duffy as his replacement. Becky has already made her mark on this issue of the magazine and we look forward to working with her in the months and years ahead to keep refining and developing the way these pages are designed.

From this issue we also welcome Dave Unwin to our team of writers. This is something of a 'blast from the past', as Dave and I worked together for many years at *Today's Pilot* (where Dave was Editor and I was his Deputy Editor from 2000 until 2006). It has been great fun "getting the band back together" and Dave has some exciting From the Cockpit articles planned for future issues.

I hope you enjoy this issue of the magazine, which we would like to dedicate to Kev. This one's for you mate!

Until next time
Blue Skies



Steve
Stephen Bridgewater
Editor



JETS PHOTO OF THE MONTH

This month's Photo of the Month comes from our very own Rebecca Gibbs, who is normally more at home with words than images! The image shows the Swiss Air Force PC-7 Team appearing at this year's Royal International Air Tattoo at RAF Fairford. The team was formed in 1987 flying nine Pilatus PC-7 Turbo Trainer aircraft but in October 2006 it changed to the upgraded NCPC-7. Based at Dübendorf Air Base the team consists of volunteer pilots whose day jobs normally see them flying the F/A-18 Hornet.



www.jetismag.co.uk

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Jet Noise



Kevin Whyman – 1976-2015

It is with a heavy heart that we report the death of Kevin Whyman while flying Folland Gnat T.I G-TIMM during an airshow at the CarFest North event at Oulton Park on August 1.

Kev, along with his teammates in the Gnat Display Team and fellow trustees at the Heritage Aircraft Trust, was a great friend of this magazine and those of us

who produce it. His enthusiasm for flying the Gnat was infectious and he will be sorely missed by his family and many friends.

Kev was sponsored by the Royal Navy through his Sixth Form studies and had reserved entry for officer training & flying training in the Fleet Air Arm. However, military cutbacks in the early 1990s reduced the Navy's aircrew requirements so he instead completed a flying scholarship with the RAF at the age of 18.

Kev studied for Economics at Peterhouse, Cambridge University, where he joined the University Air Squadron (CUAS) and commenced Elementary Flying Training (EFT) on the Bulldog aircraft. He also coxed Cambridge to victory in the 1996 and 1997 University Boat Races against Oxford.

Kev joined the RAF in 1998 and flew the Tucano and Hawk before leaving in 2001 and taking a trading job with an investment bank in the City of London.

He had flown the Gnat since 2005 and also displayed the Jet Provost. In 2007 he founded

Kev Whyman seen during the Gnat Display Team's 2015 pre-season training sessions at North Weald



Richard Freail

the Gnat Display Team with his colleagues.

Kev leaves behind a wife and young daughter as well as countless friends and fans. To further add to the tragedy Kev's wife was four months pregnant with their second child at the time of the accident.

Many have asked to contribute to a fund for Kev's family and to this end the team has established a page where donations can be made. Please visit <http://gogetfunding.com/in-loving-memory-of-kevin-whyman/> to find out more.

Steve Bridgewater

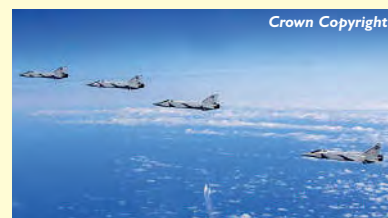


G-TIMM in her element climbing out of RAF Waddington in 2013. The aircraft was built in 1962 as XP504 and served with 4 FTS at RAF Valley. In its civilian life it was originally painted silver to represent XM693 but in recent years it had been painted to depict Ray Hanna's XS111 from when he was the Red Arrows' team leader

Airbus Announces A320PF Conversions



Airbus has signed an agreement with Singapore-based ST Aerospace to offer passenger-to-freighter (P2F) conversion solutions for its A320 and A321 aircraft. Airbus foresees a significant market demand of more than 600 P2F aircraft over the next 20 years in the small freighter segment. The A320P2F, with eleven main-deck container positions, will be capable of carrying 21 metric tonnes of payload over 2,100nm, while the A321P2F with 14 main-deck positions will be able to carry up to 27 tonnes over 1,900nm. The first converted A321P2F will be delivered in 2018



Crown Copyright

Four MiG-31 Foxhounds photographed from an RAF Typhoon on July 24

RAF INTERCEPTS TEN RUSSIAN JETS IN A SINGLE DAY

On Friday July 24, as part of NATO's mission to police Baltic airspace, RAF Typhoons intercepted no fewer than ten Russian aircraft during a single Quick Reaction Alert mission. The Typhoons, from 6 Sqn at RAF Lossiemouth, were launched after multiple groups of aircraft were detected by NATO air defences in international airspace near to the Baltic States.

Once airborne, the RAF jets identified the aircraft as four Sukhoi Su-34 Fullback fighters, four Mikoyan MiG-31 Foxhound fighters and a pair of Antonov An-26 Curl transport aircraft. The aircraft were monitored by the RAF Typhoons and escorted on their way.

Grim Reapers 'Top Squadron'

Four F-15C Eagles from the 493rd Fighter Squadron at RAF Lakenheath, Suffolk perform a precision break for the camera as the unit, known as the Grim Reapers, celebrates being named the USAF's Top Fighter Squadron for 2014 and receiving the Raytheon Trophy.

Unfortunately, the base was forced to cancel its 'Fourth of July' celebrations this year due to "the most current local threat assessments." Colonel David Eaglin, 48th Fighter Wing vice commander, said: "We have to put public safety first and foremost. We apologize for any inconvenience this cancellation has caused, and we will continue to work with our UK counterparts – both military and civilian – to make sure we keep our Airmen and the local communities safe"



USAF Ioannis Lekkas

The Latest News from the World of Jets

Duxford Battle of Britain Airshow to Feature Classic Jets Aplenty

The Imperial War Museum's Battle of Britain Anniversary Show, which takes place at Duxford, Cambs on September 19-20, will obviously feature impressively large numbers of Spitfire and Hurricanes.

However, classic jet lovers will also be in for a treat with appearances by North Weald-based Hawker Hunter T.7 G-BXFI/WV372 and Mikoyan Gurevich MiG-15UTI N104CJ – the latter coming all the way from Norway for the show.

The Polish-built MiG, which belongs to the Norwegian Air Force Historical Squadron, is painted to represent an aircraft flown by pioneering cosmonaut Yuri Gagarin.

Advance tickets for the show, which also features the RAF Red Arrows (Sunday only), are on sale until September 13. You can't buy tickets on the day.



The Norwegian Air Force Historical Squadron's MiG-15 is set to make its Duxford debut on September 19-20 at the advance-ticket-only Battle of Britain Anniversary Show

Norwegian Air Force Historical Squadron

Garuda Indonesia's Paris Order Spree

At the recent Paris Air Show Garuda Indonesia signed Letters of Intent (LOI) for the purchase of 30 Airbus A350-900 aircraft as well as 30 Boeing 787-9 Dreamliners and up to 30 Boeing 737 MAX 8 airliners.

The airline says it plans to use the A350s to develop its medium and long haul network, with the aircraft offering the ability to fly non-stop from Jakarta or Bali to Europe.

"The agreement is part of Garuda Indonesia's revitalisation program in order to provide our passengers with the best possible experience with the youngest fleet in the sky and to support the airline's future plan to further expand its network globally," said Arif Wibowo, Garuda Indonesia's president and CEO. "The 787 Dreamliner and 737 MAX are extraordinary aeroplanes with exceptional economics that will keep us competitive and bring a new level of service excellence for our customers."

Garuda Indonesia seamlessly connects 76 destinations worldwide to not only one of the largest economies in Southeast Asia, but also an array of exotic locations in the beautiful archipelago of Indonesia. It operates close to 600 daily flights and its fleet of 169 aircraft have an average age of less than five years.



Included in the deal are 30 examples of the Airbus A350-900, which Garuda will use on medium and long haul flights



The 777-300ER is capable of flying 4,900 miles with a full payload, making it the world's longest-range twin-engine freighter

Qatar Boosts its 777 Fleet

On the opening day of the Paris Air Show 2015 in June, Qatar Airways announced an order for ten Boeing 777-300ERs and four 777-300LRs, valued at \$4.8 billion at list prices. "Acquiring technologically-advanced aeroplanes such as the 777-300ER is integral to our expansion strategy," said His Excellency Mr Akbar Al Baker, CEO of Qatar Airways. "With the addition of these 777-300ER to the 50 777-300LR already on order, we are confident of continuing the tremendous legacy of the 777."

Meanwhile, the government of Qatar has also signed an agreement for the purchase of four more Boeing C-17 Globemaster III airlifters. These aircraft will join the Qatar Armed Forces' existing fleet of four and help meet their on-going airlift requirements.

Trident Unveiled

On July 11, G-ARPO – the world's last complete Hawker Siddeley Trident 1C – was unveiled to the public following a five-year restoration at the North East Land, Sea and Air Museums (NELSAM) in Sunderland.

The aircraft is painted in the colours of Northeast Airlines, which flew Tridents in the 1970s before merging into British Airways. No other aircraft is currently preserved in these colours. Save The Trident, the group formed to rescue this aircraft, is now actively fundraising to restore the wings and tail of the aircraft, which are currently in storage.

The event saw over 40 former flight attendants and pilots who flew the aircraft on active duty take part in the ceremony. These included Captain Richard Boas, the last person to fly G-ARPO when it was delivered to the Civil Aviation Authority's Fire Training School at Teesside Airport in December 1983. G-ARPO is now open to the public on selected weekends.



More than 40 former Trident air and cabin crew attended G-ARPO's unveiling on July 11

Sales Boost for Super Tucano

According to US sources, Lebanon is now the fifth largest recipient of US military aid in the world. With neighbours including Syria and Israel, this is perhaps unsurprising and the US State Department has recently approved a possible \$462 million sale of six Embraer A-29 Super Tucano light attack aircraft to Lebanon to increase the country's counterterrorism capability. Meanwhile, Ghana is also said to be in discussions with Embraer for the possible delivery of five Super Tucanos. Mali ordered six examples during the recent Paris Air Show.

Jet Noise



Victorious Zeus Demo Team

Among the participants taking home awards from the Royal International Air Tattoo at RAF Fairford on July 17-19 was the Hellenic Air Force Zeus Demo Team, which won the Best Livery award. Demo pilot Maj Sotiris Stralis said: "It has been a pleasure for the Hellenic Air Force display team 'Zeus' to participate for the first time at RIAT 2015, and a true honour to be awarded the best painted aircraft trophy. See you next year!"

Other award winners included the Tri-national Tornado Training Establishment Tornado flypast (which won an impromptu award from RIAT CEO Andy Armstrong) and Finnish F/A-18C Hornet, which was awarded the Paul Bowen Trophy for the Best Solo Jet Demonstration.

Wing Cdr Jonathan Nixon, chairman of the Flying Control Committee, presented The Canestra Trophy for the Best Flying Demonstration by an overseas participant to the Slovenian Pilatus PC9 trainer and the Steedman Display Sword – presented for the Best Flying Demonstration by a UK participant – was awarded to the RAF Typhoon and Spitfire Synchro Pair.

The 'As the Crow Flies Trophy', awarded for the best overall flying demonstration as voted for by the Friends of the Royal International Air Tattoo, was presented to the Vulcan To The Skies Trust, a fitting tribute to Vulcan XH558 in its final display season.



Richard Freail

A bumper crowd of almost 150,000 people were treated to a spectacular display of aviation from across the globe during the three-day Royal International Air Tattoo at RAF Fairford. Among the 232 aircraft from 27 air arms at the show was this stunningly painted F-16 from the Hellenic Air Force Zeus Demo Team

HEATHROW'S THIRD RUNWAY?

In his much awaited report, Airports Commission chairman Howard Davies has recommended a third runway be built at London Heathrow Airport to ease aviation congestion in the south-east of England.

While each of the three schemes shortlisted was considered a "credible option" for expansion, the commission unanimously concluded a new north-west runway at Heathrow Airport was its preferred option.

According to Davies, the Heathrow expansion represented the strongest case and offers the greatest strategic and economic benefits argued the commission, with the potential to provide around 40 new destinations from the airport and more than 70,000 new jobs by 2050.

The commission reported that the Gatwick scheme was feasible, but the additional capacity would be more focused on short-haul intra-European routes and the economic benefits considerably smaller.

Responding to the publication of the Final Report, Darren Caplan, chief executive of the Airport Operators Association (AOA), the trade body representing over 50 UK airports, said: "The AOA supports all airports that wish to grow and believes in making best use of existing capacity at UK airports.

"The Government should respond swiftly to maintain momentum, remove uncertainty and ensure the UK gets the additional capacity it so vitally needs as soon as possible."

Elsewhere, Charles Buchanan, chief executive at London Ashford Airport at Lydd, Kent, said: "The challenge now is for politicians to deliver on this expert verdict and ensure that the additional capacity is developed within the next 15 years. In the meantime, the strain on aviation capacity in the South East will continue to grow, placing even greater burdens on the nation's economy. There must be recognition that smaller, modern regional airports like London Ashford Airport at Lydd have a key role to play in providing much-needed extra capacity in the immediate future."



Via NEAM
The museum's Phantom (66-0249) was flown by Lt Col James Brunson and Major Ralph Pickett during the Vietnam War and shot down a MiG-21 on December 22, 1972 while flying cover for a B-52 bombing raid

New England Vietnam Exhibit

As part of the 50th Commemorations of the Vietnam War, the New England Air Museum in Windsor Locks, Connecticut has opened a new temporary exhibit featuring 18 aircraft that either served, or represent types that flew with US forces during that conflict.

Included in the display are numerous helicopters and piston powered aircraft as well as a McDonnell Douglas F-4D Phantom II, Douglas AD4-1 Skyhawk, North American F-100A Super Sabre, Lockheed F-104C Starfighter, Martin RB-57A Canberra, Douglas A-3B Skywarrior and Republic F-105B Thunderchief combat jets.

Ospreys for Japan

Bell Boeing has been awarded a contract to provide five V-22 Osprey tilt-rotor aircraft to Japan. This is the first sale of the aircraft through the US government's foreign military sales programme. The contract for the Block C aircraft includes support, training, and equipment. The versatile V-22 will greatly enhance the capabilities of Japan's Ground Self-Defense Force, while providing an ideal platform for relief efforts in response to natural disasters. The V-22 is currently in service with the United States Marine Corps and the Air Force Special Operations Command. This year, the United States Navy announced their decision to procure 44 V-22 aircraft.



US Navy
A US Marine Corps V-22 similar to the aircraft set to be provided to Japan's Ground Self-Defense Force

The Latest News from the World of Jets

Midair Squadron Stands Down

In a brief statement made on July 9, the Kemble-based Midair Squadron announced its withdrawal from all airshow participation for the remainder of the display season.

The organisation, which operates an English Electric Canberra PR.9 and a pair of Hawker Hunter T.7s, says: "The overwhelming success of last year has made it necessary to put a number of strategies into place in order to secure the aircraft's flying future; causing a more protracted than anticipated process.

"Excitingly the Squadron has been working hard to have charitable trust status established. Once founded, this trust will manage the flying and maintenance operation of these iconic British aircraft, safeguarding their participation on the display circuit for years to come.

It is anticipated that the aircraft will fly towards the end of the year, with the intention being to make a return to the display circuit in 2016.



The Midair Squadron's Canberra PR.9 is currently the only airworthy example of the English Electric classic. Hopes are high that it will return for the 2016 airshow season



Typhoon IPA7 during the Aerodynamic Modification Kit trials at Manching

Typhoon 'Mods'

Airbus Defence and Space has successfully completed flight-testing a package of aerodynamic upgrades to the Eurofighter Typhoon swing-role fighter that promise to further enhance the aircraft's agility and weapons-carrying ability.

The Aerodynamic Modification Kit (AMK) is part of the Eurofighter Enhanced Manoeuvrability (EFEM) programme and entails the addition of fuselage strakes and leading-edge root extensions. These increase the maximum lift created by the wing by 25%, resulting in an increased turn rate, tighter turning radius, and improved nose-pointing ability at low speed – all critical fighter capabilities in air-to-air combat.

Eurofighter test pilots, joined in the latter stages by operational pilots from Germany, Italy and the UK, completed 36 sorties from Manching, Germany on the IPA7 Instrumented Production Aircraft. Eurofighter Project Pilot Germany, Raffaele Beltrame, said: "This programme has been a tremendous success with very impressive results – in some areas even better than we expected. We saw angle of attack values around 45% greater than on the standard aircraft, and roll rates up to 100% higher, all leading to increased agility."

NEWS IN BRIEF

Customs officers working at London Heathrow Airport may have let several 'high risk' international flight passengers through security in 2014, according to a new report produced by the Chief Inspector of Borders. The investigation raises concerns over security procedures and claims that the airport's Terminal 5 had no one on duty at its customs channels on eight separate occasions. The report highlights that these lapses were when potentially high-security passengers might have been present.

Airbus says it won \$57 billion worth of business at June's Paris Air Show for a total of 421 aircraft. The deals comprise firm orders for 124 aircraft worth \$16.3 billion and commitments for 297 aircraft worth \$40.7 billion. The A350 XWB continues to attract new business, with commitments for 31 A350-900s, reinforcing its leading position as the world's most modern, advanced widebody aircraft.

The Royal Malaysian Air Force fleet of MiG-29N fighter aircraft will remain "an important asset to the country's air defence" according to RMAF's chief general, Datuk Seri Roslan Saad. He has confirmed there has been no decision to replace the type and the aircraft will still remain in service.

During June's Paris Air Show, Boeing Business Jets launched the new BBJ MAX 9 with an order by an undisclosed European customer. The BBJ MAX 9 sale marks the fifth BBJ MAX order. Boeing has previously booked four orders for the BBJ MAX 8 model.

News reported on the website of the Chinese People's Liberation Army seems to indicate that China is planning to develop a short-range vertical take-off and landing (VTOL) fighter. Pundits have speculated the aircraft could be used in the defence of islands in the South China sea.

On December 12, easyJet will start the twice-weekly London (Gatwick) to Friedrichshafen route. This new service will be operated with Airbus A319s.

During the Paris Air Show Boeing indicated it was willing to sell used Fairchild A-10 Thunderbolt II attack aircraft abroad, if and when they are retired by the USAF.

Ryanair has voted unanimously to accept the IAG offer for Ryanair's 29.8% shareholding in Aer Lingus Group plc. Ryanair's Michael O'Leary said: "We believe the IAG offer for Aer Lingus is a reasonable one in the current market and we plan to accept it, in the best interests of Ryanair shareholders. The price means that Ryanair will make a small profit on its investment in Aer Lingus over the past nine years."

Airbus Patents 'Son of Concorde'

In early August, the Airbus group lodged documents with the US Patent Office relating to an "ultra-rapid air vehicle" and "method of aerial locomotion", which would cruise at an altitude of more than 100,000ft and carry up to 20 passengers or two or three tons of cargo for distances of up to 5,500 miles. This would mean an aircraft capable of flying from London to New York in just an hour - opening up the possibility of a transatlantic return journey in a day.

Power for the new aircraft would come from three different types of engines including "at least one" conventional jet and a hydrogen and oxygen powered rocket to give a "near vertical" climb. Once the aircraft is supersonic the conventional jet would be "retracted" and one or more ramjets would take over to power the aircraft on the edge of space.

Airbus claims the aircraft would be suitable for "VIP passengers who require transcontinental return journeys within one day" and military users. The latter could use it for reconnaissance and "ultra-rapid transport of high added-value goods or elite commandos".

Jet Noise



BLACKJACK BACK?

Speaking at a recent press conference in France, Russia's Deputy Defence Minister Yuri Borisov said the nation was planning to resume production of the Tupolev Tu-160 Blackjack supersonic strategic bomber. However, this is unlikely to happen before 2023. The new version of the Tu-160M2 will have new engines and upgraded avionics



EXERCISE INDRADANUSH

RAF and Indian Air Force fighter jets and tankers participated in Exercise Indradanush over the UK in July. The two-week exercise saw the Indian Sukhoi Su-30MKI Flankers and Illyusion IL-78 Midas tankers deploy to RAF Coningsby and RAF Brize Norton to train with the RAF's Typhoon force



Crown Copyright/Cpl Paul Oldfield

Third RAF Atlas

The RAF's latest Airbus A400M Atlas was delivered to RAF Brize Norton on July 6. The aircraft is the third of 22 A400M Atlas to be received by the UK as part of a £2.75 billion programme to meet the UK's future air mobility requirements. The Atlas fleet is due to replace the C-130 Hercules when it goes out of service in 2022



Crown Copyright/Andrew Linnett

Lightning II makes First Ski-Jump

On June 19, British test pilot Pete 'Wizzer' Wilson became the first pilot to launch the Lockheed Martin F-35B STOVL variant from a ski-jump.

The launch took place at NAS Patuxent River in Maryland, USA from a land-based ski jump and the trials demonstrate the aircraft's ability to take-off safely and effectively from a ramp similar to that which will be used on the UK's new Queen Elizabeth aircraft carrier.

BAE Systems test pilot Pete Wilson said: "It's always exciting when you get to do something in aviation for the first time. We spend literally years planning these 'firsts', with hundreds of hours in the simulator as the event gets close, but even with all the preparation the test team remains focussed on the potential that something unexpected might happen. As is usually the case, the jet performed as expected and it was a real pleasure."

Meanwhile, a week earlier, RAF test pilot Sqn Ldr Andy Edgell released two inert 500lb Paveway IV precision-guided bombs from aircraft BF-03 over the Atlantic Test Ranges. This was the first time the F-35 had dropped Paveway munitions.



Lockheed Martin

'Wizzer' Wilson eases the F-35B off the ramp during its first ski jump launch

Jin Air 737-800

On July 27, Jin Air celebrated the arrival of its first direct-delivered Next-Generation Boeing 737-800. Jin Air is the low-cost affiliated company of Korean Air and currently serves 16 routes in Asia, operating a total of 15 aeroplanes



Boeing

Marines Declare the F-35B Operational

On July 31, the US Marine Corps' F-35B Lightning II aircraft reached initial operational capability with a squadron of ten F-35Bs ready for worldwide deployment. Marine Fighter Attack Squadron 121 (VMFA-121), based in Yuma, Arizona, is the first squadron to become operational with an F-35 variant, following a five-day Operational Readiness Inspection.

The USMC has trained and qualified more than 50 Marine F-35B pilots and certified about 500 maintenance personnel to assume "autonomous, organic-level maintenance support" for the F-35B.

Meanwhile the USAF's 34th Fighter Squadron – known as the *Rude Rams* – was reactivated at Hill AFB, Utah, on July 17, 2015 in readiness for USAF F-35A operations. The squadron, which dates back to World War Two, was retired as an F-16 unit in 2010 as part of a USAF restructuring plan, but returns to become the first operational USAF unit to fly combat-coded F-35s. The squadron's first F-35A is scheduled to arrive at the base near Salt Lake City in September.

DAS Milestone

The Duxford Aviation Society (DAS) celebrated its 40th anniversary at IWM Duxford on June 17.

DAS is a voluntary organisation which came into being in 1975 and exists to preserve historically important British civil airliners, support IWM Duxford and promote knowledge of the development of British civil aviation through acquisition and restoration.

Over 200 DAS members enjoyed a full day on site, with events that showcased the range and scope of DAS activities. Chairman David Garside spoke about the Society's



David Garside, Chairman of Duxford Aviation Society, with Mr and Mrs John Hutchinson, on the steps of the Airspeed Ambassador

past, present and future and other highlights included an entertaining talk by Captain John Hutchinson about life as a Concorde pilot.

The Latest News from the World of Jets

Big Two Estimate a Bright Future

Both Boeing and Airbus are predicting that demand for new airliners will increase over the next 20 years.

Boeing projects a demand for 38,050 new aeroplanes over the next two decades, an increase of 3.5% from last year's forecast. By the end of the period the commercial aeroplane fleet will double from 21,600 aeroplanes in 2014 to 43,560 aircraft in 2034. Boeing says 58% of the 38,050 aeroplanes delivered over that time will be to accommodate growth. It expects passenger traffic will continue to grow at about 4.9% per year and cargo traffic will grow at about 4.7% per year.

Boeing says the single-aisle market continues to be the fastest-growing, largest overall segment, requiring 26,730 aeroplanes over the coming two decades. These aircraft are the foundation of the world's airline fleet, carrying up to 75% of passengers on more than 70% of the world's commercial aviation routes.

Airbus is slightly more conservative and projects global passenger traffic will grow at an average 4.6% a year between now and 2034, driving a need for some 32,600 new aircraft worth US\$4.9 trillion. Airbus says passenger and freighter fleets will increase to 38,500 over the period.



Airbus at the 2015 Paris Air Show; sharing its passion for aviation and hoping to sell its fair share of the 32,600 new aircraft it predicts will be needed over the next 20 years

A330-300 Regional

Saudi Arabian Airlines, the national carrier of Saudi Arabia will become the first airline in the world to operate the new Airbus A330-300 Regional.

Passenger demand in Saudi Arabia is experiencing high growth both on domestic and regional routes and the new A330-300 Regional variant, specially designed for regional and domestic operations, is Airbus' solution for markets with large populations and fast growing air traffic flows.

The A330-300 Regional is set to boost capacity on several of Saudi Arabian Airlines most in-demand routes, enabling the airline to better serve the Saudi Arabian and regional travelling public.



The A330-300 Regional is optimised to seat up to 400 passengers and offers significant cost savings through a reduced operational weight of around 200 tonnes. The reduction in fuel burn per seat and maintenance costs will result in an overall cost reduction by up to 26% compared with today's long-range A330-300

Marvellous Meteor

During the Royal International Air Tattoo at RAF Fairford on July 17-19, the Classic Aircraft Trust's Gloster Meteor T.7 was awarded 'Best Civilian Aircraft' in the Concours d'Elegance competition. The aircraft, which was on display at the invitation of BAE Systems, was on show alongside a Sopwith Camel, Hawker Hurricane and Supermarine Spitfire as well as a Tornado GR.4 and Typhoon FGR.4 to represent the history of the RAF fighter



Steve Bridgewater

India's \$12 Billion Fighter Deal 'Off'

On June 16, during the Paris Air Show, the French Ministry of Defence announced that the deal for 36 Dassault Rafale fighter jets to be sold to India would be "signed in 1 or 2 months." However, on July 30 the Indian Government formally announced the cancellation of the \$12 billion programme to purchase multi-role combat aircraft for the Indian Air Force! Indian officials provided no reason for the cancellation.

Masessa's Marvellous Mohawk Memorial

Dr Joe Masessa's Grumman OV-1 Mohawk has been repainted to mark the 50th anniversary of Vietnam War.

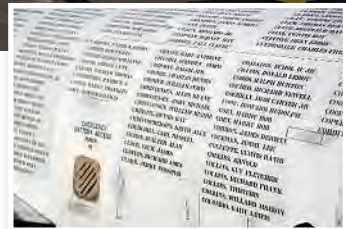
The aircraft, which was featured in the Jan/Feb 2014 issue of *Jets*, now carries the names of all 1,636 US Army soldiers who, as of January 2015, were still listed as missing in action (MIA) from the Vietnam War.

As bodies are recovered, Joe and his team will place an American flag next to their name on the aircraft. Since the aircraft was painted in January, 12 bodies have been recovered and returned home to families.

Steve Bridgewater



Dr Joe Masessa's Mohawk now wears the names of all 1,636 US Army soldiers still missing in action



BRUSH UP FOR NEWARK'S BUCC'

The Blackburn Buccaneer S1 XN964 at Newark Air Museum has recently been moved into a new location on the museum site, which will allow its repaint to take place unhindered by future museum special events. This repainting project is one of several currently in hand at the museum, which include the Canberra PR7, Vulcan, Phantom cockpit and Avro Shackleton



Howard Heeley/Down to Earth Productions

The Midas Touch



The Ilyushin IL-78 tanker was used extensively in the USSR and Ukraine before being exported to other air forces. Babak Taghvee explains how the Midas has been coming to the aid of thirsty jets for over three decades

During the Cold War a total of 47 Ilyushin IL-78s (NATO reporting name *Midas*) including two prototypes were manufactured by the Tashkent aircraft production plant between 1983-1991.

All but two examples, which were used for research and development, were delivered to two Tanker Aviation Regiments of the Soviet Air Force. However, when the Soviet Union collapsed in 1991 the 409th Tanker Aviation Regiment retained just 22 IL-78s and the others were inherited by the newly independent Ukraine. Under the Ukrainian Armed Force's Defence Doctrine, the IL-78s were used in many different roles and later sold to four air forces in Africa and Asia.

Midas

A four-engined aerial refuelling tanker; the first IL-78 prototype (c/n 0033445294) was given the civil registration CCCP-76556 and had two cylindrical tanks that gave it a 14-ton fuel capacity. This aircraft made its first flight piloted by the Ilyushin OKB test

pilot Vyacheslav S Belousov at Tashkent on June 26, 1983 almost 15 years after the launch of the heavy tanker aircraft project.

Based on the IL-76MD transport aircraft and equipped with three Sakhalin UPAZ-1A Aerial Refuelling Systems the IL-78 had both superior range and the capacity to refuel three fighter aircraft simultaneously. The new tanker proved the best candidate to replace the aged and less capable Tu-16 *Badger* aircraft, which had been converted to tankers and played an important role supporting the long-range flights of the USSR Air Force's Tu-16 *Badger*, Tu-22 *Blinder* and Tu-95 *Bear* strategic bombers in the 1980s.

IL-78 test flights, as well as the development of the aircraft's aerial refuelling systems, continued until mid-1984; the first production example (CCCP-76607) rolled out of the Ilyushin OKB factory and was delivered to the Soviet Air Force on June 19 of that year.

CCCP-76607 was later used by the 3rd Research Military-Transport Aviation Squadron of the 610th Centre for Combat



Employment and Retraining of Personnel at Ivanovo. The second and third IL-78s were later delivered on September 29 and December 29, 1984, respectively with the fourth and fifth aircraft (CCCP-76610 and CCCP-76616) were delivered on December 29, 1984 and March 31, 1985.

While the first prototype had served in the research role, the four first production IL-78s entered service with the 1st Instruction Military-Transport Aviation Squadron. The staff developed methods for aerial refuelling operations in 1985 and they trained the first IL-78 pilots and crewmembers as well as publishing all of the required flight and operation manuals specific to the type.

409th Aviation Regiment

On June 25, 1986, when nine IL-78s were ready at Ivanovo, two of them (CCCP-76609 and CCCP-76610) were delivered to the 106th Heavy Bomber Aviation Division of the 37th Air Army VGK at Uzyn Air Base, Ukraine.

The aircraft served in the 409th Heavy Bomber Aviation regiment and replaced its Tu-95MKs, which were either retired or passed onto other units. Later, four further IL-78s (CCCP-76616, -76632, -76646 and -76653) were transferred from Ivanovo to Uzyn in Ukraine.

"Fears attempted to sell N78GF to the Pakistani Air Force"

Main: UR-76742 spent four years in service of Ukraine-based BSL Airlines carrying freight all over the world. In 2006, after seven years in storage at Melitopol, the Pakistan Air Force acquired the aircraft and it was restored by NARP. It was handed over in December 2009 and received the PAF serial R09-001

Chris Chennell via Author

Right Top: A grainy photograph of the prototype IL-78 (CCCP-76556) was the first sight many westerners had of the Midas. This aircraft made its first flight piloted by the Ilyushin OKB test pilot Vyacheslav S Belousov at Tashkent on June 26, 1983

Right Middle: Aviakompania Busol (Busol Aircompany) was one of three commercial airlines that received demilitarised IL-78s from the Ukrainian Ministry of Defence. Included in the seven examples operated by the airline was UR-UCF (UR-76412) which later transferred to Ukraine Cargo Airways. It was retired in 2001 and placed into storage at Mokrya, where it is seen here

Nils Mosberg via Author

Right Bottom: IL-78 Midas CCCP-76689 was built for the Russian Federation and delivered on September 30, 1986. It served the Russians until 1995 when it was handed over to the Ukrainian Air Force. A year later it transferred to Ukraine-based BSL Airlines but returned to the air force in 2008

Below: The Indian Air Force operates seven IL-78MKI aircraft, which it refers to as the MARS (Mid Air Refuelling System). All seven aircraft, including RK-3452 seen here landing at RAF Fairford in July 2007, are operated by 78 Sqn

PRMAVIA Collection



The regiment's designation was duly changed to the 409th Aviation Regiment of Tanker Aircraft and its primary role became provision of aerial refuelling for the Tu-95MSs of both the 1006th and 182nd Heavy Bomber Aviation Regiments based at Uzyn and Mozdok Air Bases.

The type's first mission was performed over the Arctic Ocean on July 16, 1986 and later there were daily aerial refuelling training flights with Sukhoi Su-24M(R)s from Dubno, Chernyakhovsk and Dzhida Air Bases. The first experimental aerial refuelling of the Mikoyan Gurevitch MiG-31B and Sukhoi Su-27 took place over the Akhtubia area in the Caspian Sea in 1986.

In 1987 the Uzyn-based IL-78s were tasked to support Polish-based Sukhoi Su-24M flights at Zagan and in February 1987 the first Tu-95MS Arctic flights towards Graham Bell Island and Franz Josef Land were performed with



the IL-78s accompanying the Bear-Hs while operating from Arctic bases.

By the end of 1989, the unit had 22 IL-78s, which were widely used to support Tu-95Ms in long-range patrols. That said, while the tankers' primary role was aerial refuelling, they regularly carried freight to/from Uzyn. The conversion process from

tanker to cargo aircraft took just six hours.

Ukrainian Air Force

After Ukraine became an independent state in 1991 the 106th Heavy Bomber Aviation Division was demilitarised. All of its bombers were stored while most of their flight crews returned to Russia, but the 409th Tanker Aviation Regiment remained active. A third of its aircraft served in the cargo role to carry freight all over the world but eventually these too were gradually grounded.

In 1992/3, during the Nagorno-Karabakh war between Armenia and Azerbaijan, Ukrainian IL-78s flew regularly from Mozdok in Russia to Yerevan in Armenia to supply the beleaguered country with gasoline. In 1993, they smuggled 300,000 litres of gasoline from the Krasnodar territory of Russia to Yerevan in nine flights without getting customs' clearance.

However, on September 3, 1993 the crew of IL-78 UR-76744 were ready to board their aircraft, which was feigning a cargo of plums. In reality it was carrying 28 tons of gasoline in two tanks and when this was detected by Krasnodar customs officers the crew were arrested.

Gradually most of the IL-78s were converted to IL-76MDs to be used by the Ukrainian Air Force (UAF) or semi-private air cargo companies.

For sale

In 2000, the last of the stored Tu-95s of the 1006th Heavy Bomber Aviation Regiment were scrapped and the Ukrainian

government decided to abandon Uzyn and destroy its runway.

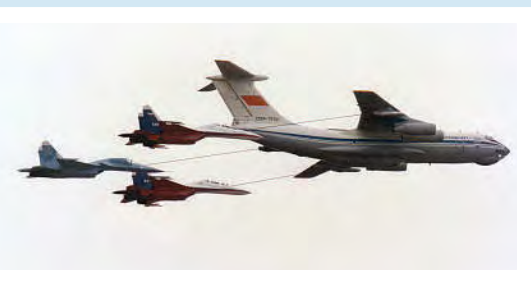
Nearly all of the remaining IL-78s at the air base had been converted to IL-76MDs and were regularly being leased to air cargo companies around the world. They were all transferred to Melitopol airport and joined IL-76s operated by the UAF's 25th Transport Aviation Brigade. By then just two IL-78 tankers had been kept active, both with a pair of operational UPAZ-1As under their wings to support the UAF's Su-24M/Rs operated by the 7th Tactical Aviation Brigade at Starokostiantyniv.

Algerian acquisition

In 1998, Algeria began negotiating with the Ukraine to acquire some of its IL-78s. A contract was finally signed and the Ukrainian State Company Ukrspecexport sold six examples to Algeria; these being overhauled by the Nikolaev Aircraft Repair Plant (NARP) before delivery.

The first two aircraft received were UR-76662 and UR-76690, which had been used by Bosnia Airlines and Busol Airlines and had large amounts of flying hours remaining before their next overhaul. The aircraft received Algerian civil registration codes (7T-WIS and 7T-WIN, respectively) and were delivered to the air force in 1999 after receiving full Algerian markings and colour schemes.

In 2001, the third IL-78 (7T-WIF) was delivered and 7T-WIL, which had previously served as a cargo aircraft in the UAF at Melitopol, was delivered in 2002. Final





Above: This unmarked IL-78 is the former Ukrainian Air Force UR-76744, which was restored and modernised by NARP in 2013. This picture shows the aeroplane during its post overhaul and modernisation check flight at Kulbakino on March 23, 2014. The aeroplane is now in service with the PLAAF at Wuhan-Yangluo and serialised 20641, but its aerial refuelling systems were stripped down for research and study in late 2014

Andrey Rakul via Author

Left Top: The former Ukrainian Air Force UR-76730 flew with BSL Airlines from 1995 and later became the second IL-78MP to join the Pakistan Air Force. In PAF service it flies as R10-002 and is seen here returning from a 'Post Overhaul Functional Check Flight' at Kulbakino on July 23, 2010

Evgeny Melnik via Author

Left Middle: Russian-operated Midas CCCP-76701 refuels a pair of Sukhoi Su-27 Flankers from the Russian Test Pilots School and a Su-32 at the Moscow Airshow. This IL-78 was later withdrawn from use and was last noted in a derelict condition at Ramenskoye

Left Bottom: An IL-78 refuels a Mikoyan Gurevich MiG-29 Fulcrum during a training sortie

"The primary role was aerial refuelling"

overhauling and renovation at NARP was completed in 2003, with 7T-WIH and 7T-WIQ the last to arrive in Algeria.

All six Algerian IL-78s went into service with 374 Squadron at Boufarik Air Base. Although they mostly carry just two UPAZ-1A under wing refuelling systems, just three of the aircraft (four at maximum) are kept in air-to-air refuelling configuration with the others predominantly used as freighters.

Stranded in America

In late 2005 another UAF IL-78 (UR-76759) was sold to a US private company, North American Tactical Aviation Inc (NATA). Prior to delivery, the aircraft was overhauled by the NARP and painted in a gunship grey colour scheme. Nine months after delivery, the FAA issued the

IL-78 with the civil registration N78GF.

Based in Newark, Delaware NATA had been established by Gary R Fears and planned to use the IL-78 as a tanker in contracts with the USAF but the project was suspended when the company filed for bankruptcy.

Fears attempted to sell N78GF to the Pakistani Air Force, but when the aircraft and its Ukrainian crew were leaving North Texas Regional Airport en route to Pakistan (via refuelling at Wittman Regional Airport in Wisconsin) they were ordered not to leave America. N78GF now resides in Salt Lake City, having been owned by the Bank of Utah since 2012.

Another UAF IL-78 (UR-76767) had similar destiny to UR-76759. The aircraft was purchased by NATA in 2009, to be used beside N78GF and it was expected



Equipped with just a pair of UPAZ-1A aerial refuelling systems 7T-WIF is one of only two Algerian Air Force IL-78s that are still equipped for air-to-air refuelling. The air arm's other four Midas* are either grounded or being used as cargo aircraft. This image shows 7T-WIF on final approach to Boufarik Air Base in June 2012

Kingvarg - Algerian Spotters via Author

that the US Navy would charter the aircraft for aerial research and training purposes.

On March 1, 2009 the aircraft was registered N78RX and the company received its first order from a Middle Eastern customer shortly afterwards. However, due to NATA's financial problems, it too was not allowed to leave the US. The aircraft is now owned by IL78-2 LLC and stored in the US.

Pakistani Tankers

Financial problems also blighted Kiev and forced the Ukrainian government to reduce its Armed Force's expenditure and sell equipment.

Problems with Russia and the Ilyushin OKB also made it difficult for the NARP to provide spare parts for the IL-78s and the UAF's IL-78 fleet had reached their maximum time between overhaul (MTBO). Their engines also required overhaul and it was therefore deemed more profitable to sell the ageing and expensive to maintain jets rather than continue using them as freighters.

The Angolan Air Force had already acquired an IL-76TD (D2-FEW) and in 2006 the Pakistan Air Force (PAF)

became the third military customer for the ex-Ukrainian airframes. The PAF sought to acquire IL-78 tankers to support operations of its PAC JF-17 Thunder fighter aircraft as well as its IFR (In-Flight Refuelling) equipped Dassault Mirage IIIs.

In December 2006 a contract was signed with Ukrspecexport for the supply of four IL-78s (UR-76675, 76682, 76730 and 76742), which were all between 19 and 20 years old at the time. The airframes were delivered to NARP between 2007 and 2008 to be overhauled and modernised.

The first master life-extension procedure (major overhaul with a life extension) ordered by Pakistan was started in early 2009 and the fully refurbished aircraft rolled out of the facility at Kulbakino in November the same year. The first IL-78MP was re-serialised R09-001 and its test flights continued until December 4 when it was handed over to the PAF.

The second IL-78 (R10-002) performed its first functional check flight in July 2010

Right: R09-001 was the first IL-78MP delivered to the Pakistani Air Force after overhaul and restoration in Ukraine. It had previously served the Soviet Air Force as CCCP-76742 and the Ukrainian Air Force as UR-76742 and was delivered to Pakistan on December 4, 2009. It can be seen while delivering fuel to a Mirage IIIDP

Rogier Westerhuis / Aero Image via Author

Below: BSL Airlines was one of the Ukrainian government-owned airlines linked with the Ukrainian Air Force to use its air assets as commercial cargo aircraft. This included the use of IL-78s and UR-76689 was one eleven used by the airline. The aeroplane was later stored at Bila Tserkva until 2013, when it was brought up to ferrying condition and relocated to the Kulbakino Air Base for restoration and overhaul. It was delivered to the PLAAF in 2015

Chris Chennell via Author

"All six Algerian IL-78s went into service with 374 Sqn"





and was delivered in August of that year. Meanwhile work on the third and fourth airframes (R11-003 and R11-004) ended in February and August of 2011 respectively.

All four aircraft serve with the 10th Squadron at PAF Base Nur Khan at Islamabad International airport and see

extensive use in both tanker and transport roles.

Chinese IL-78s

With almost 1,500 fighter aircraft and 120 strategic bombers in its inventory, the Chinese People's Liberation Army Air Force

(PLAAF) had insufficient tankers to support its extensive fleet of combat aircraft.

Therefore, in 2005, it was announced that China intended to purchase 30 IL-76TDs and eight IL-78s from Russia. Later, in September of that year, it was claimed by news agencies that a contract had been signed with the Tashkent Aviation Production Association for the procurement of 34 IL-76TDs and four IL-78s. However that contract was put on hold in 2009.

In December 2011, the PLAAF signed a contract with Ukrspesexport for the acquisition and export of three overhauled UAF IL-78s that had been subjected to a life extension programme. The total cost of the aircraft was US\$44.7 million.

The first of China's three IL-78s was the former UR-76744; one of two still airworthy in the UAF in 2009.

The tanker had been put up for auction on June 14, 2011 and after it had been acquired by the PLAAF overhaul began at NARP in January 2012. After more than two years of extensive work it was rolled out of the repair plant in March 2014 and following several functional check flights it was handed over to the PLAAF at Wuhan-Yangluo on September 18, 2014. It later entered service with the 38th Air Regiment 13th Transport Division and was serialised 20641.

Two more IL-78s (ex-UR-76670 and UR-76689) are currently undergoing overhaul and lifetime extension at Kulbakino and will be delivered to the PLAAF later this year. They will serve until the planned tanker version of the Y-20 transport aircraft eventually enters service.

From the original 21 IL-78s inherited from Russia just one (UR-76760) remained in service with the Ukrainian Air Force in January 2015. Today, some 48 IL-78s are in service with the air arms of Algeria, China, India, Pakistan and Russia; thirteen of them are former Ukrainian IL-78s. ●

SPECIFICATION ILYUSHIN IL-78 MIDAS



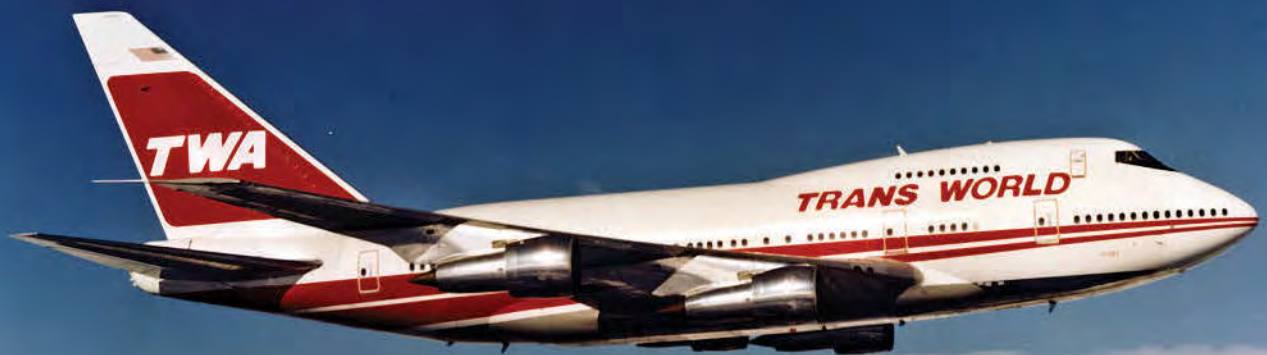
Crew	6
Length	152ft 10in (46.59m)
Height	48ft 5in (14.76m)
Wingspan	165ft 8in (50.50m)
Wing area	3,200sq ft (300m ²)
Empty Weight	158,733lb (72,000kg)
Max Take-Off Weight	462,971lb (210,000kg)
Max Speed	459kts (528mph/850km/h)
Service Ceiling	39,370ft (12,000m)
Ferry Range	4,536 miles (7,300km)
Powerplant	Four Aviadvigatel D-30 KP turbofans (27,000lb/thrust each)
Armament	Nil
Capacity	282,042lb (127,932kg) of jet fuel
First Flight	June 26, 1983

Artwork: Andy Hay / www.flyingart.co.uk



SPECIAL PERFORMANCE **THE 747SP STORY**

Designed to exploit the gap between the Boeing 707 and the new 380-seat 'Jumbo Jet', the dumpy 747SP boasted remarkable long range. As Michael Allsop reveals, it also enabled a number of airlines to enter the world of widebody jets



Trans World Airlines operated three 747SPs from 1979 to 1986. They were acquired for long distance routes to the Middle East but the routes never materialised and the jets were used instead on night flights between Los Angeles and Boston as well as international flights to Paris

When its revolutionary Boeing 747 'Jumbo Jet' entered service in early 1970, Boeing found itself with the largest passenger-carrying airliner in the world.

It soon became obvious that no other manufacturer could compete with the mighty 747 in terms of mass transportation; so some chose to concentrate on filling the airlines' other needs.

Capability gap

With the Boeing 707 seating up to 170 passengers and the new 747 catering for upwards of 380, the likes of Douglas and Lockheed realised there was capability gap for a jetliner capable of seating 250.

Douglas' tri-jet DC-10 first flew in August 1970 and Lockheed's three-engined L-1011 TriStar followed it into the skies in November of the same year. Both were selling well and Boeing realised it needed to act quickly to ensure it didn't lose market share.

The task was handed to Joe Sutter, who had already designed the 747 and seen the project through to fruition. He initially considered a three-jet airliner so as to compete with the DC-10 and L-1011's fuel economy. This would result in a 33% reduction in fuel burn as well as reducing the aircraft's weight by around seven tonnes, but calculations revealed

the cost prohibitive design and test work would take far too long. By the time such an aircraft took to the skies the Lockheed and Douglas aircraft would have stolen a significant market lead.

'Chopped'

Sutter went back to the drawing board. He knew that 'stretched' versions of Boeing airliners had long found success but on this occasion he had to rethink the process

N747SP aloft on its maiden flight on July 4, 1975. The aircraft performed so well that the entire flight envelope was explored, from stall speed to 'do not exceed' speed



would result in a lighter aircraft that would trade weight for range. The project was dubbed the Boeing 747SB (Short Body) concept and design proceeded apace.

Pan Am

The project received a welcome shot in the arm in 1973 when Pan American World Airways and Iran Air approached Boeing to request an airliner that could operate on 'long and thin' routes.

"Sutter came up with the decision to 'chop' his beloved 747"

and soon came up with the decision to 'chop' his beloved 747. This would be both quicker and cheaper than designing a new aircraft from scratch and, he surmised,

These were to destinations beyond the range of the L-1011 and DC-10, with passenger numbers too low to justify the use of a standard 747.

It was at this point that Sutter's decision to retain the four-engined configuration paid dividends and the projected long-range performance of the 747SB made it ideal for both Pan Am and the Iranians. Within weeks Pan Am had ordered ten aircraft and Iran Air soon followed suit.

Green light

The Pan Am order alone was valued at \$280 million and gave the project sufficient impetus to progress beyond the drawing board. By mid 1973 the aircraft had been re-designated as the 747SP (Special Performance) and Boeing projected a market for 214 airframes, with a break-even point of 45 sales.

Sutter and his team finalised the design with a length of 184ft 9in – some 48ft 4in shorter than the standard 747-100. They surmised that this, combined with other weight saving modifications, would result in a weight reduction of 45,000lbs but the jet would still be able to accommodate around 280 passengers.

The wing was essentially unchanged but used lighter materials throughout

The first prototype, N747SP, was rolled out on May 19, 1975



CLASSIC AIRLINER



The first prototype 747SP about to depart Kabul on November 18, 1975 destined for Bombay. The 2,330 mile flight to India took 4 hours 23 minutes and senior executives from Arian-Afghan Airlines and Afghanistan government officials were carried as part of a sales drive in the area



Air China's B-2454 was originally built for Braniff in 1981 as N1608B but was never delivered. It joined CAAC in 1982 as N1301E and became B-2454 when the airline was rebranded as Air China in 1989. It later flew with various owners as VH-OZX and D6-OZX but was scrapped in 2008 in South Korea

and the complicated triple-slotted flaps were replaced by simple single-slotted units. The wing also lost the under-wing 'canoes' that housed the flap mechanisms on larger 747s. The tailplane was 10ft greater in span and the vertical fin was also extended slightly.

Maiden flight

With development progressing on schedule, the first 747SP (the appropriately registered N747SP) was rolled out of the factory on May 19, 1975 and performed its maiden flight on July 4 – ten days ahead of schedule. The honour of making the debut outing fell to Jack Waddell, who had

also flown the prototype 747 on its first sortie.

N747SP was aloft for three hours that day and explored the entire flight envelope from stall speed to a VNe (never exceed speed) run of Mach 0.92.

Flight testing proceeded without incident and the lightweight 747 soon revealed itself to be a spectacular performer. With a reduced all-up weight but retaining the same thrust as a 'full-sized' 747 the 'SP' was impressively quick.

Record breaker

Keen to promote the new aircraft's capabilities, Boeing seized on this newfound speed and on November

12, 1975 the fourth prototype flew non-stop from New York to Tokyo in 13 hours and 33 minutes – with 200 passengers on board! When the aircraft had completed the 6,927 miles, it even had over 30,000lbs of fuel remaining.

Needless to say, the aircraft sailed through its type certificate programme and the FAA certified the 747SP for passenger flying on February 4, 1976.

Into service

The first example was delivered to launch customer Pan Am on March 5 and the type carried its first fare paying passengers the following month. It was popular with passengers and airlines alike and over the coming months and



Air Namibia 747SP V5-SPF began life with South African Airlines in 1977 as ZS-SPF. It joined Air Namibia on lease in 1990 and was operated until 1998 when it joined Linhas Aeras de Mocambique. In October 1998 it was damaged by fire following an engine explosion shortly after take-off and was never rebuilt

years it would both establish and break various distance and speed records. However, not all was rosy in the world.

The 1970s oil crisis meant the price of jet fuel rocketed and, combined with US airline deregulation, this began to signal bad times for the 747SP. Pan Am had previously increased its initial order of ten aircraft to 25 but with financial problems plaguing the American flag carrier, it only ended up receiving the original ten.

Likewise, Qantas only took two aircraft (despite initial enthusiasm for the project) and the order book began to dry up, especially as later airliners

matched or exceeded the 'SP's performance with lower purchase and operating costs.

Operators

Nonetheless, the aircraft did find a niche with a number of operators and, in many cases, allowed smaller carriers to expand into the world of widebody jets.

Some, such as Aerolineas Argentinas, Tajik Air and Qatar Airways operated just a single aircraft but others operated entire fleets of 'SPs.

Air China used the type on its Pacific routes as well as its first route to USA (Beijing–Seattle). Air China 747SPs also flew from Beijing to Vancouver

and New York and remained in service until the early 2000s.

South African Airways operated six 747SP aircraft on flights from Johannesburg to European destinations during the apartheid years when its aircraft were not allowed to overfly African countries. The 'SP's extra range allowed the aircraft to fly around the 'Bulge of Africa' and on April 1, 1977 the airline inaugurated the first direct 747SP flight between London and Cape Town. The last example finally retired in 2006.

In the USA, Trans World Airlines (TWA) operated three 747SPs from 1979 to 1986. They were acquired for long distance routes to the Middle East but the routes never materialised and the jets were used instead on night flights between Los Angeles and Boston as well as international flights to Paris.

Two TWA aeroplanes were later sold to American Airlines, which used them on its Dallas-Fort Worth to Tokyo service as well as operating routes between New York and London and New York to Brussels.



Two TWA aeroplanes were later sold to American Airlines, which used them on its Dallas-Fort Worth to Tokyo service as well as operating routes between New York and London and New York to Brussels. N601AA served TWA as N57202 and joined American in 1986, with whom it flew until 1994 when it joined Kazakhstan Airlines as UN-001. It later passed through various owners as P4-AFE and TF-ABN before being scrapped at Luxemburg in 2002



Iran Air flew just four 'SPs. These included EP-IAA, seen here visiting London Gatwick in December 1976. It was eventually retired in 2014 and is currently stored in Tehran Caz Caswell

SPECIFICATION BOEING 747SP

Crew	3
Capacity	233-375 passengers
Length	184ft 9in (56.31m)
Height	65ft 10in (20.06m)
Wingspan	195ft 8in (59.64m)
Wing area	5,500sq ft (511m ²)
Empty Weight	336,870lb (152,780kg)
Max Take-Off Weight	670,000lb (304,000kg)
Max Speed	591kts (680mph/1,095km/h)
Service Ceiling	45,100ft (13,746m)
Ferry Range	7,650 miles (12,320km)
Powerplant	Four Pratt & Whitney JT9D-7R4W or Rolls-Royce RB211-524C2 turbofans (46,500lb/thrust each)
First Flight	July 4, 1975

Andy Hay / www.flyingart.co.uk

Elsewhere in the USA, United Airlines acquired its 747SPs from Pan Am in 1986 and used them on flights to London, Hong Kong, Tokyo, Buenos Aires, Rio de Janeiro and São Paulo. Meanwhile Braniff took delivery of three 747SPs for its ultra-long haul routes in the Pacific and South America.

Reopened

The last regular production 747SP was delivered to the Iraqi Government in August 1982. It was the 44th example to be produced and many observers thought they'd seen the end of the production line.

However, in 1987 Boeing agreed to reopen the line to produce one



ZS-SPE joined South African Airways in 1976 and was named 'Hantam'. SAA later leased it to various operators including Luxair (as LX-LGY), Air Mauritius (3B-NAR) and Air Namibia (V5-SPE). It was finally scrapped in 2008 Tom Singfield Collection



Pan Am 747SP N539PA 'Clipper Black Hawk' lands at Hong Kong's Kai Tak Airport in January 1980. It later joined United Airlines as N148UA and was then sold to the Government of Qatar as VP-BAT, with whom it still flies Adrian M Balch

final aircraft. This 747SP (c/n 23610) was destined for the United Arab Emirates Royal Flight and first flew on March 31, 1987. With the 45th aircraft complete, Boeing finally shut down the 747SP line for good.

While the aircraft met limited success with the airline industry, it found a new lease of life with the ultra-rich. The high performance, low capacity 747SP became the aircraft of choice for heads of state, celebrities and heads

of industry wanting the ultimate in executive transport.

Still going strong

Of the four 747SPs that entered service with Iran Air, just one (EP-IAC) remains active today; this being the only example left in passenger service in 2015.

However, a dozen other examples continue to fly with corporate and government operators around the globe. The governments of Bahrain, Oman and



NASA's Stratospheric Observatory for Infrared Astronomy has had its fuselage modified to carry a 2.5m diameter reflecting telescope to high altitude NASA

Qatar each fly single examples while the Government of Saudi Arabia retains three airframes. Other examples continue to fly with Ernest Angley Ministries, Fry's Electronics and Las Vegas Sands while Pratt & Whitney Canada (PWC) retain two 747SPs as engine test-beds.

SOFIA

While the PWC test-beds are certainly unusual aircraft, the most distinctive 747SP to have ever flown must surely be NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA). This aircraft has had its fuselage modified to carry a 2.5m diameter reflecting telescope to high altitude where it is unaffected by more than 99.9% of

the light-absorbing water vapour in the atmosphere. Observations are made through a 13ft square hole in the port rear fuselage and a sliding door covers the aperture when the telescope is not in use.

Legacy

Boeing said it needed to sell 45 examples to 'break even' and it did just that, but having to reopen the production line to do so would not have come cheap. Irrespective of whether the aircraft was deemed a commercial success, the 747SP played an important role in proving technologies that would later be employed on the 'full-sized' 747 and other members of the Boeing family. ●



Pratt & Whitney Canada uses a pair of 747SPs as engine test-beds. In this case the test unit is mounted on the side of the forward fuselage PWC



Ex-Pan Am 747SP VP-BAT visiting Heathrow on May 21, 2011 while in service with the Qatar Amiri Flight Caz Caswell

Qantas operated just two 747SPs – VH-EAA (illustrated at Melbourne in May 1984) and VH-EAB. This aircraft served the airline from 1980 until 2002 Tom Singfield Collection



USS *INTREPID*



The museum's Grumman F-14 Tomcat (BuNo 157986) was the seventh built and was later converted to Super Tomcat configuration with a pair of General Electric F110-GE-400 engines. It led the way to the highly improved and updated F-14D that served the US Navy with distinction

Just a few minutes walk from the bright lights of Times Square and Broadway, the USS *Intrepid* is berthed in downtown New York City as a floating museum.

Dr Nia Jones pays a visit to the 'Floating I'

The USS *Intrepid* is one of 24 Essex-class aircraft carriers built for the US Navy during World War Two and was commissioned in 1943. Known to her seamen as 'The Fighting I', the ship participated in several Pacific Theatre campaigns and survived five kamikaze attacks and a torpedo strike.

In the early 1950s she was re-commissioned as an attack carrier and participated in the Vietnam War and the Cold War. NASA later used the *Intrepid* as the recovery ship for both Mercury and Gemini space missions.

Floating tribute

In 1974, prominent New York real estate developer and philanthropist Zachary Fisher joined forces with journalist Michael Stern to save the decommissioned *Intrepid* for posterity, in memory of the more than 50,000 men who served aboard her and the 270 who paid the ultimate sacrifice while operating on or from her decks.

Today she is berthed on the Hudson River as the centrepiece of the *Intrepid* Sea, Air & Space Museum. Just a few minutes walk from Times Square, Broadway and New York City's other highlights, the 36,380 tonne, 872ft long aircraft carrier that dominates the waterfront is a popular tourist attraction – and rightly so.

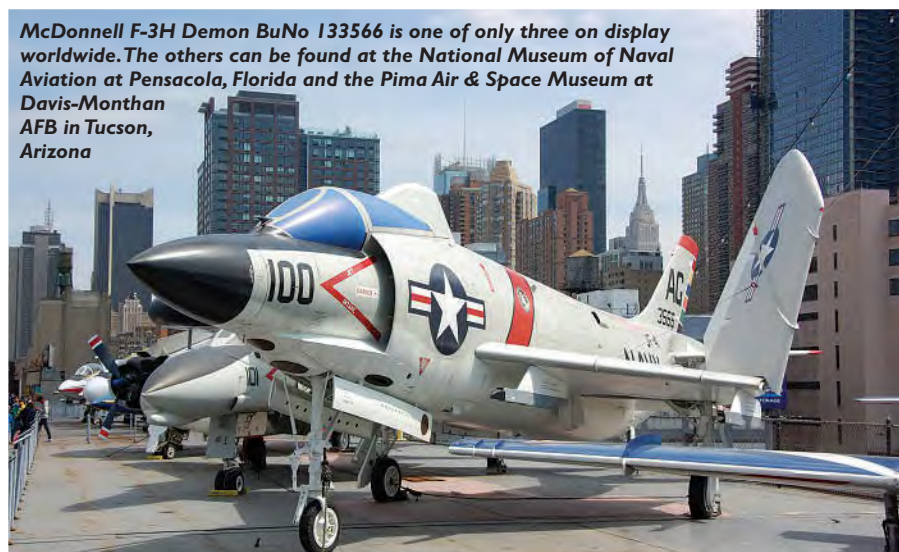
Below deck

Visitors to the *Intrepid* enter below decks and it is easy to lose both hours and your bearings as you wander around looking at the various exhibits and the amazing infrastructure needed to keep 3,000 enlisted sailors, officers and Marines at sea for months at a time.

Among the highlights are the Squadron Ready Room where pilots received their final briefing before taking off on their missions, the Combat Information Centre where crew members tracked the location and movement of all nearby aircraft and ships (both friend and foe) and the Mess Deck that has been restored to its 1969 configuration, complete with custom paint colours and its 'Wild West' theme!

Also on view are the *Intrepid's* fo'c'sle as

McDonnell F-3H Demon BuNo 133566 is one of only three on display worldwide. The others can be found at the National Museum of Naval Aviation at Pensacola, Florida and the Pima Air & Space Museum at Davis-Monthan AFB in Tucson, Arizona



well as dormitory-style accommodation used by junior officers; state rooms for higher-ranking officers and the cramped berths issued to enlisted sailors.

Hangar deck

The aircraft hangar area can also be found below decks and today this is home to displays, models, restored aircraft and the Exploreum, which is an interactive exhibition space designed especially for families.

Aircraft below deck include a World War Two Grumman TBM Avenger as well as examples of early jets including a North American FJ-3 Fury and a Douglas A-4B Skyhawk.

"A fantastic family day out"

Main deck

However, the majority of the aircraft are displayed outside aboard the *Intrepid's* main deck.

Of course, US Navy aircraft fittingly take prominence aboard the ship and these range from the piston-powered Douglas A-1 Skyraider and Grumman E-1 Tracer airborne early warning (AEW) aircraft, through to a mix of very rare jet fighters.

Among the highlights are the seventh Grumman F-14 Tomcat built – which was used as the prototype Super Tomcat in 1973 and is preserved as such. It is joined on deck by a Grumman A-6 Intruder that was used as a radar and avionics test-bed, and iconic fighters such as the McDonnell Douglas F-4N Phantom II and Vought F-8 Crusader.

One of the rarest aircraft in the collection is the McDonnell F-3H Demon (BuNo 133566), which is one of only three on display worldwide. Today it is parked alongside a Grumman F-9F Cougar and Grumman F-11 Tiger (which wears the markings it wore when flying with the Blue Angels demonstration team) to represent three of the US Navy's earliest jet fighters.

Other air arms

The deck is not solely dedicated to naval aviation however; and immaculate examples of a US Marine Corps AV-8C Harrier; US Army UH-1 Iroquois, US Coast Guard Sikorsky H-19 and a USAF Lockheed F-16 Fighting Falcon are also on view.

Ironically, the aircraft that dominates the flight deck is not a naval aircraft either. The first production Lockheed A-12 (the predecessor of the SR-71A Blackbird) is parked on the rear of the deck and serves as an impressive 'advert' to passing tourists as they walk along the waterfront.

Space Shuttle Pavilion

On April 27, 2012 NASA Space Shuttle *Enterprise* was flown into New York's JFK

Among the international aircraft on show is this pair of Polish built MiGs; both are displayed in bright colour schemes



Below decks can be found a Douglas A-4B Skyhawk, Grumman TBM Avenger, Piasecki UH-25 helicopter and this immaculate North American FJ-3 Fury



When it was built, the USS Intrepid weighed 36,380 tonnes and measured 872ft long. Today the aircraft carrier dominates the New York City waterfront

International Airport and was moved by barge to the *Intrepid* six weeks later.

Enterprise was the first Space Shuttle and was built to test the aircraft's gliding characteristics. It was constructed without engines or a functional heat shield, and was therefore not capable of space flight.

Today, the Shuttle is housed within a specially constructed pavilion aboard the main deck where visitors can also see exhibits about space flight and science, including a Soviet Soyuz TMA-6 space capsule.

In order to make room for the Shuttle, the trustees of the museum transferred its Douglas F3D Skyknight, Supermarine Scimitar and a MiG-15 to the Empire State Aerosciences Museum near Schenectady, New York.

Overseas presence

It is also refreshing to see a number of international airframes preserved aboard the *Intrepid*. These include an Israeli-built IAI Kfir; Polish-built examples of the MiG-17 Fresco and MiG-21 *Fishbed*, a French Dassault Étendard IV and even an Italian Aermacchi MB-339 – the latter painted in the colours of the Frecce Tricolori display team.

Although the aircraft are displayed with ample space around them, the trustees of the *Intrepid* Sea, Air & Space Museum could

not find space for British Airways Concorde G-BOAD above or below deck. As such, the aircraft is displayed on the dock alongside the ship and visitors can tour the airframe that still holds the world speed record for passenger airliners (it flew from New York to London in 2 hours, 52 minutes and 59 seconds on February 7, 1996).

The USS *Intrepid* is a most unusual and fascinating museum that offers an insight into life above and below decks from the 1940s to the 1970s. It also makes for a fantastic family day out when you've 'done' the New York tourist trail and shopped until you've dropped! ●

OPENING HOURS

The museum is open daily from 10am to 5pm and until 6pm on Saturdays, Sundays and Public Holidays between April 1 and October 31. Admission costs \$31 for adults, \$27 for students, \$24 for youths (7-17), \$17 for children (3-6) and \$24 for veterans. Additional \$20 fees (\$15 for children/youths/seniors) apply for those wanting to tour Concorde or the Space Shuttle exhibition. Visit www.intrepidmuseum.org for more information.

Pioneering Viscount



THE WORLD'S FIRST TURBOPROP PASSENGERS



On July 29, 1950 the prototype Vickers Viscount became the first turboprop-powered airliner to carry fare-paying passengers.

Kimberley Hawkins investigates

When the prototype Vickers V.630 Viscount (G-AHRF) performed its maiden flight on July 16, 1948 it immediately became obvious that the British aviation industry had a world-beater on its hands.

By the time of the SBAC Airshow at Farnborough just over a month later, G-AHRF had already achieved the mandatory 15 hours of flying time to enable it to take to the skies and wow the crowds. The distinctively smooth whine of its Rolls-Royce Dart turboprops intrigued onlookers while industry pundits praised the large oval windows that afforded

passengers an almost panoramic view.

However, while the aircraft showed enormous promise, the Ministry of Supply was adamant that the 32-seat Viscount was not big enough and ordered a further 'stretched' prototype capable of carrying up to 53 passengers.

It would be August 1950 before the modified V.700 version of the Viscount

(G-AMAV) took to the skies, but passengers didn't need to wait that long to sample the delights of turboprop flight.

Restricted

While development of the larger and more powerful variant continued apace, Vickers carried on flight testing with G-AHRF, which was awarded a restricted Certificate of

"They would go down in history as the first commercial turboprop passengers"



G-AHRF was the prototype Viscount V.630 and was widely flown in demonstrations and airshows around the globe

“The Viscount logged almost 95 hours in just 14 days”

Left: Viscount G-AHRF resplendent in BEA colours as it prepares to take to the skies in 1950

Right: The aircraft's turboprop powerplants offered passengers a quiet and smooth flight. The Viscount's cabin also afforded a level of luxury unheard of today



(the designer of the Viscount), Sir Frank Whittle (jet engine pioneer) and Peter Masfield (BEA Chief Executive). They would go down in the history books as the first commercial turboprop passengers.

Operating as flight BE292X2, the Viscount taxied out at London's Northolt Airport and took to the skies at 12.48.

Seventy minutes later G-AHRF and her historic passengers landed safely at Paris-Le Bourget Airport. The aircraft had flown the route at 18,000ft and had averaged 237kts.

Festival flights

Over the next two weeks the Viscount would complete 36 further round trips to Paris carrying 1,516 passengers. The aircraft logged almost 95 hours in just 14 days.

With the London-Paris route thoroughly tested, BEA then turned its attention to the London-Edinburgh sector. Catering for the increased demand coinciding with the annual Edinburgh Festival, G-AHRF (piloted again by Rymer and Wakelin) flew eight return trips to/from the city's Turnhouse Airport.

The route was normally flown by BEA's Douglas DC-3 and took 135 minutes. However, the Viscount was able to cover the same route in 105 minutes and offered passengers a much smoother and quieter experience. Some 299 paying passengers took the opportunity to fly on the revolutionary turboprop airliner, paving the way for the future.

G-AHRF returned to Vickers on August 23, having given BEA valuable experience in operating the aircraft. These flights not only proved the reliability of the type, they demonstrated the Viscount's popularity with passengers and paved the way for the first 20 Viscount V.700 aircraft that entered regular passenger service with BEA in April 1953. ●

Airworthiness on September 15, 1949.

This enabled the aircraft to undertake demonstration flights and test routes around the globe, but did not allow the carriage of fare paying passengers. Vickers and British European Airways (BEA) therefore pressed on with the programme and on July 27, 1950 G-AHRF became the first Viscount to be certified for commercial use.

Pioneering Pax

G-AHRF was immediately leased to BEA, which was keen to capitalise on the new aircraft's capabilities and score a significant public relations coup.

Two days later, on July 29, Captain Dick Rymer and co-pilot W J Wakelin welcomed aboard 14 fare paying passengers (who had booked thinking they would be travelling in a piston-powered Vickers Viking!) and ten VIP guests including George Edwards

G-AHRF was also used for a number of route-proving flights and is seen here visiting Zurich in March 1950. It has already gained BEA colours



ENTENTE DISCORDIALE

The SEPECAT Jaguar story

A first for international co-operation
Richard Freail examines how the
Anglo-French Jaguar came to be built

In the early 1960s the Armée de l'Air (French Air Force/FAF) identified the need to replace its ageing light attack aircraft, including the Dassault Mystère, as well as its Lockheed/Canadair T-33 and Fouga Magister trainers. The French were seeking a small, cost-effective but cheap, subsonic trainer with light-attack capabilities which could operate from unprepared grass strips. Designated the ECAT (École de Combat et d'Appui Tactique – Tactical Combat Support Trainer), by 1964 the FAF decided to procure a single design as a tactical support fighter with a secondary advanced training capability, to enter service in 1970.

French concepts...

Five companies responded, including Breguet with the Br.121 developed from the Br.1001 Taon – its unsuccessful submission to the 1950s NATO standardised fighter competition. This was now a larger and more capable aircraft, to be fitted with Rolls-Royce RB172 powerplants. Breguet proposed five models: 'A' – tactical fighter-bomber; 'B' – two-seat fighter-bomber; 'C' – interceptor; 'D' – advanced

trainer and 'P' – tactical reconnaissance.

Breguet had not been a major factor in the French aircraft industry for two decades but in 1965 its proposal was chosen for further development.

Marcel Dassault had expected his company to win and was outraged, but in due course his company would have a direct and, unfortunately, negative influence over the project.

... and British ideas

Across the Channel, the British were in a similar quandary. Despite having a supersonic fighter, the English Electric Lightning, in its armoury the RAF had so far eschewed purchasing a supersonic trainer. Instead, pilots trained on the comparatively sedate Hunting Jet Provost and then moved onto the more advanced Folland Gnat, a small but nimble aircraft with an extremely cramped cockpit – unsuitable for some pilots – and lacking the ability to carry external stores. The Hawker Hunter, a fighter and ground-attack aircraft, was drafted in to supplement the Gnat and alleviate some of its drawbacks.

Contemporary thinking viewed the jump



"Marcel Dassault was outraged"

from Gnat to the proposed aircraft of the next decade, such as the British Aircraft Corporation (BAC) TSR-2 and Hawker P.1154, as just too great, leaving pilots unprepared for the front-line; a demand now existed for a supersonic trainer. In contrast to the French position of strike aircraft first, trainer second, the British regarded training as the primary role for any new airframe. By 1963, Air Staff Target (AST) 362 was seeking such an aircraft to be in service by the 1970s. However, with its Hunter ground-attack aircraft likely to need replacing in the mid-1970s, the RAF began to view a new supersonic trainer as a potential ground-attack replacement for the Hunter.

In contrast to France, where simple fixed-wing designs were being submitted for consideration, complex airframes utilising

The lines of the SEPECAT Jaguar are clear in this artist's impression of the Breguet Br.121 which, in 1965, was chosen for development as the French ECAT (Tactical Combat Support Trainer). To meet British demands for supersonic performance a number of design changes were required



The French Air Force ordered 160 single-seat Jaguar A and 40 twin-seat Jaguar E, with the first being delivered in 1972. After the 1991 Gulf War the French started the gradual withdrawal of the type and the last squadron stood down in 2005. This is E-22 - the 22nd Jaguar E constructed - serving with EC 2/7 at St Dizier



The first prototype to fly was French twin-seat Jaguar E-01 (F-ZWRB) which completed its maiden flight on September 8, 1968 with Bernard Witt at the controls. The aircraft was lost in March 1970 when it suffered an engine fire on approach and the pilot was forced to eject



variable geometry (VG) were being suggested by the major UK manufacturers. However, for all its advantages on larger supersonic aircraft, VG was not the way forward for smaller airframes: there was too much of a weight and space penalty to make its application practical. It also made the aircraft unnecessarily complicated for student pilots.

Fourth Dimension: Politics

In the early 1960s, informal discussions between Peter Thornycroft, Secretary of State for Defence, and his French counterpart, Pierre Messmer, highlighted that they were engaged in similar projects. In 1963 the French had delivered an unexpected rebuff to the UK's attempts to join the European Economic Community (EEC) and the following year the UK government changed, with Denis Healey appointed as defence minister in a Labour administration. With a financial crisis looming and spiralling defence costs, Healey was determined to



The French Navy ordered 40 Jaguar M aircraft to operate from carriers. Prototype M-05 (F-ZWRJ) undertook sea trials on the Clemenceau in 1970 - it had a strengthened internal airframe, an arrestor hook stressed to 5G, a Martin Baker Mk9 Zero-Zero seat and a twin nose-wheel/single wheel main undercarriage arrangement. A laser rangefinder was fitted as standard. It was cancelled in January 1973



The second RAF prototype Jaguar S-07 (XW563) was used by BAC to supplement the work of the Jaguar International demonstrator XX108. It retained the tail RWR but the glass apertures in the nose were faired over. Overwing pylons carry Matra Magic AAMs. The airframe went to RAF Brüggen in 1978 for ground instruction use



A Royal Air Force of Oman Jaguar OS (204) of 20 Sqn, armed with practice munitions, flies over the desert near Thumrait in September 2009. The Omanis ordered a total of 20 single-seat (OS) and four twin-seat (OB) Jaguars in two batches in 1974 and 1980. The last four aircraft were retired in August 2014 *Peter R Foster*

act. Defence and the aviation industry were still suffering the lingering consequences of the Conservative Party's 1957 White Paper arguing for missiles and not manned aircraft and the effect of acquisitions and enforced mergers of aerospace companies. Good relations with the French were, however, important as the government believed that joint projects might improve the chance of acceptance into the EEC.

Talks between the two air staffs helped foster a mutual understanding and a converging of specifications, leading to a Memorandum of Understanding being signed in May 1965 for joint working on two military projects.

First was the Anglo-French Variable Geometry (AFVG) strike aircraft, to be based on the BAC R45 with the UK acting as design lead. Secondly there was an advanced trainer/light-attack aircraft, based on the Breguet Br.121, with France having design lead and the engines being supplied by an RR/Turbomeca collaboration.

By the 1965 Paris Air Salon, business was sufficiently well advanced for the partners to announce the new aircraft's name – Jaguar.

Joint project

A joint venture company, SEPECAT (Société Européenne de Production de l'Avion d'École de Combat et d'Appui Tactique), was formed by BAC and Breguet in May 1966 to produce the Jaguar and AFVG.

The nose, fuselage, centre sections and undercarriage were to be manufactured by Breguet and the wings, tail unit, rear fuselage and engine intakes by BAC. The parts would be assembled at identical production facilities at Warton, near Blackpool, Lancashire and at Toulouse-Blagnac airport, France. However, two major changes occurred during the project: in 1967 Breguet was effectively taken over by Dassault and, although first suggested in 1967, BAC and Hawker Siddeley were nationalised forming British Aerospace (BAe) in 1977.

Each nation made an initial order of 150 aircraft. France split theirs equally between

"Good relations with the French were important"

the single-seat strike Jaguar A (Appui – support) and the twin-seat trainer Jaguar E (École – school). At this stage the RAF ordered 150 twin-seat Jaguar B (British) trainers but no tactical aircraft. However, British demands for a supersonic trainer would significantly alter the airframe design including a thinner, smaller wing, an area ruled fuselage, an increased weapon and fuel load and a raised rear cockpit to provide a better view for the instructor.

Engine

Rolls-Royce/Turbomeca Ltd was chosen over SNECMA/Bristol-Siddeley and was registered in the UK in 1966 as the body to develop and manufacture new engines for the Jaguar, producing them in Derby, UK and Tarnos, France.

The new RT172 engine was named after the Adour, a river in SW France, and was required to have good fuel consumption and high thrust for take-off, supersonic and low-level operations. Rolls-Royce was responsible for the combustion chamber, turbine and mixer, while Turbomeca manufactured the compressors, gearbox afterburner and jet nozzle assemblies.



India was the largest export customer for the Jaguar where it is called the Shamsher (Sword of Justice). Although retired elsewhere, many remain in service with the IAF and are currently subject of a modernisation programme. Jaguar IS, JS184 heads a line up of maritime radar-equipped Jaguar IMs and a twin-seat Jaguar IT, JT066

The Adour 101 was first bench tested at Derby in May 1967 but was to prove problematic with reheat issues highlighted in ground and, later, air tests. An improved Adour 102 introduced a 'part-throttle reheat system' (PTR) which helped improve performance. The 102 was fitted to all RAF production aircraft and French examples after the first ten. Later improvements saw the Adour 104, with 5,320lb/thrust and 8,040lb/thrust with reheat, fitted to all RAF and FAF Jaguars.

A further modification, particularly in relation to flight safety and engine fires, saw 50 RAF single-seat and twin-seat Jaguars upgraded with the Adour 106, with the last being delivered in early 2005.

UK mess!

The RAF lost three major strike aircraft projects in just four years: the government cancelled TSR-2 in 1965; the French manufacturer Dassault pulled out of the joint, but British-led, AFVG in 1966 on the grounds of cost but in reality to develop and promote its own swing-wing strike aircraft, the Mirage G and then in 1968 Healey cancelled the General Dynamics F-111K, the replacement for the TSR-2, again on the grounds of cost



The RAF Jaguars' four key camouflage schemes are displayed at RAF Coltishall: the early all-over green/grey camouflage, Desert 'Pink' for aircraft that took part in the Gulf War 1990/1, all-over grey introduced from the mid-1990s and a temporary winter scheme for aircraft deployed to NATO's northern flank, e.g. Norway



The RAF's second prototype, Jaguar S-07 (XW563), first flew in 1970 and was used to test UK nav/attack systems. Here, the aircraft is loaded with four 1,000lb bombs, four Matra 155 rocket pods and a 264 Gal fuel tank



and the UK's reducing defence commitments east of Suez.

After losing the AFVG, the only viable replacement at this late stage was the Jaguar. The RAF changed its requirements in early 1967 ordering 110 'B' trainers and 90 British 'S' (Strike) variants. Once the F-111K was cancelled, the UK government solved the increasing hole in the RAF's strike capability by ordering Buccaneers and Phantoms – although many were simply transferred from the Royal Navy's inventory as its fixed-wing operations came to an end. The aim was to use the Phantoms in the strike role initially and then move them to air defence to supplement and then take-over from the Lightning.

A significant change in NATO strategy from 'massive nuclear retaliation' to 'flexible

response' required a greater emphasis on conventional forces, whilst still maintaining a nuclear deterrent. To meet these new demands, the RAF now sought at least 96 Jaguar S aircraft to replace 70 Phantoms. With the loss of aircraft like the TSR-2, PI 154 and AFVG, the case for a supersonic trainer was less clear cut and the RAF again changed its order – to 165 single-seat strike Jaguars and just 35 twin-seat trainers for OCU and continuation training. The French order was also modified: taking only 40 twin-seaters as conversion trainers out of an order of 200 aircraft. The RAF and FAF's concepts for training had moved on, and the idea of the Jaguar as an advanced supersonic trainer was now dead.

The training needs of the both nations

After serving as an operational aircraft, Jaguar XX765 was loaned to BAe Systems in 1978. It was fitted with a Dowty Boulton Paul fly-by-wire system and painted in the 'Raspberry Ripple' colours of RAE and is seen here undertaking tests in 1982. It was later fitted with a carbon fibre wing with enlarged leading-edge extensions and Active Control Technology. It is now preserved at the RAF Museum Cosford



the Aéronavale expressed concern about its single-engine performance. Although considered as superior to its rivals, the Aéronavale regarded it as expensive and could only budget for an eventual 60 airframes but wanted 100. Meanwhile, Dassault promoted its own product – the Super Étendard – and came out the winner. The Aéronavale purchased Dassault's aircraft, albeit only ordering 60 of the single-engine aircraft, due to increasing costs, while the order for the 50 Jaguars was transferred to the FAF.

French Jaguars

Deliveries to the FAF began in May 1972. EC 1/7 and EC 3/7 both giving up ageing Mystère IVs to receive Jaguars and move to St Dizier. EC 1/7 became operational in June 1974 and EC 3/7 the following year. EC 2/7 was the wing's training unit and

were eventually met through different programmes; the UK chose the BAe Hawk, a subsonic trainer/light attack aircraft while the similar Franco-German Alpha Jet met the requirements of the FAF.

Prototypes

The first sign of the Jaguar was a wooden mock-up of the British Jaguar B built at Warton and shown at the Paris Air Salon in 1967. The two governments then signed an agreement for the production of the first 400 aircraft in January 1968.

Eight flying prototypes were manufactured – five French and three British. The first, Jaguar E-01, was rolled out at Toulouse-Blagnac on April 17, 1968. After ground and engine tests, and taxiing trials, its maiden flight was flown by Bernard Witt from the French Flight Test Centre, Istres on September 8, 1968. It flew for 25mins and reached 17,000ft; it then went supersonic on its third flight.

Test flying proceeded swiftly and 1969 witnessed five more prototypes, four French and one British, join the programme. The final two British aircraft were flown in 1970 and 1971.

Although Jaguar E-01 missed the Farnborough Show in 1968 due to teething problems three prototypes, E-01, E-02 and A-04, appeared at the Paris Air Salon in June 1969 and the following year E-01, A-03, M-05 and S-06 attended Farnborough.

Testing continued apace and within nine months of the last prototype, Jaguar B-08, flying, the first aircraft were being delivered to the Armée de l'Air in early 1972.

However, one early casualty was the Jaguar M (Marin - Maritime) destined for the Aéronavale (French Navy) which had ordered 40 M and ten 'E' trainer aircraft. It first flew in November 1969 but was cancelled in January 1973 when

Two Jaguar GR.1As (XX720/GB and XX723/GQ) of 54(F) Sqn in 1995 displaying the old (green/grey) and new (grey) camouflage schemes. The aircraft in the foreground, XX720/GB, was one of 18 Jaguars previously upgraded to 'Jaguar International' standard and loaned to the Indian Air Force while waiting for its own deliveries. XX720 was flown from the UK to Ambala, spending 11 hours in the air, and served the IAF between July 1979 and February 1984



"RAF Coltishall became home to the UK Jaguar strike force"

stood up in 1974, with a secondary tactical support role. EC 4/7 converted onto Jaguars and joined the wing in 1980.

The second wing was 11 Escadre at Toul which began its transition from F-100 Super Sabres in 1974. ECs 1, 2 and 3/11 were all operational by 1977. EC 4/11 was added in 1978, based at Bordeaux it converted from Sud-Aviation Vautours. The third, and final, wing was 3 Escadre at Nancy where EC 3/3 operated Jaguars in the radar suppression role between 1977 to 1987. At any time, approximately just two-thirds of the Jaguar force was operational (about 130 aircraft), the rest being stored for attrition and wartime reserve.

Roles for French Jaguars included conventional and nuclear attack as well as army support, anti radar and ECM missions. They were often deployed in 'post-colonial' wars such as in Chad, Mauritania

and the Central African Republic, gaining the soubriquet 'Jaguar Diplomacy'. More significant conflicts, undertaken as part of allied coalitions included the Gulf War (1991), Bosnia (1995) and Kosovo (1999).

The FAF Jaguars were a basic and unsophisticated platform, but nevertheless performed well. Not as well equipped with avionics as their British counterparts, it was expected that they would reach obsolescence sooner. Following the Gulf War where the Jaguar comprised a significant proportion of France's successful contribution, their draw-down commenced in 1992 with EC 4/1 standing down. A phased reduction reached the end in 2005 when EC 1/7 disbanded on July 1.

British Jaguars

The UK formed eight squadrons and a training unit with their Jaguars, an aircraft that

for a period from the mid-70s to mid-80s was the most important strike aircraft in its inventory. In service the Jaguar S became the GR.1 and the Jaguar B, the T.2. Both were different from their French counterparts particularly in having more advanced avionics and navigation/attack systems fitted.

The Jaguar OCU received its first deliveries from May 1973 at RAF Lossiemouth and in due course became 226 Operational Conversion Unit (OCU). With significant defence cuts following the fall of the Berlin Wall, the unit was rebadged as 16(R) Squadron in 1991.

The first operational unit was 54(F) Sqn in March 1974, followed by 6 Sqn in September. Once operational status was gained both moved to RAF Coltishall, which became home to the UK's Jaguar strike force. In 1976, they were joined by 41(F) Sqn whose primary mission



RIGHT TOP: In October 1998 RAF Coltishall held a 25th Jaguar anniversary 'photo call' which included aircraft decorated with markings of former units. Jaguar T.2B XX146 GT of 54 (F) Sqn carries the markings of 14 Sqn, a Jaguar unit based at RAF Brüggen between 1975-85

RIGHT MIDDLE: The 'Jaguar Wing' at RAF Brüggen comprised 4 squadrons - 14, 17, 20 and 31 and was extant between 1975 -1985, when the last squadron converted onto the Tornado. A Jaguar, fully loaded with cluster bombs and sidewinders, of 14 Sqn is captured on exercise at low-level in typically dull German weather

RIGHT BOTTOM: Jaguar GR.1A XZ361/T, in arctic camouflage, lands in extremely wintery conditions in the Arctic Circle. In March 1996, Jaguars from 41(F) and 54(F) Sqn operated from Bardufoss for Exercise Battle Griffin; Jaguars from RAF Coltishall were frequently deployed to protect NATO's northern flank.



was reconnaissance.

Overseas, the type served in significant numbers in RAF Germany with the Jaguar force forming at RAF Brüggen from 1975-77 with four squadrons – 14, 17 and 31 transitioning from Phantoms and 20 Sqn from Harriers. A further unit, II(AC) Sqn, was reformed at RAF Laarbruch in 1976 with tactical reconnaissance its primary mission. In 1984-85, the Brüggen wing transitioned onto the Panavia Tornado, as did II(AC) Sqn in 1988.

In July 2000 the OCU departed Lossiemouth and joined the other squadrons at Coltishall. Then in March 2005, 16(R) and 54(F) Sqn were disbanded, 41(F) Sqn followed 12 months later and 54(F) Sqn moved to Coningsby to facilitate the early closure of Coltishall. The end came for the sole remaining Jaguar squadron, 54(F), in April 2007 when it was given less than a week's notice by the MoD to cease flying.

The RAF's Jaguars took part in many exercises, deployments and conflicts including the Gulf War and operations over the former Yugoslavia. Over Kuwait/Iraq the Jaguar was finally able to prove itself with 12 aircraft flying 617 operational sorties in 42 days without loss, while maintaining an excellent serviceability rate. Whereas the Middle East conflict brought about the beginning of the end for French Jaguars, for the RAF it served to reinforce confidence in the airframe and, with delays to the Eurofighter Typhoon entering service, brought about avionics and engine upgrades and continued service.

Jaguar International

The export airframe was the Jaguar International, which was closely modelled on the RAF's GR.1A. Most of the development work and sales efforts were undertaken by BAC. Dassault was never fully committed to the Jaguar and was more motivated to promote its own Mirage/Super Étendard products.

BAC pursued over 30 countries, including many in Europe, mostly without success; Switzerland purchased the Mirage and others

“Dassault seemed to undermine the Jaguar at every opportunity”

the American General Dynamics F-16 with Dassault declining to work with BAC in offering a joint Mirage (interceptor)/Jaguar (ground-attack) package. Once the Jaguar M had been cancelled, Brazil and Argentina switched to the Super Étendard. Kuwait ordered both Jaguars and Mirages through Dassault, but eventually only purchased the latter. Abu Dhabi and Pakistan both considered the Jaguar but acquired the Mirage. Significant orders from Turkey and Egypt both fell by the wayside.

However, in 1974 Oman and Ecuador both placed orders for ten 'S' and two 'B'



Three Operation Granby participants in formation in 1991, although only one took part in hostilities. The two Jaguars in the foreground, XX741/EJ and XZ396/EM, were both painted in 'Desert Pink' and sent to the Gulf immediately in August 1990. Once 'Granby Stage 3 Upgrade' Jaguars (including XX748/GK seen here at the rear) were ready, they flew out to Thumrait in November 1990 and the first wave of Jaguars returned home. XX748 undertook 36 missions during the war

aircraft which they received in 1977. Oman followed this up with a similar order in 1980. The Ecuadorian Jaguars served until 2006, but the last four Omani aircraft only stood down in August 2014.

Nigeria took delivery of 13 'S' and five 'B' aircraft in 1985 but within a few years they had been grounded, by one of Africa's richest nations, as an economy measure.

The largest customer was India which after ten years of negotiations ordered 160 aircraft in 1978; although Dassault did everything it could to scupper the deal. The first 40 were built in Europe, the rest by Hindustan Aeronautics Ltd (HAL) in India. Over the years there have been additional orders fulfilled by HAL together with a number of airframe upgrades. [See full story in Jets Sept/Oct 2013]. Indian Air Force Jaguars have a number of roles including nuclear and conventional strike, anti-shipping and reconnaissance. Today, a large number are still operational with no plans to retire them; many are just embarking on their latest upgrade - DARIN-III (Display, Attack, Range and Inertial Navigation).

Future projects

The Jaguar's development represented a first in terms of international co-operation to produce a warplane, but its full airframe and sales potential was never achieved. There were probably better aircraft – the Saab Viggen arguably being one – but for Dassault there was just too much of a conflict of interest between the Jaguar it had inherited and its own Mirage products. Dassault seemed to undermine the Jaguar at every opportunity despite owning and manufacturing the airframe, and apparently did so with the full support of its government.

However, the co-operation fostered by these two European nations, whilst not perfect, did produce an excellent strike aircraft for the RAF and paved the way for future joint projects such as the Panavia Tornado and Eurofighter Typhoon aircraft. France, however, did not join either programme. Ed: A full examination of the Jaguar in service will appear in a future edition of Jets. ●

SEPECAT JAGUAR PROTOTYPES

A/C	Seats	Country	Registration	1st Flight	Main Trials Purpose
E-01	Twin	France	F-ZWRB	Sept 8, 1968	Handling & Controls, Flutter
E-02	Twin	France	F-ZWRC	Feb 11, 1969	Engine & Flight Performance
A-03	Single	France	F-ZWRD	Mar 29, 1969	French Nav/Attack Systems
A-04	Single	France	F-ZWRE	May 27, 1969	Weapon Trials
M-05	Single	France	F-ZWRJ	Nov 14, 1969	Maritime Compatibility
S-06	Single	UK	XW560	Oct 12, 1969	UK Weapons & AAR
S-07	Single	UK	XW563	Jun 12, 1970	UK Nav/Attack Systems
B-08	Twin	UK	XW566	Aug 30, 1971	Training & Nav/Attack

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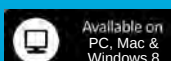
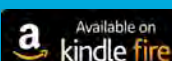
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TAMING THE BIG CAT

SEPECAT JAGUAR

Dave Unwin recalls the day he tried his hand at ground attack in a 6 Sqn SEPECAT Jaguar T.4

Brrrpt! The noise sounded more like an angry rivet gun than a 30mm cannon. Somewhere below my ejection seat hot brass casings cascaded into a container, while a stream of shells tore the target apart. It was a brief burst of fire, then the cannon stopped firing, the nose pitched up and the 'g' came on, pinning me down in my seat. The satisfied voice of Sqn Ldr Kev Marsh suddenly crackled in my helmet. "Ha!" he exclaimed, "We certainly plastered it that time!" As we rocketed back up into the sky it suddenly occurred to me that things really do happen extremely quickly during a strafing attack!

Photographer Duncan [Cubitt] and I had arrived at RAF Coningsby in Lincolnshire bright and early on a beautiful September morning, where Flt Lt Frankie Bulcher had met us at the guardroom. After a coffee over at 6 Sqn it was off to the equipment section to be measured and fitted with a 'bone dome' and the rest of my flying kit followed by a flight medical. The medical went very well as (surprisingly) it revealed that I was lighter than I thought! We then returned to the squadron to study a video on the Martin-Baker Mk.9 ejection seat. As



The T.4 has a single 30mm cannon on the port side of the fuselage



The Jaguar is definitely an aircraft that flies through the air, not upon it (KEY – Steve Fletcher)

we weren't scheduled to launch until after lunch, Frankie then kindly took Duncan and I out to one of the squadron's single seat Jaguar GR.3s. This gave me the opportunity to inspect the machine in detail, as it would be fundamentally identical to the aircraft I would fly. This is because (aft of the cockpit) the GR.3 and T.4 are essentially the same, with the only real difference being that the T.4 has just a single cannon.

Walkaround

As we walked towards the GR.3, three things struck me – firstly how big and heavy it seemed; secondly, how small the wing was and finally how modern it looked! In fact, I thought that it looked much more contemporary than the Tornados on the neighbouring dispersal, despite the fact that the prototype first flew almost 40 years ago. It is also a very elegant aircraft, probably because its length is more than twice the wingspan. It looks fast, even when it's standing still, while the missile rails, bomb pylons and cannon ports all emphasise its aggressive appearance.

As we began to move around the aircraft I mentioned to Frankie that the undercarriage looked particularly robust, and he explained that (unusually for a fast jet) the Jaguar was designed to be able to operate from unprepared strips. Consequently, the tyres are (by fast jet standards) relatively low pressure, and all the wheel-well doors close after



The engines are two Rolls-Royce/Turbomeca Adour Mk.106 turbofans, which produce up to 8,401b/l thrust in afterburner

tanks that the Jaguar can carry. It has a small amount of anhedral and is fitted with leading edge slats and double-slotted trailing edge flaps, although there are no ailerons. Instead, lateral control is provided by two-section spoilers and augmented by the all-flying tailplane, which can move differentially. As I looked aft towards the tailplane I could clearly see that it also has anhedral, in fact significantly more than the wing.

Moving further along the fuselage, the next items to catch my eye were the pair of large airbrakes. These are of the door

and that rather than redesign the fin and rudder the ventrals were added instead. I also noted the arrester hook between the tailpipes and the detachable tail cone, which covers the drag chute.

While we'd been inspecting the aircraft Frankie had revealed that the Jaguar was his first combat jet, and that while he was very much looking forward to converting onto the Typhoon next year that he would miss flying the Jag. He also explained that despite its age it was still a very capable fighter-bomber, and that the 'nav kit' was particularly good. He was clearly a great fan of the machine, so I asked him how it could be improved. "More power", he replied instantly. "It was never the most powerful aircraft, even in its heyday", he continued "and compared to most modern jets it just doesn't have enough thrust."

"Its length is more than twice the wingspan"

the undercarriage has locked down. Nevertheless, I couldn't help but think that designing an aircraft with a wing-loading as high as 124lbs/ft² and a MAUW of over 33,000bs to be able to take off from a grass runway was somewhat optimistic!

The wing is festooned with pylons, both under and, unusually, over the wing, for the various bombs, rockets, missiles and drop

type and are located immediately aft of the main undercarriage and in front of the pair of ventral fins. I thought at once that these fins looked like 'add-ons', and a later look through the giant Key Publishing photo archive soon confirmed that the prototype did not have them. I imagine that the flight test programme had revealed that the directional stability was unsatisfactory,



Battle briefing

Time now for the briefing. Every sortie by an RAF aircraft is fastidiously planned, right down to the minute when we would walk out to the jet. I was extremely impressed by the amount of pre-flight planning and briefing that our flight involved, although I'll freely admit here that I probably only managed to assimilate about a quarter of the information! It was like trying to drink from a fire hose! To complicate matters further, the RAF uses an incredible amount of acronyms and initialisms – even in conversation! This is SOP, as it allows the maximum amount of info to be promulgated ASAP i.e. PDQ – QED!

Anyway, I did manage to absorb the salient points, which were that I'd be flying in a flight of two Jaguar T.4s – call sign 'Tempest'. I would

a HAS (Hardened Aircraft Shelter) as its single 30mm cannon was loaded.

Having climbed up the ladder to the rear cockpit (which is quite a long way off the ground) I settled myself onto the Martin-Baker Mk.9 zero-zero ejection seat and began the process of strapping myself in assisted by Sqn Ldr John Townsend. When strapping into a fast jet you really do become an integral part of the aircraft, and literally cannot move except for your head, arms and legs. I checked in with Kev over the intercom and then lowered the clear visor into place before lowering and locking my canopy, then removed the safety pin for the ejection seat. Although I've armed a seat on quite a few occasions now, I always pause for a second and reflect that I am now sitting on a live rocket or cartridge. On this occasion my

“How it could be improved? More power!”

be flying with Sqn Ldr Kev Marsh and we were Tempest Lead, while Frankie and John Hoyt were Tempest Two. After a pairs take off, we'd drop some practice bombs on the Donnanook air-to-ground weapons range, then head out to sea where I'd try my hand at flying the Jag with some general handling. We'd then attack RAF Coltishall in Norfolk before transiting at low-level to the Holbeach air-to-ground weapons range in the Wash. Here we'd drop more bombs and also strafe, before returning to RAF Coningsby for a pairs GCA (Ground Controlled Approach), and then some visual circuits.

Spooling up

This all sounded good to me, and I must admit to a certain amount of excited anticipation as we walked out to our jet, which was parked in

mind was further concentrated by the fact that our aircraft was still in the hangar!

The master annunciator panel by my right knee suddenly illuminated as Kev began to bring our Jaguar to life. First he started the small onboard APU, and this was quickly followed by the starboard engine, which spooled up with a muted whine – at least it seemed muted to me. Outside in the HAS, the noise level was phenomenal, as Duncan explained later:

While Kev continued with his post-start checks, I began to familiarise myself with the cockpit layout and instrument panel. All of the primary flight and navigation information is displayed in the HUD, along with the weapons aiming data. The panel is dominated by a large, centrally mounted moving map, with a selection of analogue standby flight instruments to its left and the engine gauges



Our aircraft was XX840, coded 'EY'. It was the 28th T.2 built and was one of a batch of 20 T.2s produced by BAC at Preston between November 1974 and November 1975. It first flew on May 17, 1975 and was upgraded to T.4 standard in 1998 All KEY – Duncan Cubitt unless stated

The wing is festooned with pylons, both under and, unusually, over the wing for the various bombs, rockets missiles and drop tanks that the Jaguar can carry. It has a small amount of anhedral and is fitted with leading edge slats and double-slotted trailing edge flaps



The large door-type airbrakes are located immediately behind the main undercarriage



As the Jaguar was designed to cope with unprepared strips the undercarriage is particularly robust

to its right. The flight instruments consist of an angle-of-attack (Alpha) indicator, ASI, attitude indicator, altimeter and HSI, with a small VSI below the altimeter. At the bottom left of the panel is the trim position gauge, combined flap and slat position indicator and three green arrows for the undercarriage. The engine instrumentation consists of a fuel flow meter; analogue fuel tank quantity gauges and digital fuel totaliser, along with N1, EGT and nozzle position gauges for each engine. Interestingly, there really

Apart from the two-seat cockpit the Jaguar T.4 differs very little from its single seat brethren

KEY – Steve Fletcher



There are two large ventral fins aft of the airbrakes



aren't that many instruments. For example, insufficient hydraulic pressure or excessive oil temperature are only shown on the master annunciator panel.

Two long panels either side of the pilot carry the throttles, undercarriage and flap levers, along with a plethora of other switches and knobs. There are also several other levers that open and lock the canopy, deploy the drag 'chute and release the arrestor hook. Two items set into the glareshield particularly caught my eye – a

big red 'alarm' light and the guarded 'Clear AC button'. As its name implies, this button clears the aircraft of all its external stores (including the pylons) instantly. I could easily see how this could be very useful.

Sprint start

The post-start checks were soon completed and Kev taxied slowly out of the HAS. As soon as we were outside he advised me to clip the canopy partly open, explaining that we really only needed to keep it shut while starting up in the HAS because of the fumes. As we trundled along the taxiway, I glanced in the rear-view mirror and noted that Tempest Two was following us out to the runway. At the end of the runway I locked the canopy down while Kev ran through the pre-take off checks. We then rolled out onto the runway and lined up to the left of the centreline with Tempest Two slightly behind and to our right.

As Kev pushed the throttles up to dry military power, the Jaguar squatted down on its nosewheel like a sprinter on the blocks. There was a sudden jerk as Kev released the brakes and we bounded forward. A second or two later he lit the afterburners, I felt a small 'thump' in my back and then real acceleration pushed me back in the seat as we raced down the runway. The airspeed was building in the Head-Up Display at a gratifyingly fast rate, although our Jaguar certainly seemed to have little inclination to fly. As we roared past 160kts, still very much

ground-bound I began to wonder if we were going by road! Then, as the indicated airspeed rolled up in the HUD to 180, Kev rotated at a smooth and steady 3deg/second and we roared up into the sky.

Fully loaded

Flaps, slats and wheels were all quickly retracted, although as the flaps went 'up' there was a warning warble from the 'Master Caution' and the yellow 'ALT 2' caption suddenly illuminated. "Don't worry about that," came Kev's confident voice – so I didn't!

As we rolled smoothly into a steep 180-degree turn to starboard, a quick glance in the mirror showed that Tempest Two was holding perfect formation as we scorched towards the coast and the air-to-ground weapons range at Donnanook. Kev then told me to "follow through", so I settled my hands and feet lightly on the controls.

My initial impressions were two-fold: tremendous momentum and immense power. As we raced along I began to decipher the hieroglyphics glowing in the HUD, and then transferred my gaze to the panel. The fuel flow gauge was indicating that 50kg [110lbs] of Avtur a minute was flowing into the twin Adours, a fact confirmed by the totaliser, which was already clicking remorselessly down towards zero. Despite the fact that there was obviously some thermal activity in the air mass, the ride was absolutely rock-solid. With such



The arrestor hook is evidence of aircraft's naval ancestry



There is an arrestor hook between the tailpipes and below the detachable tail cone which covers the drag 'chute

a small wing the wing loading is very high and consequently the Jaguar is definitely an aircraft that flies through the air, not upon it.

As we headed towards the range Kev began setting the aircraft up for 'bombs', then called for a frequency change, paused and said "Tempest". "Two" came the immediate response.

Take it from me readers, the cockpit of a fighter-bomber is a really busy place, and I really was not only already massively impressed by Tempest Flight's cool, calm competence but was also starting to feel my age a bit, as I was struggling to keep up. Indeed, I have to admit here that the first couple of attacks were a blur: I was struggling to identify the

targets and it seemed that no sooner had I spotted it then Kev had released one of the 30lb practice bombs and we were pulling up and then rolling in for the next attack. The hard manoeuvring (we were constantly pulling between +3 and +4g) had bled off a lot of our energy, and I felt a small 'thump' in my back as Kev 'stroked' the burners before pulling back up and then rolling in for another attack.

Taking control

We then left the range and headed out across the Wash, where Kev handed control to me. Great!

I experimented with a few turns of varying degrees of steepness and quickly

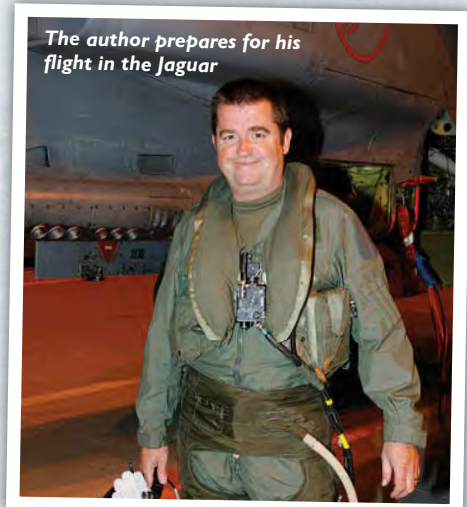
began to appreciate that the Jaguar needs a fair bit of sky to turn at 450kts. I also got the impression that the control harmony was not the textbook 1-2-3 (i.e. the ailerons are the lightest control and the rudder the heaviest). It actually seemed to me that the elevator was lighter than the ailerons. This also explains why I consistently keep gaining height in the turn. Well, anyway-that's my excuse and I'm sticking to it!

Still, my wild excursions in altitude certainly kept the boys in Tempest Two busy – I was probably the ropiest 'Lead' it's ever been their misfortune to have to formate on!

In fact, handling-wise the Jag probably is the 'last of the real jets'. Unlike more modern aircraft, there are no computers to prevent a pilot from pulling too hard and overstressing the aircraft, or to prevent roll-inertia coupling. This is an aerodynamic phenomenon that has caused quite a few accidents to fast jets over the years. Basically, it is a function of the aircraft's rate of roll along with its longitudinal axis relative to the line of flight. Should the aircraft be rolled with the nose either pitched up or down relative to its line of flight it rapidly diverges in pitch and can actually tumble end over end. Needless to say, if this happens the whole thing quickly comes unglued.



Our jet was located in a HAS as its single 30mm cannon was loaded



The author prepares for his flight in the Jaguar



This is the front cockpit. All of the primary flight and navigation information is displayed in the HUD, along with the weapons aiming data. Two long panels either side of the pilot carry the throttles, undercarriage and flap levers, along with a plethora of other switches and knobs. There are also several other levers that open and lock the canopy, deploy the drag chute and release the arrestor hook



This is the rear cockpit. Note the large, centrally-mounted moving map, with the analogue standby flight instruments to its left and the engine gauges to its right

Attack

Kev then took control for the next segment of the sortie - an attack on 'the home of the Jaguar' - RAF Coltishall in Norfolk. As we scorched in from the sea I glanced across at Tempest Two and thought how sleek the shark-like shape scudding in from the slate-grey sea looked. The IP for the attack was a small windmill between a canal and a railway line, so I thought I'd spot it OK. In fact, I only saw it for the briefest of moments before we commenced our attack. That said, as we were flying at 250ft AGL with a groundspeed of 480kts (eight nautical miles a minute, or over 800ft/sec) I'm amazed I saw it at all!

After Coltishall it was a brief, low-level run across the countryside at 420kts before we launched into another series of attacks at Holbeach. At this speed I have to admit that I would have been quickly and totally lost if I hadn't had the excellent moving map in front of me. After a couple of runs Kev then set us up for what promised to be the most exciting part of the sortie - some

strafing runs. This was great. A fast shallow dive, a brief brrrrpt from the cannon and then screaming skywards. We made four runs, and I finally began to understand how people fly into the ground when strafing. It all happens incredibly quickly, and there really is no margin for error.

Landing

Tempest Two suddenly announced that they were 'bingo' (low on fuel) so we formed up for a pairs GCA into Coningsby. This was extremely interesting, as to avoid stepping on any instructions from the radar operator, Kev used hand signals to tell Frankie and Chris when to extend their airbrakes and lower their undercarriage. Tempest Two landed from their approach but we went around. As we turned downwind Kev talked me round the circuit while I followed through lightly on the controls. He had already explained that the principal value for the approach was Alpha (angle of attack) not airspeed, so as the Jag swung from base

onto final we stayed on the PAPIs with the throttles, while using the stick to hold ten units of Alpha in the HUD. At this point I was glad that Frankie had told me during the pre-flight that the buffet was pretty pronounced on the approach, because although the speed was around 180-190kts the Jag really was buffeting! As we flashed over the numbers the nose pitched up slightly until we had 12 Alpha, Kev squeezed the throttles closed and we thumped onto the runway. With aircraft in this class, the prerequisite for a good landing is for the wheels to make contact in the touchdown zone. A smooth landing is most definitely of secondary importance. We then lowered the nosewheel and Kev pulled the drag chute handle. Wow! As the chute deployed the retardation was so strong that I lurched forwards in my harness!

Taxiing back in with the canopy open and the chute billowing in the rear view mirror, I carefully inserted the seat's safety pin and reviewed the previous 80 minutes. The overwhelming impression was just how busy a ground-attack fast jet pilot is. I'd struggled to keep up most of the time, and this was on an easy trip down to the local range! One thing's for sure though - although it really is hard work it is also tremendously exciting! ●

SPECIFICATION SEPECAT JAGUAR T.4



Crew	2
Length	57ft 6in (17.53m)
Height	13ft 5in (4.89m)
Wingspan	28ft 6in (8.69m)
Wing area	258.33sq ft (24.0m²)
Empty Weight	15,432lb (7,000kg)
Max Take-Off Weight	34,000lb (15,500kg)
Max Speed	729kts (839mph/1,350km/h)
Service Ceiling	45,000ft (13,716m)
Ferry Range	2,190 miles (3,524km)

Powerplant 2 x Rolls-Royce/Turbomeca Adour Mk.106 turbofans (5,600lb/thrust each or 8,040lb/thrust in afterburner)

Armament One 30mm DEFA cannon plus pylons to carry a mixture of Matra rocket pods (with 18x 68mm SNEB rockets each), air-to-air missiles, bombs and reconnaissance pods

First Flight September 8, 1968
(Jaguar E prototype)



A formation of Jaguar GR.1As in 1988, 15 years after the type first entered service with the RAF, from 6, 41(F) and 54(F) Sqns, based at RAF Coltishall. The aircraft are XZ372/ED 6 Sqn, XZ358/L 41(F) Sqn and XX955/GK 54(F) Sqn.







"ONE OH WONDER"

*The McDonnell CF-101 Voodoo served the Canadian Armed Forces for more than 20 years. **Robbie Shaw** looks at the service life of the supersonic all-weather fighter interceptor and recalls his flight of a lifetime*



The XF-101 Voodoo took to the skies on September 29, 1954 and the type would later establish the world speed record at 1,207.60mph

The prototype McDonnell XF-88 Voodoo first flew on October 20, 1948 and was designed as an escort fighter for the US Air Force's Strategic Air Command manned bomber force. However, the aircraft did not perform to specification and the programme was terminated in 1950.

No sooner had the project been cancelled the outbreak of the Korean War revealed the need for a fighter escort. McDonnell resubmitted its proposal but this time in a much heavier and faster

format, complete with afterburning engines giving a 33% increase in thrust. This aircraft was accepted by the USAF and went into production as the F-101 Voodoo in 1952, the prototype taking to the air on its maiden flight on September 29, 1954.

USAF service

The Voodoo became operational with the USAF in May 1957 with the F-101A and F-101C versions used for tactical attack, the RF-101A and C for reconnaissance and the F-101B as an interceptor. There

was also an F-101F dual control two-seat trainer. Many of the F-101A and C variants were eventually converted to the unarmed RF-101G and H configuration for the Air National Guard in the reconnaissance role, both of these versions augmenting the RF-101A/C which were used extensively in Vietnam.

Exports were limited but the Chinese Nationalist Air Force (Taiwan) operated at least eight ex USAF RF-101As and the aircraft found great success with the Royal Canadian Air Force (RCAF).



Canadian rejection

At the time of its introduction into USAF service, the Voodoo was the most powerful fighter of its day, but the aircraft was initially rejected by the Canadians.

In the late 1950s the Canadian interceptor force of CF-100 Canucks was becoming obsolete, and the aircraft were due to be replaced by the Avro CF-105 Arrow. However, this programme was suddenly cancelled in 1959 and as a result Canada once again looked at the Voodoo, this time giving it the thumbs up.

Converted for Canucks

The RCAF Voodoos differed little to their USAF cousins but were armed with either two Douglas AIR-2A Genie rockets or two Hughes AIM-4D Falcon missiles. These weapons were carried internally on a rotary armament door situated underneath the fuselage to the rear of the nose wheel bay. On the armament door one side had the fittings to take the Genie, whilst on the other side two Falcons were attached to launch rails which



In the last months of service, Bagotville's 425 Sqn painted up CF-101B 101014 in this striking livery known as 'Lark One'. Rather unflatteringly it was sometimes referred to by other squadrons as 'Chicken One'

Author's collection via Don Spering



Lifting off the runway at Tyndall AFB in Florida is 409 Sqn CF-101B 101034. The aircraft was one of the Canadian team participating in the 1982 William Tell competition *Author*

retracted into inbuilt recesses on the door.

The Genie was not actually a missile but an unguided rocket with a 1.5 kiloton nuclear warhead that provided a destructive radius of over 1,000ft. The Genie could reach speeds of Mach 3 and entered service in 1957.

The smaller AIM-4D Falcon was the world's first air-to-air guided missile, and



The Voodoo traces its history back to the 1948-built XF-88. The aircraft promised much but failed to deliver in terms of speed or fuel burn so the project was cancelled in 1950

had a speed in excess of Mach 4 which, considering this was some 50 years ago, was very impressive. The Falcon had a rather long initiation time of thirty seconds, and once the first missile was launched the second followed automatically half a second later. So keeping the second missile for another target was not an option!

The CF-101B variant had a Hughes MGII

"Canada once again looked at the Voodoo, this time giving it the thumbs up"

The sole EF-101B 'Electric Jet' of 414 Sqn seen here blasting out of CFB Chatham on September 28, 1984. The silver nose is the result of a repair following a nosewheel collapse

Author



fire control system with Data Link for vector and target information. The CF-101F dual control version was also fully operational with a second stick in the rear cockpit, though from this position the undercarriage, flaps, airbrakes, brake parachute and afterburner could not be operated.

Squadron service

The last of 807 Voodoos built rolled off the production line in 1959, and aircraft from this batch, including the final Voodoo built, were transferred from the USAF to the Royal Canadian Air Force (RCAF) in 1961. These comprised 56 F-101B and 10 F-101F, being designated CF-101B and F in Canadian service.

The B model was a two-crew aircraft designed as an interceptor with a lengthened fuselage that sacrificed fuel for a rear cockpit for the navigator and intercept radar. Featuring dual controls, the CF-101F was used as a trainer.

"The aircraft retained their in-flight refuelling capability but the RCAF did not possess any tankers"

The initial crews were trained at Hamilton AFB in California and the first aircraft arrived in Canada in October 1961. These were immediately assigned to CFB Namao, Edmonton, Alberta where they equipped 425 Sqn, which was designated the conversion unit for the type.

Further deliveries continued to equip 409, 410, 414 and 416 Sqns and 3AW(F) OTU. This batch of aircraft retained their in-flight refuelling capability, but as the RCAF did not possess any tankers



With gear retracting 416 Sqn CF-101F 101003 blasts off from Chatham Author



409 Sqn Voodoo 101064 in natural metal finish in 1978 Author's collection via Don Spering

this feature was never utilised.

In 1968 the RCAF, Navy and Army were integrated to become the Canadian Armed Forces (CAF), and about this time the USAF had started to send some of its Voodoos to the storage depot (MASDC) at Davis-Monthan AFB, Arizona.

Many of the Voodoos in storage had considerably less airframe time than the Canadian aircraft, even though many were two or three years older than those in service in Canada.

Overhaul

In 1971 the RCAF decided to upgrade its Voodoos and the remaining 47 CF-101Bs and nine CF-101F aircraft were returned to the USAF at Davis Monthan AFB in exchange for 66 ex-USAF



CF-101B 101065 of 416 Sqn off the eastern seaboard of Canada Author



Smoke from the tyres as 416 Sqn CF-101F 101006 touches down at Chatham Author

machines that had been in storage.

The 'new' aircraft (56 'B models and ten 'F models again) were flown to Bristol Aerospace at CFB Winnipeg for overhaul and modifications to the engines, ejection seats and avionics. They were then fitted with the improved MG13 fire control system and infra-red detection equipment in place of the flight refuelling probe. The infra-red sensor head was mounted externally on the nose just forward of the canopy, and was the most distinguishing feature between the 'old' and 'new' Voodoos.

The new batch was delivered to 409, 410, 416 and 425 Squadrons. Of the old aircraft which were returned to Davis-Monthan many were scrapped in situ, though some were issued to the USAF Air National Guard, including 20 which were converted



A line-up of 416 Sqn Voodoos on the Chatham ramp Author

A pair of 416 Sqn Voodoos, including 'Lynx One' break away from the author's camera

Author



to the RF-101B reconnaissance version.

QRA

For many years Canadian Voodoos undertook Quick Reaction Alert (QRA) duties as part of the North American Air Defense (NORAD). They operated alongside USAF F-101, F-102 and F-106 aircraft in operations such as *Cold Shaft*, which saw 409 Sqn covering the west coast of Canada from CFB Comox whilst 416 and 425 Sqn protected the east coast from CFB Chatham and CFB Bagotville respectively.

Each squadron kept two aircraft fully armed on five-minute readiness, and at CFB Chatham 416 Sqn continued this task right up to its disbandment as the last operational Voodoo squadron in 1985.

In the case of 416 Sqn once the claxon was sounded the two Voodoos would transit to Gander, Newfoundland. Here they would quickly refuel and standby to intercept and shadow approaching Soviet Tupolev Tu-95 Bears, usually at considerable range and without in-flight refuelling capability. The Voodoo crew had to keep an eye on their fuel gauges, and it was not uncommon for the Bear pilots to try and entice the Voodoo further out to sea.

For interception at night the Voodoo had a searchlight in the port side of

the fuselage just below the navigator's cockpit. When Voodoos carried out night intercepts the crew of the Bears often retaliated by pointing a searchlight directly at the cockpit of the Voodoo.

From the cockpit

On September 27, 1984 I had the privilege of flying in a three-ship formation of 416 'Lynx' Sqn Voodoos from CFB Chatham.

After completion of ejection seat procedures, which seemed quite complicated compared to Martin-Baker seats, I gathered my heavy parachute and walked out to CF-101B Voodoo 101035 where my pilot, Lt Larry Martin,

was completing his walk round check.

It was only as I climbed the ladder to the very spacious cockpit (normal for US-built fighters) that I realised what a large 'beast' the Voodoo was; the ground seemed a long way away.

Feeling lost without a G-suit I quickly strapped in, the engines rumbled into life and the canopy came down. As the aircraft does not have a parking brake, very little power was required for the aircraft to move forward as we moved out; taxi speed was limited to 25kts to prevent the brakes overheating.

With flaps down (there are only two positions – up or down) we



In the latter period of service with 409 Sqn the unit applied red and blue horizontal stripes to the rudder of some aircraft, as seen here on CF-101B 101032 at Namao, Alberta Author



Known as 'Hawk One', 409 Sqn applied this attractive scheme to CF-101B 101057 in the latter part of its career with the unit

Author's collection via GB Aircraft Slides

lined-up on the runway as number three of a three-ship formation.

As the lead aircraft began his take-off run, our eyes moved to the number two pilot positioned on our port side. With a hand chop signal from him the brakes were released and power applied. The pilot of number two then clearly nodded his head, our signal to select afterburner.

The selection of afterburner was quite evident, as with a bang and a kick in the pants our acceleration increased dramatically. Nosewheel steering was used until about 70kts when the rudder became effective. At 135kts the nose was lifted and at 170kts (after only 3,500ft of runway) we took to the air.

"The infra-red sensor head distinguishes between 'old' and 'new' Voodoos"

Undercarriage was retracted before the limitation speed of 250kts and afterburner deselected. At this stage the Voodoo is almost as smokey as the Phantom.

Smooth operator

Already I was impressed by how smooth

With plenty of smoke, 416 'Lynx' Squadron CF-101B 101056 powers out of Chatham into cloudless skies

Author



and quiet the Voodoo was and we quickly set ourselves up for a couple of PIs (practice intercepts). The number two aircraft and ourselves flew as targets while the lead aircraft was vectored onto us by the Regional Air Defence Centre until he has us either visually or on his own radar.

The Voodoo was susceptible to pitch-up during high angles of attack where the wingtips stall and vortices flow over

the T tail thus accentuating the problem. About 10,000ft would be required to recover from a pitch-up condition.

Being a large heavy aeroplane with small thin wings the Voodoo was also very prone to roll-coupling during high rates of roll, and for this reason continuous rolls were prohibited, otherwise loss of control would ensue and the aircraft would probably suffer structural failure. At



The honour of the last flying Voodoo in the world fell to 414 Sqn's CF-101F 101006, seen here at CFB North Bay on October 3, 1985

Author

In its attractive 416 Sqn 'Lynx One' colours CF-101B 01043 seen over its base, CFB Chatham, New Brunswick

Author



least two RCAF Voodoos were lost due to roll-coupling.

'Chute landing

On our return to Chatham the other two aircraft landed while we left the circuit for a low-level acceleration, which when the 'burners' were lit was exhilarating. The airspeed indicator is digital rather than analogue and it was amazing to watch the figures spin as the speed built up. We then returned to the circuit for a break to land,



'Lynx One' of 416 Sqn near its base at CFB Chatham, New Brunswick

Author



In October 1984, only months from the unit disbanding as a Voodoo squadron, 416 Sqn deployed several aircraft to CFB Cold Lake to participate in a Maple Flag exercise. Several aircraft wore water-based camouflage paint over their gloss grey, including CF-101B 101035

Author

airbrakes were extended momentarily, (there is no speed limitation) and downwind the undercarriage was lowered.

Final approach was flown at the rather fast speed of 175kts with airbrakes out and flaps down. On landing our brake 'chute was deployed and the nose held high to dump excess speed using aerodynamic breaking. As we cleared the runway the canopy was opened a few inches, but only a few inches, for in marked contrast to the smooth flight, taxiing is extremely bumpy and causes much vibration hence, whilst taxiing, she is nicknamed the 'washing machine'.

Final flight

The last USAF Voodoos were withdrawn from use in 1982 but the RCAF examples soldiered on. In the final few months operating the Voodoo, 416 Sqn were kept very busy. In addition to maintaining the *Cold Shift* alert the squadron deployed four aircraft to Cold Lake in October 1984 for a *Maple Flag* exercise, and another four to Nellis AFB to intercept bombers taking part in the *Giant Voice* competition.

Additionally, the squadron provided a pair of aircraft known as the Bobcats to participate in a number of airshows; thrilling the crowds with their high speed manoeuvres with lots of 'burner. The Bobcats' finale was at the Shearwater International Air Show at the end of September 1984.

Two Voodoos remained in service with 424 Sqn after the stand-down: the unique EF-101B electronic jamming aircraft (also known as the 'Electric Voodoo') and a single CF-101F trainer. The unique EF-101B was a converted F-101B incorporating the electronic jamming suite from an EB-57E Canberra. It finally returned to the

USA on April 7, 1987 while the CF-101F (101006) made the world's last Voodoo flight on April 19 of that year when it was delivered to CFB Chatham for eventual display at CFB Cornwallis, Nova Scotia.

There is no doubt that the Voodoo gave sterling service to the RCAF. During 23 years of operation in Canada the aircraft had a very acceptable accident rate and only 28 out of the 133 Voodoos operated were lost. This may sound excessive but was very favourable for an ageing supersonic aircraft, especially when compared to the 114 CF-104 Starfighters that were lost by the RCAF in accidents.

The 'One-O-Wonder' is sorely missed by both crews and enthusiasts alike, but most of all by the navigators, as for them it was the end of fast jet flying as the single seat Hornet replaced the Voodoo. It truly was the end of an era. ●

SPECIFICATION MCDONNELL CF-101B VOODOO



Crew	2
Length	67ft 5in (20.55m)
Height	18ft 0in (5.49m)
Wingspan	39ft 8in (12.09m)
Wing area	368sq ft (34.20m ²)
Empty Weight	28,495lb (12,925kg)
Max Take-Off Weight	46,665lb (20,715kg)
Max Speed	985kts (1,134mph/1,825km/h)
Service Ceiling	58,400ft (17,800m)
Ferry Range	1,520 miles (2,450km)
Powerplant	2 x Pratt & Whitney J57-P-55 turbojets (11,990lb/thrust each or 16,900lb/thrust each in afterburner)
Armament	Two AIM-4D Falcon heat-seeking air-to-air missiles and two AIR-2A Genie unguided nuclear rockets mounted on rotary armament door.
First Flight	September 29, 1954 (XF-101)

Artwork: Andy Hay / www.flyingart.co.uk

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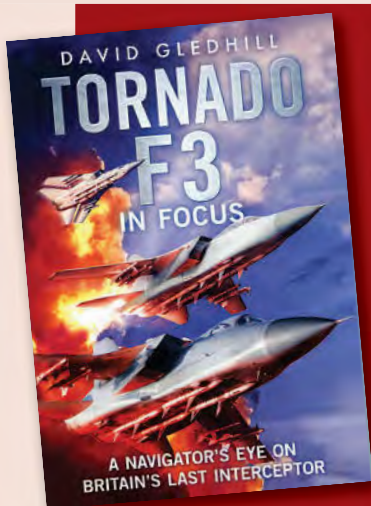
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Testing Times

The team put the latest jet-related books and products to the test



BOOK

Tornado F3 in Focus: A Navigator's Eye on Britain's Last Interceptor

David Gledhill
Fonthill Media
288 pages, hardback,
B&W & colour
ISBN 978-1-78155-307-7
£25.00

The author has followed up his excellent *Phantom in Focus* with this volume about the Tornado, which encompasses his time with the F2 and F3 ADV variants, including tours as an OCU instructor.

The F3 ADV had a troubled and controversial history and this is well covered with the politics, bureaucracy and procurement processes all discussed. The book provides a significant insight into what it takes to bring a new aircraft into service and keep it up to date.

There is a wealth of detail about the aircraft itself, including diagrams and photographs, and a mix of technical information and personal accounts. Despite this, it's easy to read and won't lose the reader in excessive detail that is beyond their comprehension.

Further chapters deal with operational deployment, exercises and war. This is the definitive account of the Tornado ADV in RAF service and, we suspect, it's unlikely to be beaten anytime soon. Buy it now!

BOOK

My Target was Leningrad – V Force: Preserving our Democracy

Philip Goodall
Fonthill Media
208 pages, hardback,
B&W & colour
ISBN 978-1-78155-181-3
£20.00

Unlike many authors writing about the Cold War period, Philip Goodall pens his accounts from first-hand experience. He entered the RAF in 1953 and after jet training on the Meteor and Canberra, he was posted to the Middle East to fly the Valiant in activities over the Suez Canal.

He was a member of the only V Force crew to be awarded the Malayan General Service medal and would later go on to fly the Vulcan as well as commanding 27 Sqn at Scampton. In 1972, Goodall was posted to the Headquarters of Strike Command with specific responsibility for producing the RAF's Nuclear War plans.

As such, *My Target was Leningrad* is unique in that it is a human story, not just a list of technical facts and bomber data. Among the 112 black-and-white and 32 colour photographs are many previously unpublished images from the author's private collection. This is the chilling story of what really happened and how close the world came to World War Three and a nuclear apocalypse.

Very highly recommended!



BOOK

Harrier Boys Volume One – Cold War through The Falklands (1969-1990)

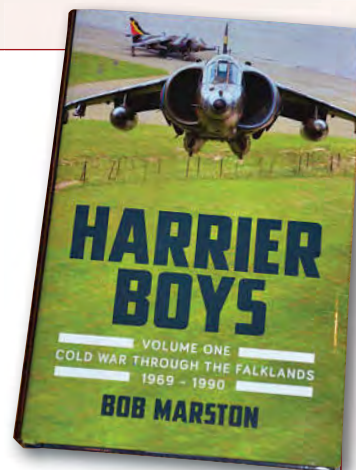
Bob Marston
Grub Street
192 pages, hardback,
B&W & colour
ISBN 978-1-909808-29-4
£20.00

After *Lightning Boys* (1 & 2), *Vulcan, Hunter, Buccaneer, Victor, Jaguar, Valiant & Phantom Boys*, where next for the series offering genuine insight into squadron life?

Well, the Hawker Siddeley/BAE Systems Harrier (always a crowd favourite) is the latest aircraft to receive the treatment and join the 'Boys' franchise.

This book comes from the pen of Bob Marston, who flew 3,300 hours on Harriers and was also the RAF's display pilot for the type for two years. The pages are packed with accounts that portray the excitement, camaraderie and pride of those who worked on the Harrier.

The Cold War years are brought to life by contributors including Graham Williams (who



flew the Transatlantic Air Race), Peter Dodworth, a member of the original Harrier Conversion Team, Peter Harris, a participant in the early defence of Belize, Sir Peter Squire, OC 1(F) Sqn during the Falklands conflict, and Australian Dave Baddams, who commanded the Royal Navy Sea Harriers of 800 NAS.

This book will be followed by Volume Two (currently slated for 2016), which will cover the second generation of the Harrier, starting with the RAF's GR.5s and including vivid accounts of action in Iraq, the Balkans, Sierra Leone and Afghanistan.

BOOK

Flight – The Evolution of Aviation

Stephen Woolford & Carl Warner
Carlton Publishing
164 pages, hardback,
B&W & colour
ISBN 9780233004594
£20.00

Although this attractively designed book does not focus solely on 'our' era, there is much to interest the average Jets reader.

Countless authors have tried to document the history of aviation and this will never be possible in such a slim publication. Rather than try to be definitive, Woolford and Warner (who work at the Imperial War Museum Duxford as Head of Interpretation and Collections and Research, and Information Manager, respectively) have drawn together a collection of images, documents and



anecdotes to produce a memorable account of the first century of aviation.

The images (the quality of which sadly favours the earliest eras) are supported by 20 facsimile items including George Cayley's 1849 design for a glider, the log book kept by Arthur Whitten Brown during the first ever transatlantic flight and the Apollo 11 mission report of the moon landing.

BOOK

Testing to the Limits – British Test Pilots Since 1910 (Volume One: Addicott to Huxley)

Ken Ellis

Crecy Publishing

256 pages, hardback, B&W & colour

ISBN 9780859791847

£24.95

There was once a time when British test pilots were household names and the 'rock stars' of the industry.

This new book from former *FlyPast* editor Ken Ellis is the culmination of a 20-year project to chart the careers and endeavours of over 400 company test pilots. Inter-related biographies brim with types first flown, incidents and anecdotes, including first-hand quotes. It is the most comprehensive study on the subject ever produced and will eventually be followed by a second volume featuring those pilots whose names begin with 'J' onwards.

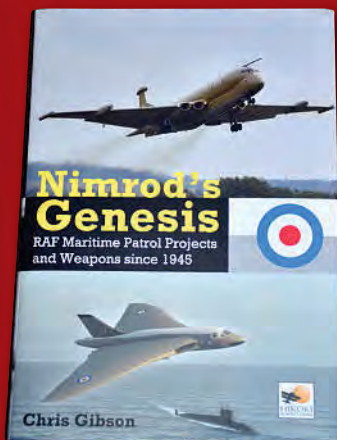
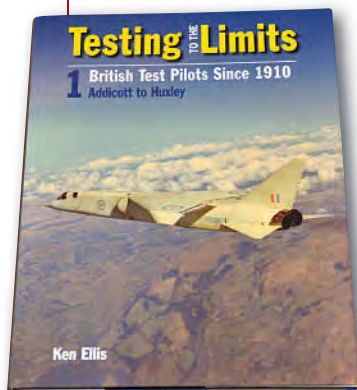
From Short biplanes of 1909, the book traces the history of British test flying and aircraft through both World Wars into the post-war jet age. Included are the challenges of the 'sound barrier' and the pressures of

the 'Cold War' to the supersonic Concorde, the Harrier 'jump-jet' and today's fly-by-wire Typhoon.

Designer-pilots, flight test observers, the Empire Test Pilots' School, the relentless

pace of production, engine test-beds and the origins of the ejector seat are all covered here.

This is not just a tribute to a band of elite aviators it is also a vibrant commentary on the failures and successes of the British aircraft industry.



BOOK

Nimrod's Genesis – RAF Maritime Patrol Projects & Weapons since 1945

Chris Gibson

Crecy Publishing

176 pages, hardback, B&W & colour

ISBN 978 19021 09473

£29.95

Chris Gibson's track record for producing well researched, informative and thought provoking 'what if' books about Cold War aircraft and projects means he is the obvious candidate to produce a tome about post-war maritime patrol aircraft. He doesn't disappoint!

The MoD invested huge amounts of time and money in developing a counter-threat to the Soviet Navy and this book tells that behind-the-scenes story. Arguments raged over whether the ageing Shackleton should be replaced by versions of the Vulcan, Britannia, VC10 and Trident, before one man strode into the MoD building in 1964, settling the debate with what became Nimrod.

The book tracks the project from start to finish as well as looking at the alternatives that never left the drawing board – including the unusual circular wing rotor ASW aircraft! Gibson provides a fascinating insight into the aircraft, weapons and sensors developed to counter the Soviet submarines. He also offers his thoughts on what might eventually replace the Nimrod in British service.

DVD

Early Soviet Jet Fighters

Yefim Gordon & Dmitry Komissarov

Crecy Publishing

432 pages, hardback, B&W & colour

ISBN 978 190210 9350

£34.95

Because of the Stalinist era in which the first Soviet jets were developed, up until now little has been known about the early post-war aircraft from the design bureaux of Mikoyan, Yakovlev, Lavochkin, Sukhoi and Alekseyev and even relatively well-known types such as MiG-9 and Yak-15 have previously only been covered in superficial detail.

Other early jet types, proposals and projects were virtually unknown in the West.

This gap is now redressed by the famous Soviet aviation historian Yefim Gordon and here he draws on extensive research from design bureau files, official documents and military archives, many of which have only very recently become available, having been labelled 'Top Secret' for decades.

This volume presents in considerable detail the development, history and technical specifications of the earliest Soviet jet fighters and the extensive illustrations – around 750 photos, over 50 specially-commissioned colour drawings and a host of line drawings – are mostly from previously classified sources, the majority of which are previously unseen.



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Animations include flaps, spoilers, ailerons, elevators, rudder, engine fans, operating

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passenger and cargo doors, operating thrust reversers. Even the ailerons and elevators droop when engines are shut down. There's also a large animated cargo door on freighter variants.





MULTI RECORD SETTING GALAXY



Earlier this year a Lockheed C-5M Super Galaxy set no fewer than 45 records!
Tom Pierce reveals all

In the early morning hours of April 3, a Lockheed C-5M Super Galaxy aircrew from Travis AFB, California, put the aircraft's capabilities to the test and achieved their goal of establishing 45 previously unset records!

The aircraft was loaded with pallets, fuel and the aircrew amounting to a total all-up weight of 731,220lbs (including the weight of the aeroplane itself) and was crewed by eight members of the USAF, including staff assigned to the 60th Air Mobility Wing's 22nd Airlift Squadron and the 349th AMW's 312th Airlift Squadron.

Heavy lifter

Speaking after the event, the aircraft's pilot, Major Jon Flowers said: "We took on approximately 265,000lbs of cargo and our goal was to climb as fast as we could at 3,000, 6,000 and 9,000m. We got up to an altitude of approximately 37,000ft [11,277m] before we ran out of performance."

New model

The USAF says the new ability of the C-5M, when compared to the earlier A, B and even C models, to reach speeds at a faster rate, is critical for its modern role in the military.

"The [Galaxy] model before this was

performance limited," said Major Flowers, who is the 22nd Airlift Squadron's 'chief of standardisation and evaluation'. It did not have the climb capability or the cargo capability [and] the C-5M has been changing the game for the warfighter.



The inside of the record-setting C-5M Super Galaxy from the 22nd Airlift Squadron at Travis AFB, California. The cargo hold is filled with pallets making the total weight of the aircraft 731,220lbs

USAF/Ken Wright



Master Sgt Matt Thomas, 22nd Airlift Squadron section chief of loadmaster standardisation and evaluation, listens to his headset and watches out the window on April 3 during the pre-flight checklist aboard the record-setting Super Galaxy USAF/Airman 1st Class Amber Carter

The 22nd Airlift Squadron's C-5M Super Galaxy takes off from Travis AFB early on April 3, 2015
USAF/Ken Wright



Left: The C-5M Super Galaxy from the 22nd Airlift Squadron arrives at Travis AFB, California early on April 3, 2015. The flight, which lasted approximately one hour, claimed 45 aeronautical records, positioning the US military's largest airframe as the world's top aviation record holder with a total of 86 world records USAF/Ken Wright

Below: Pilot Major Jon Flowers from the 22nd Airlift Squadron at Travis Air Force Base, California in command of the Galaxy's flight deck on April 3
USAF/Airman 1st Class Amber Carter

flight, altitude with payload, time-to-climb, time-to-climb with payload and greatest payload to 9,000m categories. Among the highlights were records for flying at 37,000ft with a payload of 265,000lbs and a 'time to climb' to 37,000ft of just 27 minutes and 30 seconds (while carrying 265,000lbs of payload!)

The Super Galaxy has now unofficially claimed a total of 86 world aeronautical records, surpassing the B-1B Lancer at 83 records.

"The successful completion of this mission exemplifies both the great teamwork required by the whole team to keep Travis' aircraft flying and the fabulous strategic mobility capabilities the C-5M brings our combatant commanders around the world," said Colonel Joel Jackson, 60th AMW commander, after the sortie. "Thanks to everyone who contributed to this powerful showcase of Travis' culture of excellence." ●

Tonight we made that point and put the capabilities in the record books."

Joint effort

The USAF was at pains to explain that these records were very much a team effort saying: "aerial porters to maintainers, active duty and reservists from Team Travis made a joint effort to effectively achieve this goal."

"We're honoured to play a role in this historic demonstration," Colonel Matthew Burger, 349th AMW commander told the media. "The new capabilities of the C-5M make America better equipped for the global challenges of the 21st Century."

Establishing standards

Although the C-5M didn't break any records that night, the crew 'established standards' in 45 previously unset record categories within the C-I.T jet class category for altitude. As such they 'created' their own records.

These standards fall within the horizontal





A rare joint appearance by the YF-22 and YF-23 in late 1990 USAF Museum

ADVANCED TACTICAL FIGHTER

The Raptor and the Grey Ghost

Twenty five years on from the maiden flights of the Northrop/McDonnell Douglas YF-23 and the Lockheed YF-22, *Kimberley Hawkins* looks back at the USAF's Advanced Tactical Fighter competition

By the early 1980s the USAF had already set its sights on a replacement for its F-15 Eagle fighters. The Eagle had only been in service since 1976 but across the Iron Curtain, the Soviets were already developing the Sukhoi Su-27 and Mikoyan Gurevich MiG-29 – and the Western world was beginning to feel vulnerable.

On May 21, 1981 the USAF issued the specification for an Advanced Tactical Fighter (ATF) to nine aircraft manufacturers (Lockheed, Boeing, General Dynamics, Fairchild, McDonnell Douglas, Northrop, Grumman, Vought and Rockwell) as a Request for Information (RFI).

The specification and 'must have' list was the most complex ever issued. Use of new technologies such as composite materials, advanced flight control systems

and lightweight alloys was stipulated. The ATF would need to have a supercruise capability (supersonic flight without afterburners), thrust vectoring, be 'survivable', stealthy and easy to maintain while being capable of taking off and landing on relatively short runways.

The USAF released funding for a formal RFI in August 1982 and seven of the original companies (Fairchild and Vought were dropped) received \$1 million in Concept Development Investigation contracts. The chosen companies submitted 19 designs between them.

Vectored thrust

Among the technologies the ATF was designed to exploit was vectored thrust; where the engines' exhaust efflux is moved up and down to help pitch the aircraft.

"The jet would need to double the F-15's sortie rate"

To produce an engine capable of pushing the ATF to supercruise speeds but also be capable of vectored thrust, the US Department of Defense (DoD) launched the Joint Advanced Fighter Engine (JAFE) technology demonstration programme. Allison, Garrett, Teledyne/CAE, Pratt & Whitney and General Electric all entered the race to power the ATF and in 1983 General Electric and Pratt & Whitney received contracts worth \$202 million to develop two competing powerplants.

Despite the perceived urgency it would be another three years, in late 1984, before the airframe's design requirements

would finally be settled upon.

At this point the USAF's Statement of Operational Need decreed that the ATF would need to have a maximum take-off weight of 50,000lbs, a combat radius of 800 miles, a supercruise speed of Mach 1.5 and the ability to operate from a 610m runway – the latter based on the assumption that the aircraft would need to operate from bomb-damaged airfields.

The jet would also need to cruise at Mach 1.5 for up to 600 miles, accelerate from Mach 0.6 to Mach 1 in 20 seconds and accelerate from Mach 0.8 to Mach 1.8 in 50 seconds at 20,000ft. Furthermore it would need to have double the F-15's sortie rate (meaning eight missions in 24 hours), be 'turned around' in just 15 minutes and the ability to fix 75% of faults in four hours.

The individual aircraft price was capped at \$40 million (in 1985 prices) based on a production run of 750 aircraft. The programme was estimated to cost a staggering \$65 billion.

Proposals

The USAF sent out formal technical requests and a year later, in July 1986, the formal Request for Proposals (RFP) was finally issued to the seven contenders.

Grumman and Rockwell subsequently dropped out of the race and Lockheed, Boeing, and General Dynamics agreed



to form a team to develop whichever of their proposed designs was selected (if any). Northrop and McDonnell Douglas joined forces with a similar agreement and on October 31 it was announced that the Lockheed and Northrop's designs had been selected as the final contenders.

As such, the Lockheed-Boeing-General

Dynamics conglomerate and a Northrop-McDonnell Douglas team were each awarded \$691 million contracts to undertake a 50-month demonstration phase. This would culminate in the flight-testing of two prototypes from each team – one powered by the General Electric YF120 engines and the other with Pratt & Whitney YF119 powerplants.

Around the same time, the US Navy announced that its Naval Advanced Tactical Fighter (NATF) programme would use a derivative of the ATF winner to replace its F-14 Tomcat fighters – this contract alone was for 546 aircraft, and the USAF envisaged buying around 750 aircraft.

YF-23

The rollout of the prototypes was initially scheduled for mid-1989, but on-going slippages delayed this. The Northrop/McDonnell Douglas YF-23 was the first of the two competing aircraft to be completed and Prototype Air Vehicle 1 (PAV-1) 87-0800 was rolled out on June 22, 1990.

The aircraft, which was painted charcoal grey and unofficially named 'Black Widow II' in honour of Northrop's World War Two-era P-61 Black Widow, was an unconventional-looking machine.

The airframe was designed to fulfil the combined needs of speed and stealth while offering agility and high-alpha flight. It was a 'triolithic' configuration with a diamond shaped trapezoidal wing, a butterfly tail and an area ruled fuselage – the latter to reduce aerodynamic drag at transonic speeds.

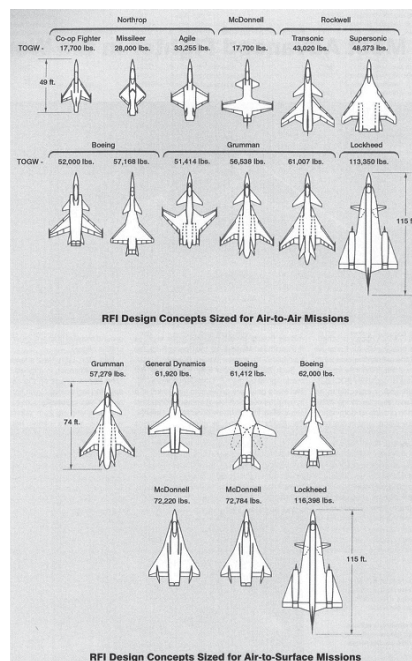
The design employed completely straight edges aligned in seven directions to minimise radar return spikes as much as possible. All the facets were smoothly blended or bevelled into three



In order to evaluate unconventional control of an aircraft in flight the USAF's Flight Dynamics Laboratory operated the Advanced Fighter Technology Integration (AFTI) programme in 1980. It flew a much-modified F-16 fitted with twin canard surfaces mounted below the air intake, a full-authority triplex Digital Flight Control System and an Automated Manoeuvring Attack System providing six independent degrees of freedom. This technology paved the way for the ATF programme NASA



The rollout of the prototypes was initially scheduled for mid-1989, but on-going slippages delayed this. The Northrop/McDonnell Douglas YF-23 was the first of the two competing aircraft to be completed and 87-0800 was rolled out on June 22, 1990



A selection of the proposals received in response to the ATF programme. Illustrated here are designs from Boeing, General Dynamics, Grumman, Lockheed, McDonnell, Northrop and Rockwell

USAF Museum

ANNIVERSARY

flowing aerodynamic masses and the all-moving butterfly 'V' tail fins controlled pitch by rotating in opposite directions and roll by turning the same way.

The YF-23's two engines were fed with air from separate nacelles fitted with 'S-ducts' to shield their compressors from radar. As with Northrop's B-2 Spirit bomber, the exhaust from the YF-23's engines flowed through troughs lined with heat-ablating tiles to dissipate heat and shield the powerplants from infrared homing missiles.

The aircraft was primarily constructed of carbon/bismaleimide and titanium but the nose was made out of aluminium. The canopy was made out of polycarbonate and the exhaust trough tiles at the back were made from Titanium Lamilloy.

To keep costs as low as possible the YF-23 utilised a number of 'off-the-shelf' components including an F-15 nosewheel and F/A-18 Hornet main landing gear units.

Maiden flight

The YF-23 performed its maiden flight on August 27, 1990 when test pilot Alfred 'Paul' Metz flew the Pratt & Whitney YF119-powered PAV-1, by now registered N231YF, for 50 minutes.

The second aircraft (PAV-2/87-0801/N232YF) followed it into the skies on October 26 with Jim Sandberg at the helm.

As with Northrop's B-2 Spirit bomber the exhaust from the YF-23's engines flowed through troughs lined with heat-ablating tiles to dissipate heat and shield the powerplants from infrared homing missiles USAF Museum



Powered by the General Electric YF120 engines and painted in two shades of grey, PAV-2 was given the nickname Grey Ghost.

Flight-testing continued apace and the Pratt & Whitney powered aircraft reached Mach 1.43 in supercruise on September 18, 1990. The General Electric-powered

example would ultimately supercruise at Mach 1.6. Neither of the YF-23s was fitted with a working vectored thrust unit.

No weapons were fired during the test programme but the YF-23 was fitted with an enclosed weapons bay to keep its weapons out of radar sight as long as possible.



The YF-23 was a beautiful aircraft with a smoothly blended wing, fuselage and tailplane



YF-23 PAV-I simulates aerial refuelling during a test flight in 1990. The aircraft's characteristic butterfly tail fins controlled pitch by rotating in opposite directions and roll by turning the same way USAF Museum

In order to demonstrate the aircraft's reliability PAV-I performed a special 'fast-paced' demonstration on November 30 when it completed six flights in just ten hours.

Testing continued until late December by which time the two YF-23s had completed a combined 50 flights and accumulated 65.2hrs.

YF-22

Meanwhile, the team at Lockheed, Boeing and General Dynamics (led by Lockheed's 'Skunk Works' division) had come up with YF-22.

Boeing was responsible for the wings and aft fuselage whereas the centre fuselage, landing gear, weapons bays and tail were built by General Dynamics and Lockheed produced the cockpit and forward fuselage. Lockheed would also undertake final assembly at its Palmdale factory in California.

Compared with the YF-23, the YF-22 was a far more conventional machine. Its wing boasted larger control surfaces and the jet had a conventional tail with a horizontal tailplane and two canted vertical fins. The manufacturers surmised this would give the jet superior manoeuvrability compared to the YF-23.

'Lightning II'

From early in the project the YF-22 was unofficially dubbed the 'Lightning II' in homage to Lockheed's World War Two P-38 Lightning fighter. This name would remain with the project until the mid-1990s, when the USAF officially named it the Raptor.

The first YF-22 (the General Electric YF120-powered PAV-I) was rolled out at Palmdale on August 29, 1990 – two days after the YF-23 had taken flight.

"The first YF-23 was charcoal grey and unofficially named 'Black Widow II'"

Allocated the USAF serial number 87-0700, PAV-I was given the civilian registration N22YF for flight-testing, which began Palmdale on September 29 with David J Ferguson at the controls. During the 18-minute flight to Edwards AFB the aircraft reached a height of 12,500ft; however, speed was capped at just 250kts.

The second YF-22, N22YX (Pratt & Whitney YF119-powered 87-0701) entered the test programme on October 30 with Tom Morgenfeld at the helm.

Flight-testing

The YF-22 was subjected to more advanced trials than were possible with the YF-23; these included flights at an angle of attack as high as 60 degrees and even live weapons testing with AIM-9 Sidewinder and AIM-120 AMRAAM missiles fired from internal weapon bays.

Testing also revealed that the vectored thrust nozzles exceeded expectations and achieved more than twice the pitch rates than Lockheed's F-16 at low speeds!

The General Electric-powered PAV-I achieved Mach 1.58 in supercruise, while PAV-2 reached a maximum supercruise speed of Mach 1.43 using the Pratt & Whitney powerplants. Both aircraft could easily exceed Mach 2.0 in full afterburner.

By the time flight-testing had been completed on December 28, the two YF-22s had flown a combined 74 sorties

and accumulated 91.6hrs of flying.

At this point PAV-I was retired (and can today be found on display at the Smithsonian's Udvar Hazy Center near Washington) but PAV-2 continued in the flight-test role. It would amass a further 61.6hrs in 39 flights before it was lost in a heavy landing on April 25, 1992 after the aircraft's software failed to prevent a pilot-induced oscillation. Tom Morgenfeld escaped without injury.

Decision time

In early 1991 both groups submitted their flight test data and final proposals to the DoD and waited to hear which had been the successful bidder.

Both the YF-22 and YF-23 were approximately 10% larger than the F-15 and carried approximately twice the F-15's internal fuel. They had around 50% more wing area than the Eagle but weighed just 30% more at combat weight.

Compared to the lightweight and affordable F-16 project, the ATF programme stuck to the more familiar doctrine of 'bigger and further' when it came to producing a long-range air superiority fighter; it was designed to penetrate deep into Soviet airspace and destroy air defence aircraft on 'home turf.'

On April 23, 1991 Secretary of the

SPECIFICATION NORTHROP YF-23



Crew	1
Length	67ft 5in (20.60m)
Height	13ft 11in (4.30m)
Wingspan	43ft 7in (13.30m)
Wing area	900.00sq ft (88.00m²)
Empty Weight	29,000lb (13,100kg)
Max Take-Off Weight	62,000lb (28,120kg)
Max Speed	1,260kts (1,450mph/2,335km/h)
Service Ceiling	65,000ft (19,800m)
Ferry Range	1,600 miles (2,575km)
Powerplant	2 x Pratt & Whitney YF119-PW-100 or General Electric YF120-GE-100 afterburning turbofans (23,500lb/thrust each or 35,000lb/thrust in afterburner)
First Flight	August 27, 1990

Artwork: Andy Hay / www.flyingart.co.uk

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Air Force Donald Rice announced the Pratt & Whitney F119-powered YF-22 as the winner of the ATF competition. The YF-23 had been faster and stealthier but the YF-22 was far more agile.

The YF-22 was also felt far more suitable to be adapted to meet the US Navy's Naval Advanced Tactical Fighter requirement – however this project was abandoned within the year and the proposed YF-22N never took to the skies.

Order book

In August 1991, two Engineering and Manufacturing Development (EMD) contracts were issued to the Lockheed/Boeing/General Dynamics team and Pratt & Whitney to produce seven single-seat F-22As and a pair of two-seat F-22Bs. These contracts were worth \$10.91 billion (\$9.55 billion for the airframe and \$1.36 billion for engines) and were just the first of many large bills to face the DoD.

At that time, the USAF planned to acquire 648 operational F-22s at a cost of \$86.6 billion but after the DoD's 'bottom up' review in September 1993, the order was reduced to 442 jets costing an estimated \$71.6 billion.

Production variant

The production version of the F-22 would differ significantly to the YF-22. The tailfins had originally been oversized because Lockheed's F-117A Nighthawk had been found to be difficult to control due to a lack of lateral control. However, the YF-22 experienced no such deficiencies and the fins on the factory produced F-22s were 30% smaller. The trailing edge of the wing was also re-contoured

RIGHT TOP: N22YF, the first prototype YF-22, aloft on its 18-minute maiden flight

USAF Museum

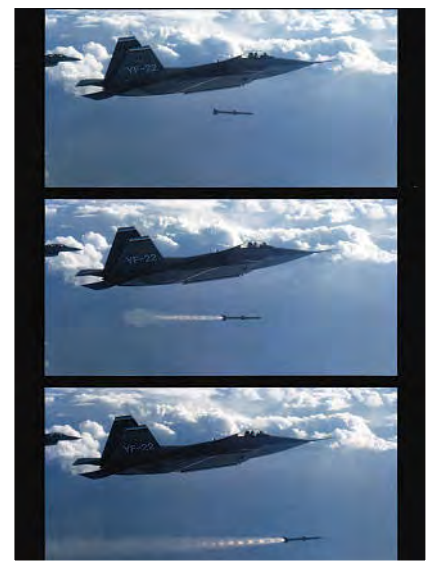
RIGHT MIDDLE: Two examples of each contender were funded by the DoD. Here the two YF-22s (N22YF & N22YX) pose for the camera in late 1990. N22YF is sporting an anti-spin parachute mounted on the rear fuselage

RIGHT BOTTOM: Unlike the YF-23, the YF-22 actually fired live weapons during its flight-test programme

WHERE ARE THEY NOW?

Today the first prototype Lockheed YF-22 (PAV-1/87-0700/N22YF) can be found at the Air Force Flight Test Center Museum at Edwards AFB in California. PAV-2 (87-0701/N22YX) was heavily damaged in a landing accident in 1992 but remains in use with Lockheed as a static test model.

Following the competition, both YF-23s were transferred to the NASA Dryden Flight Research Center, where it was planned to use one of the aircraft to study calibration techniques. This never happened and both YF-23 airframes remained in storage until mid-1996 when they were transferred to museums. PAV-1 (87-0800/N231YF) is now on display within the Research and Development hangar at the National Museum of the United States Air Force near Dayton, Ohio and PAV-2 (87-0801/N232YF) is on display at the Western Museum of Flight at Torrance Airport, California.



The two YF-22s conducting aerial refuelling trials from a USAF Boeing KC-135 tanker

and the stabilators were also modified to improve aerodynamics, strength and stealth characteristics. The cockpit canopy was also moved 7in forward to improve pilot visibility and the engine intakes were moved rearwards 14in.

The production variant of the Pratt & Whitney F119 engine began ground testing in December 1992 but the engine proved problematic to test thoroughly. It was found to be deficient in terms of fan and turbine strength and a lower-than-expected fan efficiency was also experienced. The vectored thrust nozzle was also found to be overweight (although the overall engine weight was below specification) and given its aft location this was of concern with regard to the aircraft's centre of gravity.

Delays and cuts

All of this, combined with the airframe redesign and various budgetary constraints, resulted in delays to the project. The Preliminary Design Review, a

Into service

The decision to enter low-rate initial production (LRIP) rested with the Defense Acquisition Board (DAB) in 2000 and it decreed that the F-22 programme would need to complete eleven key criteria by the end of the year in order to achieve LRIP.

The F-22 actually fulfilled eight of these tasks including a critical design review for the avionics software and flight testing at high angles of attack with weapons bay doors open. It also achieved AIM-9 and AIM-120 missile testing and by February 2001 the final flight test elements had been completed and the DAB finally gave the go-ahead for LRIP to begin in March of the same year.

The first USAF F-22 Raptors achieved Initial Operational Capability on December 15, 2005 – 24 years after the ATF programme had been launched and 15 years after the first YF-22 had taken to the skies.

Eventually the USAF's anticipated fleet of F-22 Raptors was slashed to just 187 aircraft and the last example was delivered in 2012.

The entire F-22 programme is estimated to have cost some \$66.7 billion but resulted in the world's first (and so far only) fifth generation jet fighter. ●

SPECIFICATION LOCKHEED YF-22	
Crew	1
Length	64ft 6in (19.65m)
Height	17ft 9in (5.39m)
Wingspan	43ft 0in (13.10m)
Wing area	830.00sq ft (77.10m²)
Empty Weight	33,000lb (14,970kg)
Max Take-Off Weight	62,000lb (28,120kg)
Max Speed	1,260kts (1,450mph/2,335km/h)
Service Ceiling	65,000ft (19,800m)
Ferry Range	1,600 miles (2,575km)
Powerplant	2 x Pratt & Whitney YF119-PW-100 or General Electric YF120-GE-100 afterburning turbofans (23,500lb/thrust each or 35,000lb/thrust in afterburner)
First Flight	September 19, 1990

Artwork: Andy Hay / www.flyingart.co.uk

The victorious YF-22 was significantly modified in order to become the F-22 Raptor. Production aircraft had 30% smaller tailfins and re-contoured wings and stabilators.



“Both Raptor prototypes could easily exceed Mach 2.0 in full afterburner”

major programme milestone, was reached in the spring of 1993 and the Critical Design Review (the final major milestone before assembly began), was finally completed in 1995.

A funding shortfall in 1993, due mainly to cost increases and a Congressional budget cut, was followed by two additional budget cuts in 1994 and 1995.

As such the EMD programme was ‘re-phased’ a number of times and would ultimately result in an 11-month delay in the first flight date. The two-seat F-22B was also cancelled in 1996 to save development costs.

The first production F-22 began to take shape at Palmdale in June 1995 and Boeing began assembly of the first aft fuselage in October 1995. The first two Pratt & Whitney F119 engines were installed in the first aircraft in December 1996 but a further budget reduction that year necessitated a third re-phase of the programme.

The first production F-22 was eventually rolled out at Palmdale on April 9, 1997 and the aircraft was officially named the Raptor during the ceremony. However, due to limited funding the first flight did not occur until September 7, after which the prototype F-22 was returned to the assembly line where it underwent minor structural modifications. These upgrades were completed by November 1997 and the aircraft, which was the first of nine

flyable development F-22s, was delivered to the Air Force Flight Test Centre at Edwards AFB on February 5, 1998.

Production reduction

Overall production quantity had been further reduced to just 339 jets by the mid-1997 Quadrennial Defense Review Report. The report also slowed the Low Rate Initial Production run from 70 aircraft to 58, and reduced the maximum production rate from 48 to 36 aircraft per year.

The F-22 programme experienced numerous technical problems including issues with producing titanium castings, structural weaknesses in the aft fuselage and longerons, fuel leaks and problems with both the low pressure and high pressure turbine blades.

In mid-1997 the USAF went on record to say there were 97 issues limiting aircraft operations and 68 issues limiting ground maintenance and by March 1999 the Government Accountability Office reported that the F-22 programme was projecting cost increases to the aircraft's engineering, manufacturing and development programme of \$667 million! Lockheed subsequently came up with \$660 million in cost savings initiatives and the USAF undertook several programmes to control costs.

By the end of the year, savings of \$860 million had been found... The Raptor programme was back on track, albeit at a unit cost of \$300 million per aircraft (compared to \$55 million for the F-15). Furthermore, the programme had completed only 5% of the required testing by the end of 1999 and with the Cold War now well and truly over, many began to question the need for an air superiority fighter; especially one as expensive as the Raptor.



BAC TSR.2 XR220 made a rare appearance out in the open as part of the static display at the annual RAF Cosford airshow on June 14. Normally found within the confines of the RAF Museum's Test Flight exhibition, the aircraft was brought outside to mark the 50th anniversary of the project's cancellation in April 1965. XR220 was the second development aircraft and was ready to fly for the first time on April 6, 1965, the very same day that the TSR.2 was cancelled. As such, it remained grounded for eternity *Richard Freail*



Among the more unusual 'acts' at this year's RAF Cosford airshow was a riproaring display by T2 Aviation's second Boeing 727 oil spill response aircraft. G-OSRB was flown with gusto by test pilot Dan Griffith *Richard Freail*

SHOWTIME

The Jets team reports from shows at Biggin Hill, Cosford, Coventry, Fairford, Yeovilton and the Vulcan Salute to the V-Force Tour



To mark the 75th anniversary of the Battle of Britain, the Red Arrows joined forces with the Battle of Britain Memorial Flight for two unique flypasts in June. At Biggin Hill on June 13, the BBMF's Hawker Hurricanes PZ865 and LF363 were joined by Spitfire I P7350, Spitfire V AB910 and Spitfire XVI TE311. The following day the formation was repeated at RAF Cosford, albeit without P7350. Neither day saw the team flying in blue skies but this evocative photograph, taken at Biggin Hill, sees the aircraft silhouetted in memory of the 544 allied airmen killed during the battle *Rebecca Gibbs*



Cosford Airshow was the only RAF-organised airshow in 2015. As such the event was well supported by the RAF with a varied complement of fixed-wing and rotary aircraft. These included a rare appearance by an A330MRTT Voyager tanker transport from RAF Brize Norton *Steve Bridgewater*



History was made at the Classic Air Force's Air Pageant at Coventry's Baginton Airport on July 3, 2015 when both CAF Gloster Meteors flew together for the first time since they had joined the collection. Meteor T.7 WA591/G-BWMF and Meteor NF.11 WMI67/G-LOSM, piloted by Jon Corley and Dan Griffith respectively, flew a combined routine to the delight of onlookers *Richard Freail*



Battle of Britain Memorial Flight Spitfire V AB910 flown by Flt Lt Antony Parkinson MBE joins forces with Typhoon FGR.4 ZK353 flown by Flt Lt Ben Westoby-Brooks at this year's RAF Cosford Airshow

Steve Bridgewater



As part of Vulcan XH558's Salute to the V-Force tour, the aircraft overflew the Vulcan Restoration Trust's Vulcan XL426 at Southend on June 28 *Phil Whalley*



A special 'V-Jet Formation' flypast took place at Yeovilton Air Day on July 11. Avro Vulcan XH558 was joined by Naval Aviation Ltd's de Havilland Sea Vixen XP924/G-CVIX and the two de Havilland Vampires of the Norwegian Air Force Historical Flight. While it is not known whether the three types had flown in formation during their military heyday, this fourship of classic British jets was unique in the modern airshow world and will sadly never be repeated *Richard Freail*



Another RAF Museum 'asset' on display outside at the RAF Cosford's airshow on June 14 was Hawker Siddeley Harrier GR.3, XZ997. The Falkland conflict veteran was displayed in a Belize scenario at the show and was a hit with photographers and enthusiasts alike *Peter Reoch*



Over the weekend of June 27-28, Avro Vulcan B.2 XH558 flew a nationwide salute to both the jets and people of the V-Force. Split into a northern and southern tour, 558 flew over the 14 Vulcans, four Handley Page Victors and the world's sole remaining Vickers Valiant during almost seven hours of flight. Included in the tour was Bruntingthorpe, Leics, where the aircraft's complex restoration and return to flight took place seven years ago. Here she overflies Bruntingthorpe's resident Victor K.2 XM715 Teasin Tina *Jamie Ewan*



RNAS Yeovilton opened its doors to the public on July 11 for the Senior Service's premier airshow, which saw international participation from across Europe and the USA. One of the undoubted highlights was a debut four-ship role demo from the French Navy featuring a pair of Dassault Rafale Ms and Dassault-Breguet Super Étendard SEMs. After a formation flypast, the aircraft split off into pairs before each demonstrating the operational tasks they typically undertake on a day-to-day basis. Yeovilton may have been the last chance to see examples of Super Étendards in UK skies as the type is due to be retired from service by 2016 *Jamie Ewan*



Bumper "sell out" crowds of 150,000 gathered at RAF Fairford for the Royal International Air Tattoo between July 17-19. Visitors were treated to an unusual formation flypast by Avro Vulcan B.2 XH558 and the Red Arrows. As this is scheduled to be the last year of flight for the Vulcan, organisers claimed this would be the last time both icons of British aviation would be seen together. The solo display by XH558, in the hands of Kev Rumens, will likely go down as 'the' standout display by the type since it was restored to flight seven years ago *Steve Bridgewater*



The 35th anniversary of the establishment of the Tri-National Tornado Training Establishment (TTTE) at RAF Cottesmore was marked both in the air and on the ground at this year's Royal International Air Tattoo. Similar to the collaboration that brought us the Panavia Tornado, the TTTE provided a training facility for airmen of all three air forces – Britain, Germany and Italy. Celebrating the event on the ground, a Tornado from each country received a colourful tail vinyl, which was specially adapted for each nation. Sadly the artwork was not approved for flight and was removed before the jets departed for home *Jamie Ewan*



Among the stars of the static display at this year's Yeovilton Air Day was this NATO-operated Boeing E-3 Sentry, seen here arriving the day before the show *Richard Freail*



Precluded from working up a full 'routine', Tornados from Britain, Germany and Italy performed a number of formation flypasts at RIAT; led by the RAF's Flt Lt Ollie Suckling *Steve Bridgewater*

For their combined 'BoB 75' display at Fairford, Flt Lt Antony Parkinson MBE and Flt Lt Ben Westoby-Brooks flew Spitfire I P7350 and Eurofighter Typhoon ZK349, respectively. The latter has been painted to depict Flt Lt James Nicolson's Battle of Britain-era Hawker Hurricane complete with 249 Sqn GN-A codes *Steve Bridgewater*





An unusual addition to the RIAT 2015 static park was British Airways' Airbus A318 G-EUNB, seen here departing to its base at London City Airport on Sunday afternoon *Rebecca Gibbs*



Perhaps one of the most eagerly awaited British airshow debutantes this year was the French Air Force Ramex Delta duo. The team's Mirage 2000N had been set to display at RAF Cosford Airshow in June but cancelled at the eleventh hour. The honour of hosting the team's first UK display therefore fell to the Royal International Air Tattoo at Fairford in July *Richard Freail*



One of the most dramatic and powerful display routines to appear at this year's Royal International Air Tattoo came from the Polish Air Force's Mikoyan Gurevich MiG-29 Fulcrum. Starting with a 'Lightning-esque' take-off and combining well-flown aerobatic and tactical manoeuvres, it was surprising not to see the smoky jet appear in the list of award winners *Rebecca Gibbs*



Perhaps the most welcome addition to the RIAT static park (at least as far as enthusiasts were concerned) was a pair of Spanish Air Force Northrop SF-5 Tigers. Here, two-seat SF-5M 23-16 departs after the show *Richard Freail*



History was made on the Tuesday before the show at RAF Fairford with the arrival of two Kawasaki P-1s from the Japan Maritime Self Defence Force (JMSDF) – the first time Japanese Naval assets had flown in UK airspace since 1927. The two examples of the Japanese indigenous maritime patrol aircraft were provided by VX-51 based at Atsugi and one aircraft took part in the show's daily flying display *Richard Freail*



Display teams are always a highlight at the Royal International Air Tattoo and the 2015 event attracted the national teams of France, Jordan, Switzerland, Spain (whose Patrulla Aguila is illustrated here) as well as the RAF Red Arrows *Steve Bridgewater*



'BOB' made for a wide load as the airframe was roaded down the motorway from Bruntingthorpe to Cosford

Trevor Reech

BOB'S ROAD TRIP

The RAF Museum's Vickers VC10 has arrived at Cosford after a road trip down the M6 motorway! *Steve Bridgewater* reports.

As one of the most important aircraft in the RAF's inventory over the last few decades, it was vital that a Vickers VC10 be preserved by the RAF Museum.

However, with the runway at Cosford being too short to safely land the large tanker transport (and no runway at all at the museum's Hendon site in London!) the logistics involved in preserving the aircraft were destined to be 'complicated' at least.

Final flight

The dubious honour of being the RAF's last VC10 fell to XR808 (often referred to as 'BOB' because of her '808' registration). The aircraft was flown from RAF Brize Norton to Bruntingthorpe on July 29, 2013 and landed shortly after 11.30am. She had accumulated 43,865 hours of flying time and her final landing marked the end of the VC10 in RAF service.

After a period of storage, an eight-month-long dismantling process was carried out by GJD Services, a specialist

maintenance and aircraft salvage company based at the Leicestershire airfield.

"When GJD were asked to move XR808 on behalf of the RAF Museum we were very keen to take on the challenge; to play our part in preserving this icon of British Engineering" says Gary Spoors, Accountable/Engineering Manager at GJD Services.

"Whilst we were fully aware of the scope of the challenge presented to us, it has tested our engineering skills. Working as a team we have come up with some innovative solutions to problems as they arose, all of which we have overcome. Personally, I have a great affiliation with the VC10, having worked on the type throughout



The RAF Museum's Vickers VC10 edges closer to the museum's site at RAF Cosford on June 21



"Easy does it!" XR808 'BOB' negotiates a tight corner as it approaches the RAF Museum at Cosford All via RAF Museum unless stated



XR808 is seen at RAF Fairford on July 7, 1966 shortly after being accepted by the RAF
Ray Deacon



Initial assembly took place on the active airfield at RAF Cosford. The airframe will later be moved through the fence onto the museum complex

"The route saw the aircraft pass along the M69, M6 and the M54 motorways"

various stages of my career and I wanted to ensure that XR808 was dismantled and moved with care and precision. We chose to reverse engineer the aircraft, de-ripping the various sections, wing, fin, tail and back end, in order to avoid any cuts which we felt would compromise the integrity and beauty of the aircraft. An enormous effort has gone into the dismantling of XR808 and we are very pleased with progress the GJD team has made so far. We are looking forward to the next phase and seeing XR808 complete in her new home."

Road-runner

With the dismantling completed it was time for 'BOB' to make the almost 70-mile road journey from Bruntingthorpe to Cosford, Shropshire.

The 93ft-long fuselage departed Bruntingthorpe early on Sunday, June 21 and arrived at Cosford shortly after 1.00pm. Transported on a low loader lorry, the route saw the aircraft pass along the M69, M6 and the M54 to Cosford, via the nearby village of Shifnal. Too large to pass under the railway bridge at Cosford, the fuselage made its way to Junction 4 on the M54 and through Shifnal, with some tricky manoeuvring en route, before heading onto the airfield.

Restoration

XR808's wings and tailplane followed a week later on June 28 and work then began on the rebuild. Throughout July a team of GJD engineers worked to unload the

aircraft, position and trestle the inner wings before attaching them to the fuselage.

As these words were written in early August, the aircraft was due to be transferred from the airfield at RAF Cosford to the museum's site for final reassembly, which will take place directly outside the museum's Hangar 1.

Here the wings will be rebuilt and the rear fuselage section attached. By late September the team anticipates to be fitting the fin and tailplane ready to install the engines, nacelles and outer wings. The final finishing touches of refitting the access panels and a little paintwork touch up will be carried out late October before the fully reassembled VC10 is moved into its final position next to the Lockheed Hercules C130K Mk3, where the aircraft will go on public display.

"The VC-10 formed the mainstay of the RAF's long-range strategic transport force for almost fifty years," says Ian Thirsk, Head of Collections at the RAF Museum. "For one aircraft type to have been in service for such a long period is remarkable in itself. However, when this is added to the variety of roles and worldwide scope of operations, it is clear this is a unique aircraft and it would not be possible to accurately portray the history of the RAF without an example of the type – therefore it is essential that such a pivotal and long serving aircraft is preserved by the RAF Museum." ●



VC10 XR808

The VC10 was built by Vickers-Armstrong (later the British Aircraft Corporation) and entered service with Royal Air Force in 1966. This dual-role aircraft enabled the rapid deployment of troops and their weaponry and fast jet aircraft to many theatres of operations around the world. With the ability to carry up to 124 troops at a time with nine crew members or a freight load of up to 450,000lbs, the VC10 was one of the RAF's most significant assets for nearly 50 years. The RAF VC10s allowed true global mobility, offering a combination of speed and range never previously attained by an RAF Transport Command aircraft type.

XR808 was first operated by 10 Sqn in 1966 as a VC10 C.1 variant and would go on to fly with the RAF for nearly half a decade. In October 1986 it was converted into a C.1K tanker/transport variant and during the first Gulf War XR808 flew up to 50 x 1000lb bombs at a time out to the Gulf to rearm the Tornados in theatre. During its RAF service XR808 fulfilled the air transport, VIP passenger and tanker roles and amassed over 43,865 flying hours.



YAKOVLEV'S FIRST JETS

YAK-15, YAK-17 AND YAK-23

Pete London looks at the Yakovlev Yak-15, Yak-17 and Yak-23 – three of the Soviet Union's first successful jet fighters

Born in 1906 to a well-off Moscow family, from an early age Aleksandr Sergeyevich Yakovlev was fascinated by aviation; he built his first simple glider while still at school.

Young Aleksandr yearned to enter the Soviet Union's academy for budding aviation designers, the Akademiya Vozdushnogo Flota (AVF: Academy of the Air Fleet) and he started at the bottom, joining in March 1924 as a labourer.

From that humble beginning, over the next decade Yakovlev studied and practised aeronautics with single-minded dedication, working his way up to lead his own state aviation office, or Opytnoye Konstruktorskoye Byuro (OKB: Experimental Design Bureau).

The Great Patriotic War brought unceasing activity and great achievement. In the struggle against German invasion Yak-3 and Yak-9 fighters were among the

motherland's most successful aircraft and, increasingly, Yakovlev took instructions direct from Joseph Stalin. In the process he earned many honours and in 1946 he became a General-Colonel of Aviation and a Deputy of the Supreme Soviet.

Stalin's demands

During the war Britain, the United States and particularly Germany took their first steps in jet-powered aircraft. Though aware of those events the USSR had not followed suit, but in February 1945 Yakovlev attended a Kremlin meeting at which Stalin demanded jet fighters without delay. By then Soviet development of jet engines had begun, but none were sufficiently advanced to power an aircraft.

As a stop-gap, Stalin ordered Yakovlev's OKB 115 and Artem Mikoyan's rival OKB 155 to design aircraft powered by captured Junkers Jumo 004 and BMW 003 engines respectively.

In April these instructions were underwritten by the National Defence Committee and by now the German



In a snowy landscape Yakovlev's first jet prototype, the Yak-Jumo, reveals its circular intake and broad undercarriage track. Its thick wing was a throwback to Yak-3 origins. The aircraft had a tadpole shape created by its underslung powerplant. The shield added to protect its tailwheel from efflux is just visible

All via Author unless stated

engines were also being reverse-engineered by Soviet research establishments. Concurrently, planning began for the Jumo's manufacture as the Klimov RD-10 (Reaktivnyi Dvigatel: Jet Engine), while Kazan Motors developed the BMW as the RD-20.

Yak-Jumo

For the speediest answer to Stalin's wishes, Yakovlev proposed adapting his Yak-3, replacing its piston engine firstly with a Jumo, then an RD-10 copy when it became available. The Yak-3 was well-suited for conversion: its rear fuselage, tailplane, outer wings and undercarriage would be almost unaltered, the 2,000lb/ thrust Jumo installed in an enlarged forward fuselage.

Later in April Yakovlev received the order to proceed, allocating the jet's design to project engineers Yevgeniy Adler and Leon Shekhter. Its preliminary layout was completed in just three days, and more mature drawings issued during May. The aircraft was known as the Yak-Jumo.

The jet was of all-metal construction, its fuselage fabricated from welded steel tube with a duralumin skin. The heated cockpit, covered by a bubble canopy and frameless windscreen, was almost identical to that of the Yak-3. To accommodate the Jumo 004B, its forward fuselage was deepened, the engine attached to the tubular structure on shock-absorbing rubber mountings and inclined nose-up at 4.5 degrees. Nose panelling was detachable for maintenance, using quick-release fastenings.

With its new powerplant, the aircraft assumed a tadpole-like profile, also known as 'pod-and-boom', its original low-wing layout becoming mid-wing.

Testing

Virtually hand-built with the utmost speed, the first Yak-Jumo was completed in October 1945. Ground-runs at Zhukovsky airfield, south-east of Moscow,



Yakovlev's second jet prototype was referred to as both the Yak-Jumo, and the Yak-15 RD-10. Here, on the grass during the company's flight test programme, it shows its prominent cannon armament

began immediately in the hands of OKB 115 test pilot Mikhail Ivanov, with Yevgeniy Adler as test engineer.

At once it was discovered that although the tailwheel had been fitted with a heat-shield this was inadequate - the rubber tyre melting in the jet exhaust during engine runs!

The engine also proved troublesome and a second was sent from the Tsentral'nyy Institut Aviatsionnovo Motorostroyeniya (TsIAM: Central Institute of Aviation Motors). By December an all-steel heat-resisting tailwheel had replaced the original.

A second prototype appeared later that month (referred to as both a Yak-Jumo and a Yak-15 RD-10) and although originally delivered with a Jumo this was later replaced by a Soviet replica. The new jet featured a slightly enlarged tailplane, two 23mm cannon in the upper nose and the new tailwheel. Brief taxi-runs took place before the aircraft was relegated to prolonged wind-tunnel testing.

Maiden flight(s)

Finally, on April 24, 1946, Yak-Jumo No.1 made its maiden flight from Zhukovsky in the hands of Ivanov, performing a single circuit before landing safely. That day too MiG's I-300 jet, precursor to the MiG-9, also flew.

The hold-up in the Yak-Jumo's flight was contrary to Stalin's demand for haste and at the time was explained away as due to bad weather as well as the perceived need for wind tunnel testing. However, it may have come about through Mikoyan's 'back-door influence,' causing the Yak programme to be delayed while the MiG caught up.

Evaluation by the Nauchno-Issledovatel'skiy Institut Voenno-Vozdooshnykh Seel (NII - VVS: Scientific Test Institute - Soviet Air Force) continued until late June and was trouble-free, the Yak-Jumo achieving almost 365kts at sea level.

Together with the MiG I-300, it participated in the Tushino Aviation Day on August 18. Observed by surprised western powers, the Yak was allotted the Air



Yak-15 coded 'Yellow 37' at rest on the grass. The fighter was able to operate from various surfaces, but due to its tailwheel undercarriage it left its mark on all of them. The aircraft's NS-23 cannon can be seen protruding from the starboard nose decking

Standardisation Co-ordination Committee code-name *Feather*.

Yak-15

Just after the Yak-Jumo's first flight the Soviet Council of Ministers issued a directive to OKB 115 calling for an RD-10-powered fighter to go into production. This would be dubbed the Yak-15 and was to fly at 417kts at sea level, have a range of 440 miles, a service ceiling 47,000ft and time to 16,250ft of 4 minutes 30 seconds.

Even more pressing, immediately following the Tushino display Stalin personally ordered Yakovlev to build fifteen jets for participation in that year's Red Square flypast marking the October 1917 Revolution. It was as well the Yak-Jumo's trials were proving painless!

The fifteen aircraft became pre-series Yak-15s, their Yak-3 elements taken from the production line. All examples were completed and test-flown ready for the parade, but poor weather set in and the flying display was cancelled.

Military might

By the end of 1946, production RD-10-powered Yak-15s were emerging from Tbilisi. Armament, changed from one nose-mounted 20mm Shpitalnyi/Vladimirov (ShVAK) cannon and two 12.7mm Berezin UB machine-guns to two 20mm Berezin B-20 cannon and finally two NS-23 cannon with 60 rounds per gun.

Evaluation with the Soviet Air Force continued until April 1947 with the aircraft's longitudinal stability and elevator authority criticised, but overall the aircraft was deemed fit to enter service. With Stalin taking a close personal interest and national prestige at stake, it's hard to believe the trials



Yak-15 coded Yellow 20 in flight over a bleak Soviet landscape Key Archive

could have concluded otherwise and in May 1947 a Moscow military parade included an overflight by 50 Yak-15s and 50 MiG-9s.

Below par

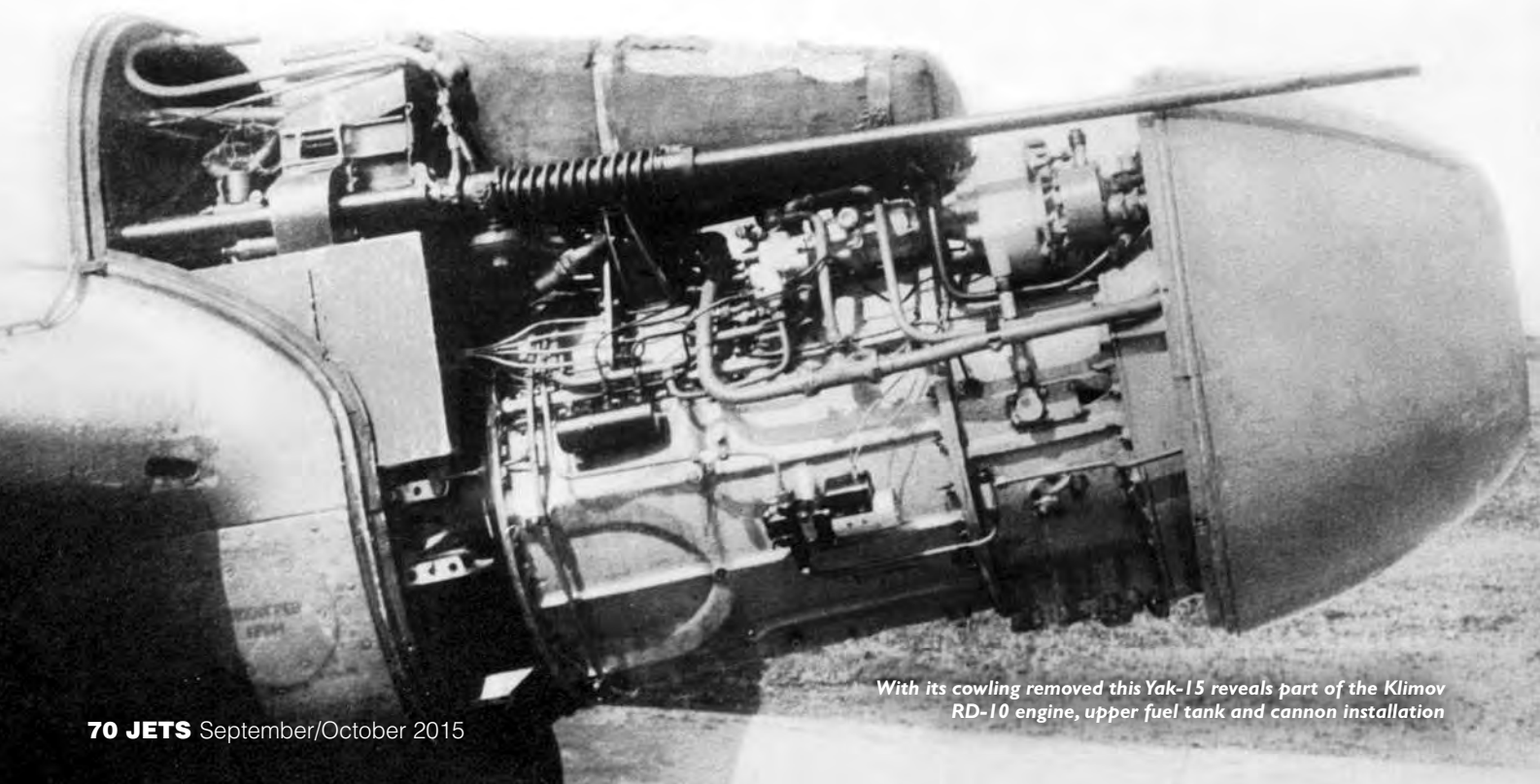
Altogether, 280 Yak-15s were built, but performance wasn't world-beating and major parts of the requirement directive were found too challenging. With a top speed of 378kts at sea level Yakovlev's fighter was substantially slower than demanded; the relatively thick wing inducing drag that prevented full advantage being taken of the engine.

A severe operational disadvantage was the miserable range of around 320 miles, less than the original Yak-3 and again well down on the requirement directive. However, the new jet was pleasant to fly and Yak-3 pilots were easily able to convert.

However the Yak-15 suffered with numerous reliability problems and on the ground the engine exhaust scoured the runway surface, shooting loose matter aft and damaging the tailplane and elevators.

Taxiing on the metal tailwheel also vibrated the rudder fiercely, which was acutely felt through the rudder pedals. Smoke would form from fuel and oil dripping onto the running engine, filling the cockpit with fumes and, to add to its woes, the RD-10 proved terribly unreliable. Initially the engine was cleared to a mere 25 hours between overhauls, but in practice that slumped to 17 hours.

As well as service with home-based fighter regiments the Yak-15 flew in East Germany, Hungary, Manchuria, Poland and Romania, but its front-line career was brief.



With its cowling removed this Yak-15 reveals part of the Klimov RD-10 engine, upper fuel tank and cannon installation

Almost from the outset it became viewed as a transitional aircraft leading to more sophisticated types.

It was also used in a conversion training role after being withdrawn from first-line duties giving many Soviet pilots their first experience of jet aircraft - in fact to help with this several Yak-15s were unofficially adapted in the field, becoming two-seaters.

During the late 1940s one example coded 47Yellow was used for air-to-air refuelling experiments, along with two Tu-2s acting as 'tankers' carrying dummy equipment.

Yak-17

The Yak-15 spawned two direct descendents and became the forerunner of several others. The sole Yak-17 RD-10 prototype was an attempt to improve performance by adopting a new laminar-flow wing, much thinner than that inherited from the Yak-3 and of altered planform. It also featured a larger tailplane and fin, an ejection seat and a reworked canopy. Since the new wings' outer sections were too slim to house the undercarriage, the main wheels retracted into the root aft of the rear spar; their track much reduced.

The sole Yak-17 RD-10 first flew on October 4, 1946 but was soon damaged when the undercarriage malfunctioned. It was never repaired.

Yak-21

The other direct Yak-15 derivative was the Yak-21 jet conversion dual-control trainer. The requirement for such an aircraft stemmed from a Council of Ministers instruction of July 1946. Accordingly OKB 115 drew up a tandem two-seater based on the fighter, at first dubbed the Yak-Vyvoznoy (familiarisation and conversion trainer). Armament was removed and a second

cockpit position added, the student sitting in the forward seat. Coded 101 Yellow, the Yak-21 prototype was built at Tbilisi and first flew in April 1947 but like the Yak-17 RD-10 it remained a singular aircraft.

Tricycle

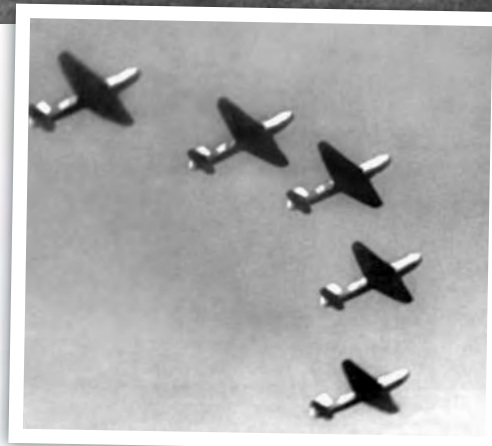
The Yak-15's trials and service life had emphasised the need for a variant with tricycle undercarriage. This led to two further single prototypes, the Yak-15U RD-10 fighter (Uluchshenny: Improved), and a trainer version referred to as either the Yak-21T (Trekholesnyy shassi: tricycle undercarriage) or the UTI Yak-17 RD-10.

Both aircraft featured revisions to their inner wings and forward fuselage and had larger tail feathers and fins. The castoring nosewheel was semi-retractable, space being limited by the engine's proximity. A fairing was attached to the nosewheel oleo, helping form a streamlining blister when it was raised, although the tyre protruded into the slipstream.

The Yak-21T was found to be slow,



The Yak-17 RD-10 development aircraft reveals its unusual main undercarriage, featuring levered suspension with leading arms, the wheels retracting into the fuselage



Large formations of jet fighters were seen as a propaganda coup by the Soviet Union's ruling Communist party. This five-ship of Yak-15s may date from the 1949 Tushino air day



The sole Yak-21 jet conversion trainer prototype was 'Yellow 101.' Its rudder bears the Cyrillic letter V, which probably indicated Vyvoznoy: familiarisation and conversion trainer

SPECIFICATION YAKOVLEV YAK-15 FEATHER



Crew	1
Length	28ft 6in (8.70m)
Height	7ft 5in (2.26m)
Wingspan	30ft 2in (9.20m)
Wing area	159.8sq ft (14.85m ²)
Empty Weight	4,082lb (1,851kg)
Max Take-Off Weight	6,030lb (2,735kg)
Service Ceiling	378kts (435mph/700km/h)
Ferry Range	320 miles (198km)
Powerplant	One Klimov RD-10 turbojet (1,984lb/thrust)
Armament	Two 23mm Nudelman-Suranov NS-23 cannon
First Flight	April 24, 1946

Andy Hay / www.flyingart.co.uk]



Yellow 45 was the sole tricycle-undercarriage Yak-15U RD-10, which led to the Yak-17. Here the aircraft demonstrates its partially-retractable nose undercarriage and wingtip fuel tanks

its RD-10 unreliable; and its range was reduced to a lowly 230 miles, partly because fuselage tankage had been reduced to allow the second seat. The instructor could not start the engine, nor operate flaps or undercarriage. Against those serious shortcomings though, the aircraft was strongly built as well as placid in the air and the lack of an alternative two-seat jet led to the Yak-21T being ordered into production under the designation Yak-17UTI in September 1947.

Yak-15U RD-10

By then the prototype tricycle-geared Yak-15U RD-10 fighter had appeared. To improve pilot comfort its cockpit was slightly enlarged compared with the Yak-15, while 44-gallon wingtip drop tanks were introduced to increase range.

The VVS observed that stability and

control of the Yak-15U RD-10 were similar to the Yak-15 but its take-off run was shorter, while landing procedures and ground manoeuvring were easier. A second set of trials during March 1948 confirmed the improvements and the aircraft entered production, becoming known as the Yak-17.

Altogether 430 Yak-17 fighters and Yak-17UTI trainers were built, the fighters probably numbering 280 and manufacture continuing until 1949. Later examples received the RD-10A engine with a 50-hour time between overhauls. The fighter variant's original NS-23 cannon were replaced by two NS-23Ks with extended barrels, while the trainer was fitted with a single 12.7mm Berezin UBS machine-gun.

In the west, being difficult for observers to distinguish from the earlier fighter, the Yak-17 also became known as *Feather*. Meanwhile the two-seat variant was dubbed

the *Magnet*. But with the emergence of the much superior swept-wing MiG-15, Yakovlev's interceptor spent only a brief period with the Soviet Air Force, its phasing-out underway by 1950.

For a time, the possibility of producing Yak-17s in Czechoslovakia was considered but the idea came to nothing. The Yak-17UTI was exported widely and used by the air forces of Bulgaria, China, Poland and Romania as well as Czechoslovakia.

Yak-23

Yakovlev's final 'pod-and-boom' fighter was the Yak-23; which benefited from the generosity of Great Britain! In 1947, with extravagant fraternalism, Britain's Labour government had presented the Soviet Union with examples of Rolls-Royce Nene and Derwent engines. Gleeefully they were copied and the unlicensed 3,500lb/thrust Derwent V replica (known as the RD-500) was seized on by OKB 115.

Though it was slightly smaller than its forebears the Yak-23 retained their general layout, but numerous major modifications were introduced, including a stressed-skin semi-monocoque fuselage. The RD-500 was inclined 4.5 degrees nose-up in the forward fuselage, its air intake featuring a short bifurcation housing a gun camera and landing light. The cockpit was given an ejection seat, a low-drag bubble canopy, an armour-glass windscreen and back-armor. To allow engine maintenance, a large section of nose panelling could be detached.

The wing, a two-spar one-piece laminar structure, was given 3.5-degree dihedral and a flush-riveted skin. Frise ailerons and hydraulically-operated slotted flaps were adopted, while 44 Imp Gal wingtip fuel tanks could be fitted. The castoring nosewheel retracted forward to fit within the intake's split and armament came from two 23mm Nudel'man/Rikhter NR-23 cannon in the lower nose, each with 90 rounds.



Soviet Air Force Yak-17 coded 46. Its wingtip fuel tanks are installed, and a gun camera is mounted above the windscreen



The Yak-17UTI was exported widely and used by the air forces of Bulgaria, China, Poland and Romania as well as Czechoslovakia – an example of the latter is seen here

Into production

Piloted by Ivanov, the first of two prototype Yak-23s (Yellow 52) first flew on July 8, 1947 and a month later he flew the aircraft in the Tushino air display. Subsequent VVS trials were generally favourable, but the absence of airbrakes, poor canopy jettison system and heavy control forces drew criticism.

The VVS's comments were partly responsible for a hesitation in commencing Yak-23 production. At the time too, the Soviets were experiencing great difficulty in manufacturing the RD-500. In July 1948 the second prototype crashed in a freak accident struck by a balance tab lost from a Tu-14 bomber flying some distance away; Ivanov was killed.

It was 1949 before production was authorised but by the close of 1950 some 313 Yak-23s had appeared, being known in the west as *Flora*.

As a contemporary of the MiG-15 though, Yakovlev's smaller slower fighter was the poor relation while in the west, the emerging F-86 Sabre was much superior. That said, the Yak could at least turn inside the MiG-15, and was a simpler aircraft able to operate from crude airstrips. Its production went ahead partly as insurance against possible difficulties in fielding MiG's fighter.

In service

In VVS service the Yak-23 flew mostly with the fighter regiments of the North Caucasus and Volga Defence Districts, acting as a low- and medium-level interceptor. It also joined the air forces of Albania, Bulgaria, Czechoslovakia (where it was known as the S-101, the 'S' indicating *S*třací *l*etoun: fighter aeroplane), Hungary and Poland.

Yak-23s entered service with the Polish



Yak-21T 'Yellow 22' in flight showing its long 'glasshouse' canopy. In September 1947 it was ordered into production under the designation Yak-17UTI Key Archive

Air Force early in 1951, some 90 examples flying with front- and second-line regiments until the mid-'50s. Also used as a trainer, the type was finally withdrawn in 1959.

On November 21, 1957 meanwhile, Polish civil-registered example SP-GLK flown by Polish pilot Andrzej Ablamowicz achieved Fédération Aéronautique Internationale class records in climbing to 3,000m in 119 seconds and 6,000m in 197 seconds.

Czechoslovakia received its first Yak-23s in late 1950 or early 1951; it seems around 21 examples were imported. Romania acquired up to 62 aircraft of which one was converted into a two-seater designated Jak-23DC (Dubla Comanda: dual control); the type lingered in service until 1958. Hungarian Yak-23s are thought

SPECIFICATION YAKOVLEV YAK-17 FEATHER



Crew	1
Length	28ft 9in (8.76m)
Height	7ft 7in (2.30m)
Wingspan	30ft 2in (9.20m)
Wing area	160.0sq ft (14.90m ²)
Empty Weight	4,588lb (2,067kg)
Max Take-Off Weight	7,126lb (3,232kg)
Max Speed	378kts (435mph/700km/h)
Service Ceiling	41,280ft (12,750m)
Ferry Range	494 miles (790km)
Powerplant	One Klimov RD-10A turbojet (1,984lb/thrust)
Armament	Two 23mm Nudelman-Suranov NS-23 cannon
First Flight	June 1947

Andy Hay / www.flyingart.co.uk]



Soviet Air Force Yak-17UTI 'Yellow 19' taxis across a frozen Russian landscape prior to a training sortie. In the rear seat, the instructor has his canopy open



The first prototype Yak-23 ('Yellow 52') reveals its redesigned fuselage for the camera (Key Archive)

to have served between 1951 and 1956. Deliveries to Bulgaria began with a batch of 12 aircraft in 1951, the following year's propaganda flypast over Sofia featuring nine examples. In addition to the Soviet-supplied aircraft several were purchased from Czechoslovakia, the Bulgarian Yak-23s toiling on until 1959.

Meanwhile in a strange episode during 1953, a Yak-23 from Romania's 135th Fighter Regiment had defected to Yugoslavia, pilot Mihail Diaconu requesting political asylum. Its national markings removed, the aircraft was evaluated by Yugoslavia's Vasduhoplovno Opitni Centar (Aircraft Test Centre).

Approaches were made to the United States' Central Intelligence Agency and eventually the Yak-23 was dismantled and shipped to Wright-Patterson AFB, Ohio for examination. There it received the temporary identity FU-599 and USAF markings before making eight flights during November 1953. Later the Yak was crated back to Yugoslavia, and thence returned to Romania.

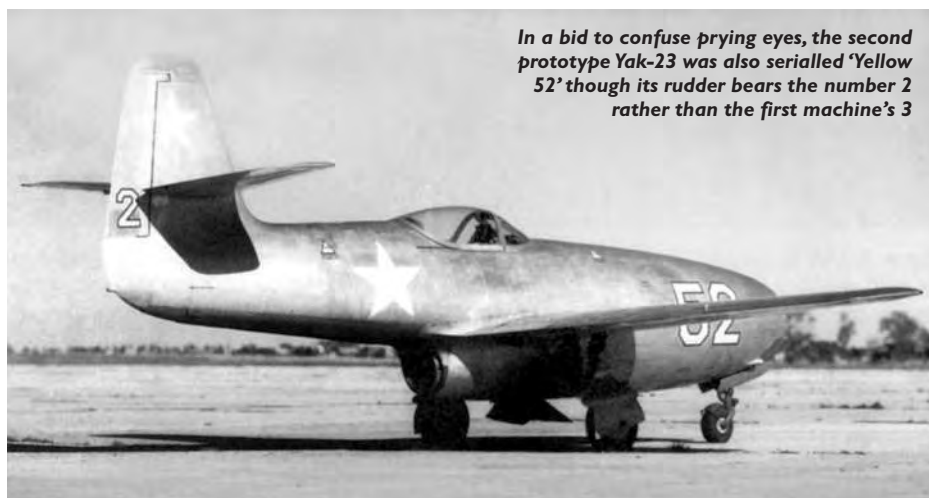
Variants

As with previous fighters the Yak-23 spawned a trainer version; the Yak-23 UTI.

The prototype (Yellow 50) appeared in 1949 and boasted a second cockpit for the instructor aft of the original rather close to the tail. The aircraft morphed into a second version; its fin increased in height, the fuselage was lengthened and cockpits moved forward, at the expense of fuel capacity which dropped to 145 Imp Gal.

A final revision gave the Yak-23 UTI a further modified and bulged rear canopy together with wing-tip tanks. Nonetheless the cockpits were found cramped and range, yet again, was considered poor so no production programme came about. Yellow 50 was later used for tests as part of an ejection seat programme.

Today, numerous early Yak jets are preserved. The only surviving Yak-15 is displayed at Moscow's Vadim Zadorozhny Museum. Yak-17s and Yak-17UTIs can be seen in Bulgaria, China, Czechoslovakia, Poland and of course Russia while Yak-23s are preserved in Bulgaria, Czechoslovakia, Poland, Romania and the mother country. The exhibits are symbols of a bygone empire; Aleksandr Yakovlev's first jet fighters played a noteworthy part in Eastern Europe's cold-war aerial presence. ●



In a bid to confuse prying eyes, the second prototype Yak-23 was also serialled 'Yellow 52' though its rudder bears the number 2 rather than the first machine's 3



Bulgarian Air Force Yak-23 during maintenance, its ground-crew looking suitably busy for the camera



A Czechoslovakian Air Force Yak-23 demonstrates the bifurcation fitted within the engine air intake. This housed a gun camera and landing light (Key Archive)



The Yak-23 UTI two-seat trainer prototype 'Yellow 50' in its original form. The instructor's rear position suffered with rather restricted visibility

SPECIFICATION YAKOVLEV YAK-23 FLORA



Crew	1
Length	26ft 8in (8.12m)
Height	10ft 10in (3.31m)
Wingspan	28ft 8in (8.73m)
Wing area	145.0sq ft (13.50m ²)
Empty Weight	4,356lb (1,980kg)
Max Take-Off Weight	7,445lb (3,384kg)
Max Speed	500kts (575mph/925km/h)
Service Ceiling	48,500ft (14,800m)
Ferry Range	640 miles (1,029km)
Powerplant	One Klimov RD-500 turbojet (3,500lb/thrust)
Armament	Two 23mm Nudelman-Rikhter NR-23 cannon
First Flight	July 8, 1947

Andy Hay / www.flyingart.co.uk

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911/15

Cargo carrier UPS operated Douglas DC-8-73F N894UP when it was photographed at Anchorage, Alaska in April 1996. The aircraft had been built for Evergreen International in August 1969 as N910CL and was finally retired in 2010. It was noted in storage at Roswell, New Mexico Robbie Shaw



DOUGLAS DC-8 VS CONVAIR CV-880

The Douglas DC-8 and competing Convair 880 enjoyed very different levels of success. Sebastian Morgan compares and contrasts the two narrow-body jetliners

After their short airline careers eleven Convair CV-880s were converted to cargo aircraft, but only four ever flew for any length of time. Venezuelan based Latin Carga operated YV-145C when it was photographed in September 1980. Two months later it was lost in a take-off accident at Caracas-Simon Bolivar Airport in Venezuela, which claimed the lives of all four crew members. The aircraft had originally been built for Delta Air Lines as N8816E in July 1962 Tom Singfield Collection



Thanks to its revolutionary DC-2 and DC-3 designs, the Douglas Aircraft Company had enjoyed a commanding lead in the American-built airliner market prior to World War Two. This continued in the post-war era with its high performance DC-4, DC-6 and DC-7 piston-powered aircraft flying routes throughout the globe.

Reticence

However, despite Britain's de Havilland Aircraft Company successfully flying (and selling) its Comet jetliner from the late 1940s, there seemed little interest in the new technology from any of the US airliner manufacturers.

Lockheed and Convair concentrated their efforts on ever-bigger piston powered machines as well as keeping an eye on the future of the more fuel-efficient turboprops. Meanwhile, Douglas retained its commanding market dominance and by 1952 it had around 300 orders in hand for its DC-6 and the yet-to-fly DC-7 – both powered by large, thirsty radial piston engines.

It would be June 1954 before Boeing's Dash 80 (the forerunner of the 707) took flight and only then did the company's competitors take notice. All of a sudden Douglas was vulnerable and it became obvious that the company needed its own jetliner if it was not to be left behind.

Tanker requirement

Boeing's 707 had been partly developed using military funding as the USAF was in need of a jet-powered aerial refueller for its new breed of jet bombers. The company had shrewdly ensured the Dash 80 could easily be converted to airline configuration; thus reducing the cost and risk of developing its own airliner with private funding.

Meanwhile, Douglas had shared similar thoughts and, working on the



The prototype Douglas DC-8-11 takes off from Long Beach, California for its maiden flight on May 30, 1958 Douglas Aircraft

assumption that the US government would reduce its own risks by awarding tanker contracts to two separate companies, it began to work on its own aircraft.

Development of the new aircraft actually started in mid-1952 and a year later it had taken the form of an 80-seat, low-wing airliner powered by four Pratt & Whitney JT3C turbojet engines. The wing was swept by 30 degrees and the narrow body resulted in a fuselage with an internal diameter of 11ft that could allow five-abreast seating. It was projected that the aircraft would have a range of up to 4,000 miles.

Even with such a promising design,

Donald Douglas and his team remained ambivalent to the new aircraft and it remained firmly on the drawing board.

Missed the boat

However, in May 1954 the USAF issued its requirement for 800 jet-powered tankers to Boeing, Douglas, Convair, Fairchild, Lockheed and Martin.

It was at this point that Douglas began work on its jetliner in earnest but by now Boeing was just two months away from flying its prototype in the air. Four months after issuing the requirement, the USAF ordered the first Boeing KC-135s – Douglas

Right: National Airlines was the first customer for JT4A-powered DC-8As. N6571C was delivered in February 1960 and, still carrying its original registration number, was last operated by Antigua Caribbean Air in the early 1980s. It was broken up in July 1984 Douglas Aircraft



International DC-8 operations were initiated by Pan American on March 27, 1960 between New York and Bermuda and, on April 27, between New York and London. DC-8-30 N809PA 'Clipper Great Republic' is seen here landing at London Heathrow on August 11, 1968. The aircraft later passed to United Airlines (as N8246U), Overseas National Airways, Aire Cardinal and Rosenbalm Aviation before joining Emery Worldwide in 1981. It was broken up at Miami in January 1986 Adrian M Balch



DC-8-54F G-BDDE is seen here at Stansted on March 3, 1983 when in service with British Cargo Airlines. Could this be the only DC-8 with a personalised registration? G-BDDE reputedly stood for Great Britain's Douglas Dc Eight! The aeroplane had been delivered to Trans Caribbean Airlines as N8783R in December 1963 and also served with American Airlines following the merger of the two carriers. In November 1983 it passed to Agro Air International as YV-447C and was subsequently broken up Tom Singfield

The first foreign DC-8 operator was Trans-Canada Air Lines and in 1960 CF-TJA was the first to join the fleet. Four years later it passed to Air Canada and is seen here at Vancouver in May 1976. The aircraft was sold to Aeronaves Del Peru as OB-R1205 in 1980 and was eventually broken up at Lima in January 1986 Caz Caswell



had hardly started preparing its bid!

Having missed the boat Douglas decided to press on with the project, by now dubbed the DC-8. Discussions with the airlines, who were now the type's only potential customer, resulted in the fuselage being widened by 15in to allow six-abreast seating and this in turn led to a general increase in dimensions throughout the airframe.

Launched

The Douglas DC-8 was formally launched in July 1955 and four versions were initially made available – all with the same dimensions but varying in fuel capacity, engines and capacity/maximum weight. The maiden flight was planned for December 1957 and entry into revenue service was proposed as 1959.

At the same time, rival company Lockheed chose to snub the jetliner market and created the turboprop-powered L-188 Electra and orders were flooding in. Meanwhile, the Comet remained grounded due to a series of fatal accidents and many airlines showed reticence towards jetliners of any breed. The jets were felt to be untried, expensive and overly technical, but Douglas knew

that as soon as one large airline made the jump, their competitors would have no choice but to follow suit.

Order book

The stalemate continued until October 1955 when Pan American Airlines placed simultaneous orders for 20 Boeing 707s and 25 Douglas DC-8s.

From then on, as Donald Douglas predicted, the orders flooded in with Eastern, KLM, JAL, National, SAS and United all ordering the DC-8. The following year saw 22 more DC-8s sold to Delta, Swissair, TAI, Trans Canada and UAT and by the

“Douglas began work on its jetliner in earnest”

beginning of 1958, some 133 DC-8s had been sold (compared to 150 Boeing 707s).

Douglas had planned to build the new jet at its Santa Monica factory in California, requiring a runway extension. But when the neighbours complained and planning permission was refused, Douglas moved its production line 30 miles to Long Beach Airport.

First flight

It was here that the first DC-8 (N8008D) was rolled out on April 9, 1958. The aircraft (a DC-8-10 variant) performed its maiden two-hour flight on May 30 with AG Heimerdinger at the controls.

Boeing delivered its first 707 in August of that year and Douglas did everything it could to close the gap. Using ten aircraft for the DC-8 flight-test programme meant the type received FAA certification in August 1959.

During the certification process the DC-8 underwent a variety of modifications, including the replacement of the original fuselage-mounted air brakes with engine thrust reversers. The aircraft was also found to be 25kts slower than expected so new wingtips and wing leading edges were designed to reduce drag.

Revenue operations were started on September 18 by Delta Air Lines (with a flight between Atlanta and New York) and, later that day, by United Air Lines between San Francisco and New York. Next came domestic operations by Eastern Air Lines (first for the Series 21) on January 19, 1960. International operations were initiated by Pan American on March 27, 1960 between New York and Bermuda and, on April 27, between New York and London (17 months after Pan Am had begun 707 transatlantic services). The first foreign DC-8 operator was Trans-Canada Air Lines (on the Montreal-Toronto-Vancouver route, commencing on April 1, 1960) with KLM becoming the first foreign DC-8 operator across the Atlantic (starting its

Amsterdam-New York service on April 16).

By March 1960 Douglas was producing eight aircraft a month to meet demand. Performance was certainly sprightly and on August 21, 1961 DC-8 CF-CPG broke the sound barrier and reached Mach 1.012 for 16 seconds in a controlled dive. In doing so it became the first civilian jet – and the first jet airliner – to make a supersonic flight.

Inadaptable

Whereas Boeing's 707 was available with several fuselage lengths and two wingspans to meet customers' specific needs, the DC-8 was steadfastly available only in one size. This made the aircraft less adaptable than its rival and soon airlines began to look elsewhere. As such, sales fell to just 26 airframes in 1962 and 14 by 1964.

Nevertheless, Douglas stuck to its guns until 1965, when it finally announced a series of three new models known variously as the 'Super Sixties' and the 'Stretched Eights'. With the ability to seat 269 passengers, the DC-8-61 and 63 had the largest passenger-carrying capacity of its era (until the Boeing



Douglas eventually relented and agreed to stretch the DC-8, thus producing the 'Stretched Eights'. Among these was DC-8-61 N8088U operated by United. It later became N825BX with Air Transport International and was scrapped in 2014 PRMAVIA Collection



Braniff International's DC-8-51 N812BN taxis out past Air Canada examples at a snowy Toronto on December 10, 1976. The aircraft had been built for National Airlines in 1962 as N875C but transferred to Braniff in 1973. In 1980 it was converted to a freighter for ARCA Colombia and became HK-2587X. It was eventually sold to Skymaster Airlines in Brazil as PR-SKY but was withdrawn from use in 1988 and scrapped at Miami by 2001 Caz Caswell

747 arrived in 1970). Douglas's new aircraft revitalised DC-8 sales and United Air Lines became the launch customer when it placed an initial order for five DC-8-61s in April 1965. The DC-8-61 was placed into revenue service by United on February 25, 1967 between Los Angeles and Honolulu. A total of 78 DC-8-61s were built in Long Beach for delivery to Air Canada, Delta, Eastern, Japan Air Lines, National, and United.

'Diesel Eight'

The early generation of jets were notoriously loud and smoky and the DC-8 soon acquired the 'Diesel Eight' moniker because of its long smoke trails. However, as early as 1966 the New York Port Authority was expressing concern about the noise to be expected from the yet to be built DC-8-61 and airlines were forced to operate it from New York at lower weights to reduce the impact.

Increasing traffic densities and the public's increasingly negative attitude to jet noise would eventually restrict the DC-8 from many airports around the world. A number of third parties developed aftermarket 'hushkits' but McDonnell Douglas (which had

been created when Douglas and McDonnell aircraft merged in 1967) would eventually go on to create the DC-8-71, 72 and 73 variants in the early 1980s – these effectively being 'Super Sixties' that had had their familiar JT3D turbojets replaced with quieter and more fuel-efficient CFM56-2 high-bypass turbofans.

All three models were certified in 1982 and a total of 110 60-Series DC-8s were converted by the time the programme ended in 1988. The so-called 'Super Seventies' were 70% quieter than their predecessors and, at the time of their introduction, were the world's quietest four-engined airliners.

Survivors

As the DC-8 was retired from passenger service, many were snapped up by cargo operators. However, following UPS's retirement of the type in 2009, the DC-8 is an increasingly rare aeroplane in the world's skies today and as a result of aging airframes, increasing operating costs and strict noise and emissions regulations, the number of active DC-8s continues to decline. It is thought just 15 are still flying when these words were written.



DC-8-51 XA-SIA was built for Aeronaves de Mexico in 1966 but served Aeromexico from 1972 until 1990 and is seen here visiting Toronto in August 1985. It later passed to Zuliana de Aviacion in Venezuela as YV-599C in 1992 but was broken up just seven years later Robbie Shaw

Convair's Skylark

Meanwhile, as Boeing and Douglas had been going head-to-head to woo customers around the globe, other manufacturers had been quietly working on their own aircraft.

One such company was San Diego, California-based Convair, which had been formed following the merger of Consolidated and Vultee. Convair created its CV-880 as a smaller and faster rival to both the 707 and the DC-8.

Convair had already produced a series of piston-powered airlines (including the CV-240, 340 and 440) and the first turboprop-powered conversion (the CV-540) had flown in 1955. However, with other manufacturers exploring jet technology, the Convair executives were keen to not be left behind and in April 1956 development of a new jetliner got underway. Initially named the Skylark, this was subsequently changed to the Golden Arrow and then the Convair 600 before the company finally settled on the CV-880 name. The latter two names were derived from the aircraft's projected top speed of 600mph or 880ft/sec.



DC-8-63 CF-CPS operating in CP Air's Skybus/Aerobus colours at Toronto in September 1980. The jet served CP Air until it transferred to Air Transport International in 1990 and was converted to a freighter as N782AL. On February 16, 1995 it was lost in a fatal accident at Kansas City Airport after the crew lost directional control while attempting to take-off with one engine inoperative Caz Caswell



Prior to merging with Flying Tigers, Seaboard World Airlines operated no fewer than 32 DC-8 convertible freighters including N8631, which was delivered new in 1961. The 'Stretched Eight' later passed to Icelandair as TF-FLB and eventually to UPS McDonnell Douglas



Delta Airlines CV-880 N8807E clearly shows the amount of smoke produced by the 1950s-era of jet airliners! This aircraft was written off at Chicago on December 20, 1972 when it collided with a North Central Douglas DC-9 (N954N) in thick fog. Luckily there were no fatalities among the passengers or crew



Northeast took delivery of CV-880 N8483H in November 1960 and just four days after its maiden flight, it set a speed record of 4 hours and 17 minutes from San Diego, California to Boston, Massachusetts. In August 29, 1963 it was sold to TWA where it was registered as N817TW and flew until 1974 when it was retired. Today its nose is preserved at Mojave Airport, California

Experience

Convair's design ethos was to create a medium-range jet that was faster than its rivals and the company already had experience in the field. Better known as a manufacturer of military aircraft, Convair's first foray into jet aircraft had come in 1948 when it produced the delta-winged XF-92 experimental aircraft. Four years later it had produced a single jet-powered version of its B-36 bomber (dubbed the YB-60) and this skillset meant it had a head start over its rivals.

It was YB-60 that first drew the attention of aviation tycoon Howard Hughes to the Convair jetliner project. Hughes, who owned Trans-World Airways, had once been confident that TWA's Lockheed Super Constellations would remain the fastest and most comfortable airliners in service but by the early-1950s he was adamant that TWA needed to enter the jet age.

Hughes saw the YB-60 as an ideal aircraft to convert to a jetliner, yet even Convair told him the aircraft was hapless. However, with a potential order from Hughes/TWA, Convair pressed on with the CV-880 programme. In April 1956, it disclosed that it had orders in hand from TWA and Delta, for 30 and ten airframes, respectively.

Development

The new aircraft would be powered by four 11,650lb/thrust General Electric CJ-805-3B

turbojets – the non-afterburning versions of the military J79, which powered many military aircraft of the period, including Convair's own B-58 Hustler delta-winged bomber.

The CV-880's fuselage was narrower than both the 707 and DC-8 and in standard configuration it would seat 110 passengers in five-abreast seating.

The 120ft span wing was swept back at 35 degrees and included a double-skinned leading edge to provide an anti-icing hot air duct. The wing was also fitted with upper-surface spoilers and double slotted trailing edge flaps.

Among the most unusual optional items offered to potential operators was a pair of 300,000-candle power flares mounted in the tailcone that could be released under parachutes in the event of a water ditching.

There was to be no official 'prototype', with the first CV-880 (N801TW) being the first 'production' aircraft. Construction went well but after production had started the FAA mandated additional instrumentation. Rather than rip open the aircraft's interior to fit this, Convair's engineers merely added a hump on the top of the fuselage.

Maiden flight

N801TW was rolled out of the factory at Lindbergh Field, San Diego in late 1958 in a white and gold colour scheme. (A gold anodised finish had originally been planned but this was dropped when the



TWA's Howard Hughes saw the Convair YB-60 as an ideal aircraft to convert to a jetliner but the plan was flawed. Instead Convair created the CV-880 to meet his requirements. TWA and Delta were the launch customer for the new jet and N804TW joined TWA in November 1963 Tom Singfield Collection

Golden Arrow name was changed.)

Preparations continued over Christmas and N801TW was ready to perform its maiden flight by January 27, 1959 when test pilots Donald P. Germeraad and Phil Prophet began the rigorous, 14-month flight test programme.

Into service

The first CV-880 entered service with Delta Air Lines in May 1960. The Convair jetliner was also ordered by Cathay Pacific, Delta, Japan, Northeast, Swissair and VIASA as well as Trans World Airlines, which was the type's major operator.

It soon became obvious that the aircraft had phenomenal performance and on February 10, 1960, Delta Airlines' second Convair 880 set a transcontinental speed record on its delivery flight. It averaged almost 558kts flying from San Diego to Miami in 3hrs, 31 minutes and 54 seconds.

Limited appeal

Immediately it became apparent that the aircraft was a 'hot ship'. It landed faster than any of its competitors but powerful brakes meant it would stop in a relatively short space – unless the runway was wet, or there was a crosswind in which case the jet could be a handful. The aircraft was also limited in range.



Nationalist China's flag carrier Civil Air Transport (CAT) operated a single Convair 880-M. Registered as B-1008, the machine was dubbed the Flying Mandarin Palace. It is seen here at Hong Kong's Kai Tak Airport in 1966 Adrian M Balch Collection

It was also of limited appeal to airlines as the five-abreast seating was unattractive to passengers and the Boeing 720 variant of the original 707 could offer similar performance (albeit not quite so fast) at a fraction of the purchase cost. The General Electric engines also had higher fuel consumption than its rival's Pratt & Whitney JT3Cs.

Modifications

In an attempt to increase the aircraft's appeal, Convair produced the CV-880M version. This incorporated four leading edge slats per wing and Krueger leading edge flaps between the fuselage and inboard engines. It also had more engine thrust, increased fuel capacity and stronger landing gear. However not even this could generate sufficient interest in the aircraft.

Just 17 orders came for the 880M – from Alaska Airlines, Cathay Pacific, Japan Air Lines and VIASA, but purchase orders (for the 880 or 880M) from Scandinavian Airlines System (SAS), Swissair, Capital Airlines, Transcontinental SA and REAL were all eventually cancelled.

The CV-880 had, oddly, been designed for shorter range routes and reduced ground times in an era where long range was desirable and ground time was not a big issue.

As such the production line was shut down after just three years. Only 65 aircraft had been produced (compared to 1,010 Boeing 707s and 556 DC-8s) and Convair's parent company (General Dynamics) lost around \$185 million over the lifetime of the project.

The type had been all but retired from passenger flying by 1970 and of the eleven jets that were later converted to cargo aircraft only four ever flew for any length of time.

CV-990

In a last ditch to recover some of the money investigated in the project Convair launched the CV-990 in 1960 and the first example took to the skies on January 24, 1961.



The United States Navy purchased one CV-880 (BuNo 161572) which was modified as a tanker and is seen here refuelling the prototype Super Tomcat. Unofficially designated UC-880, the aircraft had originally been delivered to the FAA in August 1961 as N112 and was used to train FAA flight examiners. The Navy assigned it to the Naval Air Test Center, Patuxent River, and also employed it in Tomahawk cruise missile testing. The UC-880 was destroyed in a cargo hold explosion test at NAS Patuxent River, Maryland in 1995 US Navy

SPECIFICATION DOUGLAS DC-8-11



Crew	3
Seating Capacity	127-176
Length	150ft 6in (45.87m)
Height	43ft 3.5in (12.89m)
Wingspan	139ft 8in (42.58m)
Wing area	2,758sq ft (256.20m ²)
Empty Weight	122,700lb (55,655kg)
Max Take-Off Weight	265,000lb (120,202kg)
Max Cruise Speed	435kts (500mph / 805km/h)
Service Ceiling	48,000ft (14,630m)
Ferry Range	4,330 miles (6,965km)
Powerplant	Four P&W JT3C-6 turbojets (13,000lb/thrust each)
First Flight	May 30, 1958



Japan Air Lines CV-880-22M JA8023 was named Kaede and delivered in September, 1961. It was destroyed in a training accident at Iki Airport on February 27, 1965 when it was performing a "low pass" at 150ft and "descended fast and struck the runway" before catching fire. Miraculously, the crew survived

The aircraft – later dubbed the Coronado – was spawned by American Airlines' request for an aeroplane capable of nonstop coast-to-coast flights from New York to Los Angeles against the wind.

The aircraft was 10ft longer than its predecessor. However, despite this increase in length the jet could still only accommodate 121 passengers at most – whereas the 707 and DC-8 could carry a maximum of 189 and 179 respectively. Additionally, the 990's gross weight of 255,000lbs made it almost 20% heavier than the 880.

As such the CV-990 did not meet American Airlines' specifications and it reduced its order accordingly. It entered service with the airline in 1963 but its timetables show little or no difference in scheduled time between 707 and 990A flights and the airline began to dispose of its CV-990As in 1967.

Scandinavian Airlines also operated Coronados on its long-haul schedules to Tokyo and the Far East whereas Swissair purchased eight CV-990As from 1962 and

SPECIFICATION CONVAIR 880



Crew	3
Passengers	110
Length	129ft 4in (39.42m)
Height	36ft 4in (11.00m)
Wingspan	120ft 0in (36.58m)
Wing Area	2,000sq ft (185.80m ²)
Empty Weight	94,000lb (42,750kg)
Max Take-Off Weight	193,000lb (87,730kg)
Max Cruise Speed	535kts (610mph / 990km/h)
Service Ceiling	41,000ft (12,500m)
Ferry Range	3,385 miles (4,430km)
Powerplant	Four General Electric CJ805-3B turbofans (11,650lb/thrust each)
First Flight	January 27, 1959



It was Swissair who dubbed the CV-990 the Coronado, even though Convair had already produced a flying boat of the same name. HB-ICC is seen at Zurich in May 1975 shortly before it retired. Today it can be found at the Lucerne Traffic Museum

Caz Caswell Collection

operated them on routes to South America, West Africa, the Middle and Far East, as well as heavy-capacity European routes.

Other examples served with Varig and second hand airframes found homes with Air Afrique, Air Ceylon, Balair, El Al, Garuda, Ghana Airways and Costa Rican airline APSA but the operator with greatest longevity was the Spanish carrier Spantax, which acquired 14 aircraft and retired its last in 1987.

Once again, the CV-990 lost out to Boeing, whose 720 and 727 jets had eroded its niche by the early 1960s. By the time the assembly line shut down in 1963, only 37 CV-990s had been produced, bringing combined CV-880/990 production to just 102 airframes.

Despite being loved by crews and passengers alike, the Convair airliners would ultimately fail on economic grounds. They were the fastest airliners of their generation but perhaps Convair concentrated too much on speed and not enough on ease of handling, maintenance and economics? ●



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