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From the Left Hand Seat

EDITORIAL

By the time these words hit the shelf on December 19 the Christmas festivities should be well underway so I'm partaking in an early mince pie to get into the spirit!

In recent years the run-up to Christmas in the Jets household has traditionally begun with a visit to the Honourable Company of Air Pilots Trophies and Awards (T&A) Banquet at the Guildhall in London and then the Aviators Ball at Heathrow.

Heroism

This year was no exception (although Mrs B managed to double book herself for the T&A!) and once again both events left indelible memories.

At the T&A we shared the hall with some of the bravest and most talented aviators you are ever likely to meet. There were helicopter rescue stories that genuinely made the hairs on the back of your neck stand on end, but two 'jet' related awards really caught my attention.

For their safe handling of an in-flight emergency, Cathay Pacific Captain Malcolm Waters and First Officer David Hayhoe were awarded the Hugh Gordon-Burge Memorial Award.

Having flown from Surabaya in Indonesia, their Airbus A330 aircraft, with 322 passengers and crew on board, was making its descent into Hong Kong when contaminated fuel caused a double failure, leaving the aircraft with only idle power above the South China Sea for between three to four minutes.

After gliding from 8,000 to 5,000ft, the crew regained thrust in one engine then discovered on approach that the engine was jammed at 70% power, forcing them to land at over 215kts.

The aircraft stopped with just 309m of the 3,800m runway remaining, however with the brakes now at over 1,000°C there was a risk of the tyres exploding and rupturing the fuel tanks in the wings. Captain Waters therefore took the decision to evacuate the aircraft using inflatable slides. The subsequent investigation found the 24,400kg of fuel uploaded at Surabaya, had been contaminated with salt water.

Emergency evacuation

Meanwhile, the Honourable Company of Air Pilots committee also recognised the talent and determination of Flt Lt Tim Eddy from 99 Sqn. He was flying a C-17 Globemaster tasked with an emergency evacuation of civilians from Juba, South Sudan. Ten minutes from the airfield he was advised the runway was blocked by a crashed Boeing 737. Flying overhead, Flt Lt Eddy assessed that around 5,000ft of runway was useable. Cognisant of the danger but concerned for the civilians on the ground, Eddy calculated he could make a steep approach and land using maximum braking with the crashed Boeing 737 ahead of him. With great skill and professionalism he executed a flawless landing in the most testing of conditions.

Once on the ground, he faced a chaotic situation with security in the area degrading rapidly and it became clear that far more than the expected 45 civilians needed to be evacuated ahead of a security curfew closing the airfield. Taking off just as the airfield closed, the crew managed to evacuate 182 civilians, using all available seats and strapping more than 100 passengers to the floor.

Just 12 hours later Flt Lt Eddy and his crew were once again overhead Juba for another evacuation task that proved to be equally difficult. With no Air Traffic Control (ATC) service available and an unprecedented volume of landing aircraft, the risk of mid air collision was high. Deciding to conduct an approach without ATC clearance, through the areas of lowest traffic density, the C-17 was forced to break off two approaches due to conflicting airborne traffic. Undeterred, the crew tried again, landing on the third attempt and subsequently evacuating another 93 civilians. Flt Lt Eddy's exceptional judgement, dogged determination and outstanding service in the air led directly to the safe evacuation of 275 civilians from South Sudan.

Fund raiser

The T&A is a delightful event but a month or so later the seventh annual Aviators Ball gave attendees a chance to let their hair down and party hard at the end of the season.

The Ball raises funds for the Aerobility charity, which uses the challenges of flight and exposure to aviation as a tool for improving the lives of those with disability. Whatever the age or whatever the disability, be it physical, learning or mental, or an injury acquired in conflict – Aerobility gives everyone the chance to fly and participate in aviation-related activities. During the evening I listened to the stories of many people who have been helped by the charity – and it was genuinely moving.

The entire Red Arrows team was in attendance this year, along with a mix of military, civil and private pilots as well as aviation enthusiasts and celebrities including impressionist Jon Culshaw. Auction prizes included a flight in a Hawker Hunter and a Zero G experience in the USA, and the entire evening raised more than £55,000 for this most deserving cause. It was a brilliant night.

Season's greetings

In closing, it leaves me to wish you and your loved ones a very Merry Christmas and a successful 2015. The last year has certainly been eventful but it's been a pleasure sharing it with such friendly and loyal readers and colleagues. Here's to the next year – let's make it a good one!

Until next time
Blue Skies

Steve

Stephen Bridgewater
Editor



JETS PHOTO OF THE MONTH

A highlight of the Aviators Ball (see main editorial) was the first 'appearance' by the 2015 RAF Aerobatic team, the Red Arrows. Ahead of the Aerobility charity auction, impressionist and comedian Jon Culshaw introduced the team which will be led by Sqn Ldr David 'Monty' Montenegro. He returns to the Red Arrows having previously been a member between 2009-2011. The 2015 team will comprise Sqn Ldr David Montenegro (Red 1), Flt Lt Michael Bowden (Red 2), Flt Lt Emmet Cox (Red 3), Flt Lt Stew Campbell (Red 4), Flt Lt Thomas Bould (Red 5), Flt Lt Mark Lawson (Red 6 and Synchro Leader), Flt Lt Steve Morris (Red 7 and Synchro Two), Flt Lt Olly Parr (Red 8) and Flt Lt Joe Hourston (Red 9 & Executive Officer). Once again they'll be ably assisted by Sqn Ldr Mike Ling (Red 10 and commentator).



www.jetismag.co.uk

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Lessons learned while fighting U-boats during World War Two meant Anti-Submarine Warfare became a post-war priority. Sebastian Morgan compares and contrasts two approaches to the challenge



Front Cover Babak Taghvaei Collection

Jet Noise

Lightning Saved



English Electric Lightning F3 XR713 has been saved from the scrap man after being acquired by the Lightning Preservation Group (LPG). The aircraft, which had previously been preserved at RAF Leuchars in Fife and wears the markings of 111 Sqn was put up for disposal after plans were announced to close the Scottish air base. LPG is now raising funds for the dismantling and transportation of the fighter to its new home at Bruntingthorpe, Leics. Readers can donate via www.lightnings.org.uk with additional funds needed to restore and provide an undercover home for the Lightning.

XR713 in her Hardened Aircraft Shelter at RAF Leuchars. She will soon be on the way to a new home at Bruntingthorpe



via LPG

FIRST DUTCH F-35 SQUADRON

The Royal Netherlands Air Force (RNLAf) created its first Lockheed F-35 Lightning II squadron at Eglin AFB, Florida, on November 4. Now forming on the F-35A, 323 Sqn has a long Lockheed heritage having flown the F-104 Starfighter from 1964 to 1981 when it converted onto the Lockheed Martin F-16. It will be the RNLAf's F-35 Operational Test and Evaluation squadron. The first of 37 F-35As is scheduled for delivery to the Netherlands in 2019. Meanwhile, the Norwegian government has asked for budget authorisations for a total value of 6.9 billion Kroner for the acquisition of six new F-35s – bringing the Norwegian fleet to 22 aircraft



Liz Kaszynski/Lockheed Martin

Were you at Wattisham?

The Wattisham Station Heritage Museum is in the early process of making a documentary film recording stories from people with connections to RAF Wattisham. The team is hoping to contact military and civilian personnel with a story to tell. Included in the aircraft based at Wattisham were Gloster Meteors (257, 263 and 152 Sqn), Hawker Hunters (111, 263, and 257 Sqn), Gloster Javelins (41 Sqn), English Electric Lightnings (29, 56 and 111 Sqn) and McDonnell Douglas Phantoms (23, 56 and 74 Sqn). Interested parties should contact Ken Hayward at chilton.lodge@btopenworld.com

BATIK'S NEW BUS

On November 12 Indonesia's Lion Group celebrated the delivery of its first three Airbus aircraft at a special ceremony in Toulouse. The aircraft are the first from a March 2013 order for 234 A320 Family aircraft, comprising 109 A320neo, 65 A321neo and 60 A320ceo. The initial batch of A320s are set to join the fleet of the group's full service subsidiary, Batik Air, flying on domestic and regional services



Airbus

KLM RETIRES MD-11

On October 26 KLM Royal Dutch Airlines retired its MD-11 fleet from commercial service after a final flight from Montréal Trudeau to Amsterdam. Aircraft PH-KCE operated the final KL671 service and on November 11 it was joined by the airline's other two remaining MD-11s (PH-KCB and PH-KCD) to operate three final farewell flights for enthusiasts. The aircraft will now be scrapped



KLM

The Latest News from the World of Jets

SECOND 727 FOR 2EXCEL

2Excel Aviation is set to receive a second Boeing 727 at its base at Doncaster/Sheffield Airport. It already operates G-OSRA on oil spill response operations, but an ex-FedEx 727-200F will soon join it for use on cargo charter flights to locations around the world under the Anglo World Cargo brand. Anglo World Cargo also operates the cargo terminal at Doncaster/Sheffield Airport

Steve Bridgewater



PROWLER RETIRED

The US Navy's last Grumman EA-6B Prowler made its final landing on November 14 when aircraft from squadron VAQ-134 landed back at NAS Whidbey Island after departing the carrier USS George HW Bush for the last time. In the twilight of its career, the squadron's Prowlers completed 104 combat missions over Afghanistan and were called upon to support operations against ISIS, flying another 109 combat missions

US Navy



QATAR'S FIRST A350 TAKES FLIGHT

On October 16, Qatar Airways' first A350-900 completed its maiden flight. This will become the first A350 to be delivered to a customer when it joins the airline just prior to Christmas. The airline has 80 A350s on order, including 43 A350-900 and 37 of the larger A350-1000 models

Airbus



EMIRATES' 100TH 777-300ER

Emirates, the world's largest Boeing 777 operator, received its 100th 777-300ER on October 29 – pictured here departing Paine Field, Washington. With this delivery, Emirates will have 142 777s in operation and still has a backlog of 204 Boeing 777s (including 51 777-300ERs) on order

Boeing



Saab



GRIPEN FOR ARGENTINA?

Although Argentina's Defence Minister Agustin Rossi announced on October 21 that his government would purchase 24 new Saab JAS 39 Gripen E fighters, it is thought that the British government will easily veto the plan. As the Gripen contains a substantial amount of British-built components, it is thought that the Argentine desire to buy the fighter will be impossible. Meanwhile, Brazil has confirmed an order for 36 Gripen E jets valued at US \$150 million each

MILLIONTH BA A380 PASSENGER

On November 15, British Airways carried its millionth Airbus A380 passenger. The unnamed passenger flew on BA268 from Los Angeles to London – the destination the airline's superjumbo flew to on its inaugural flight on September 24, 2013. The airline now has eight of the twelve A380s due to join the fleet flying between Heathrow and Los Angeles, Hong Kong, Johannesburg, Cape Town, Singapore and Washington. In April the superjumbos will begin flying to San Francisco, followed by Miami in October

British Airways



Pacific Aviation Museum

North American F-100F Super Sabre 58-1232 has been restored in memory of Vietnam War veteran 'Misty' pilots

Super Sabre Dedicated

The Pacific Aviation Museum at Pearl Harbor, Hawaii has dedicated its newly restored North American F-100F Super Sabre (58-1232) to the memory of Vietnam War veteran 'Misty' pilots.

Founded in 1967, a group of highly experienced volunteer fighter pilots were brought together in South Vietnam to form a Top Secret squadron. Their mission was to act as forward air controllers (FAC) and fly fast and low over the Ho Chi Minh Trail in North Vietnam and Laos, armed with only their cannons and marking rockets. When they located enemy supplies and equipment, they marked it and directed bombing strikes.

These crews were given the 'Misty' callsign, and on October 30 a number of 'Misty' veterans visited Hawaii to help dedicate the F-100F to the memory of Col 'Bud' Day (Misty 1) and Col 'Lacy' Veatch (Misty 93) – the latter a Hawaiian resident.

Jet Noise

Bye-bye Little Red

Virgin Atlantic has announced its intention to cease its Little Red operation next year. Its daily services between London Heathrow and Manchester will continue until the end of March 2015, while its flights between London Heathrow and Edinburgh and Aberdeen will continue throughout summer 2015 with the final flights in September 2015.

Since it was launched in 2013 Little Red has flown more than a million passengers between London, Scotland and Manchester and bookings initially grew steadily. However the demand has been predominantly from point-to-point customers rather than connecting traffic and a high level of connections onto Virgin Atlantic's long haul network was always important to the success of Little Red.

Sir Richard Branson said: "When the competition authorities allowed British Airways to take over British Midland and all of its slots, we feared there was little we



According to Virgin, Little Red was launched in March 2013 "as an attempt to reintroduce consumer choice on key domestic services after British Airways' takeover of bmi gifted them a monopoly on these routes"

could do to challenge BA's huge domestic and European network built through decades of dominance. To remedy this, we were offered a meagre package of slots with a number of constraints on how to

use them and we decided to lease a few planes on a short-term basis to give it our best shot. The odds were stacked against us and sadly we just couldn't attract enough corporate business on these routes."

SpaceShipTwo Lost

Tragedy struck the Virgin Galactic project when the prototype Scaled Composites SpaceShipTwo was destroyed in a fatal accident on October 31.

The aircraft was undertaking a test flight over the Mojave Desert when it broke up at high speed. The co-pilot was killed and the pilot seriously injured after being ejected from

the aircraft at high altitude. NTSB accident investigators reported: "According to the pilot, he was unaware that the feather system had been unlocked early by the co-pilot. His description of the vehicle motion was consistent with other data sources in the investigation. He stated that he was extracted from the vehicle as a result of the break-up sequence and unbuckled from his seat at some point before the parachute deployed automatically."

VIRGIN DREAMLINER

Virgin Atlantic took delivery of its first Boeing 787-9 Dreamliner on October 10 when G-VNEW arrived at Gatwick. The aeroplane, named *Birthday Girl* in reference to the UK carrier's 30th anniversary, is the first of 16 on order from Boeing. The aircraft entered service on Virgin's flights to Boston from October 28 and a second example is scheduled to arrive in December. The type will ultimately serve routes to Washington Dulles, Newark and New York JFK. G-VNEW is seen here conducting training at Nottingham East Midlands Airport on October 18.



MRJ UNVEILED

The Mitsubishi Regional Jet (MRJ) was unveiled in mid-October and is billed as the first all-Japanese airliner since the YS-11 took to the skies in the 1960s. The MRJ is a family of 70-90-seat next-generation airliners featuring Pratt & Whitney's new PurePower engines and state-of-the-art aerodynamics to drastically reduce fuel consumption, noise, and emissions. It is intended for shorter flights linking urban hubs with smaller cities and the aircraft has been developed in collaboration with Boeing. The first flight is anticipated early in 2015.

The Latest News from the World of Jets

Grant for Bristol Museum

Fundraising for the proposed £16m Bristol Aerospace Centre received a boost on November 18 thanks to a grant of half a million pounds from Viridor Credits.

The centre, which is due to open in Spring 2017 on a nine-acre site at the former Filton airfield, will focus on the various aircraft constructed by the Bristol Aircraft Corporation (BAC). The donation will be used to restore a Great War-era, Grade II listed hangar to house aircraft from the 1900s to Concorde.

"Bristol's contribution to 100 years of world aviation will be demonstrated here, telling the stories of the people who made history with world-leading design and technology, inspiring future generations of engineers," said John Lockwood, CEO of Viridor Credits, himself a former BAC employee.

Starfighter Almost Ready

'Project 637' came a step closer to reality on October 20 when the team restoring former Norwegian Air Force Lockheed CF-104D Starfighter 4637 to flying condition successfully lit the jet's afterburner for the first time.

Project leader Helge Andreassen was at the controls of the two-seat Starfighter for the run Bodø Air Base. The aircraft performed

impeccably during the ensuing fast taxi run and a first flight is planned in the near future.

This Starfighter began life with the Royal Canadian Air Force in 1962 (flying as 104637) and joined the Norwegian Air Force in May 1973. It was eventually retired and placed on display at the Bodø Air Museum but passed into the hands of the Friends of the Starfighter group in 2003. At the time of writing, the team hopes to fly the jet – now registered LN-STF – before the end of 2014.



F-104 Starfighter LN-STF is one step closer to flying after successful afterburner tests were conducted in October

TEN 737S FOR KUMMING

China's Kunming Airlines has placed a firm order for ten Boeing 737s, including four Next-Generation 737-700s and six 737 MAX aeroplanes. The commitment, valued at \$897 million, is subject to the approval of the Chinese government. The carrier currently serves more than 25 cities across China by operating a fleet of ten 737-700s and five 737-800s



Jamie Ewan

RAF'S FIRST ATLAS

The RAF took delivery of its first Airbus Military A400M Atlas on November 17 when aircraft ZM400 arrived at RAF Brize Norton (seen here). The aircraft is the first of 22 on order for the RAF and two more are expected to be delivered before the end of the year. The RAF's second A400M had earlier performed its maiden flight on October 31 and the first of 53 examples for the German Air Force took to the skies on October 14

NEWS IN BRIEF

Jersey-based Blue Islands is to suspend its Jersey to Southampton service following the sale of its final two BAe Jetstream 32s on November 16. The airline continues to operate a fleet of ATR airliners on flights to the UK, France, Guernsey, the Netherlands and Switzerland

Organisers of the RAF Cosford Air Show have announced that the 2015 event, to be held on Sunday June 14, will be an advance ticket only event. The change in policy comes as part of an effort to improve traffic flow and access to the site. Tickets are on sale now at www.cosfordairshow.co.uk, priced at £22, with free entry for accompanied under-16s. In the last two years alone, the air show has raised over £500,000 for charity

Humbly Grove-based Links Air has been awarded a four-year contract to operate Cardiff to Anglesey flights on behalf of the Welsh local government. The new contract will see a twice daily return flight being operated and replaces services previously operated by Citywing

British Prime Minister David Cameron MP has announced that the RAF's II Sqn will no longer be disbanded and that its 16 Tornado GR.4s will help with air strikes in Iraq. The squadron was due to be stood down in March as Britain withdraws from operations in Afghanistan

Leeds Bradford-based Jet2 is to lease an Airbus A330 from AirAsia X for the summer 2015 season. The aircraft – believed to be 9MXXM – will be predominantly based at Manchester and will be the carrier's first widebody aircraft

In response to the Icelandic volcanic eruption in 2010 which caused widespread flight disruption to travellers, scientists at the Met Office and Natural Environment Research Council (NERC) have developed a prototype ash detection device, capable of detecting small amounts of ash in the atmosphere. The device has been fitted on a British Airways 747 and will fly on long-haul routes around the world for a year, collecting data for analysis

Delta Air Lines has placed a firm order for 50 new Airbus widebody aircraft. The deal consists of 25 A350-900 and 25 A330-900neo aircraft. Rolls-Royce Trent 7000 engines will power the Airbus A330neo aircraft and Trent XWB engines will power Airbus A350 XWBs

Boeing is predicting that air cargo traffic will grow at an annual rate of 4.7% over the next 20 years, with global air freight traffic expected to more than double by 2033

Jet Noise

Sukhois Delivered

Sukhoi handed over a new batch of Su-34 frontline bombers to the Russian Ministry of Defence on October 15. The new bombers were delivered according to a 2012 contract for a large batch of Su-34s, which have a range of 2,500 miles and an 8-tonne payload.

Five days earlier the company also delivered a batch of Su-35 and Su-30M2 aircraft for the Russian Air Force at Komsomolsk-on-Amur and, according to Oleg Demchenko, head of Sukhoi's parent company Irkut, the manufacturer will deliver 30 fighter jets and 30 Yak-130 combat trainers to the Russian Armed Forces in 2015.



One of the distinctive Su-34 bombers is prepared for delivery to the Russian Air Force on October 15

X-37B BACK TO EARTH

On October 17, the unmanned Boeing X-37B Orbital Test Vehicle (OTV) successfully completed its third flight when it landed at Vandenberg AFB in California, concluding a 674-day test mission. The X-37B was launched from Cape Canaveral on December 11, 2012. According to Ken Torok, Boeing's director of Experimental Systems, the aircraft has flown 1,367 days in orbit in its first three missions – which is more days than all 135 Space Shuttle missions combined. The X-37B is being touted as an “affordable, responsive, unmanned, reusable space vehicle”



Dreamliner Museum Piece

Boeing donated one of the original 787-8 Dreamliner flight test aeroplanes to the Museum of Flight in Seattle on November 8. The aircraft is ZA003 – the third 787-8 produced – which circumnavigated the globe several times in 2011 and 2012, visiting 23 countries. It is the first of three flight test 787-8s Boeing plans to share with museums around the world.

“This revolutionary airplane caps the museum's collection of historic commercial airplanes, beginning with our 1932 Boeing 247, which was the first all-metal, modern airliner,” said Doug King, president and CEO, Museum of Flight. “It was followed by our 1969 prototype 747, the first jumbo jet, and now with the first composite airliner, the 787. It's an incredible addition to our comprehensive display.”

Several Boeing employees whose work played a role in the design, build and test of the 787 Dreamliner flew in the aeroplane to the museum, and when each disembarked they presented a special artefact tied to the history of the aircraft to museum volunteers and local school children. These ranged from a commemorative cachet carried aboard the 787's first flight to early artist renderings of the 7E7 and will now be housed at the museum.



Dreamliner ZA003 was donated to the Museum of Flight on November 8. Pictured here are museum visitors waiting to tour ZA003 shortly after it landed



QUICK DUCK START UP

On October 20, Slovakian start-up airline Quick Duck took delivery of its first aircraft. The ATR72-600 – OM-AQD – joined the airline direct from the Avions de Transport Régional factory at Toulouse Blagnac and is on lease from Singapore-based lessor Aviation. A second ATR72 is expected to join the airline in 2015



BA TO RETIRE 767S BY 2018

International Airlines Group (IAG) has announced that British Airways will phase out its entire fleet of 15 Boeing 767-300(ER) jets by 2018. The aircraft will be retired from long-haul sectors by 2016 to be replaced by Boeing 787 Dreamliners. The ageing 767s (and BA's 737-400 fleet) will also be replaced on short haul sectors by the A320 by 2018

The Latest News from the World of Jets

The RAF already operated four F-35Bs in the USA as development aircraft but the recent order will see 14 joining the RAF back in the UK

Lockheed Martin



British Lightning II Order

The UK Ministry of Defence (MoD) has signed a contract for the first production batch of four Lockheed F-35B Lightning II combat aircraft. The contract forms part of the MoD's investment over the next five years to procure an initial 14 aircraft.

Minister for Defence Equipment Support and Technology, Philip Dunne MP, said:

"Looking to the future, the investment we are making in the F-35 aircraft will ensure we are securing the skies for decades to come, providing the UK with the latest stealth technology and multi-role aircraft capability.

"Not only does our investment in these next generation aircraft afford us air superiority, but the UK's tier one status in the entire programme provides UK industry with a unique opportunity to produce world-leading products, technologies and manufacturing expertise for coming decades. The aircraft will be a powerful testament to the strength and capability of British industry."

Significant UK sub-contractors to the programme include BAE Systems, Cobham, GE Aviation, Honeywell, Martin Baker, MBDA, QinetiQ, Rolls Royce, Selex Galileo, Ultra Electronics & EDM Ltd.

The news comes as a UK test team has completed initial aircraft handling trials for ASRAAM and Paveway IV on the F-35B aircraft. Trial rounds, which are identical to the operational weapons, were tested for the first time during a series of flights from the US Navy's test facility at NAS Patuxent River in Maryland.

The UK has already taken delivery of three F-35B jets to date, which are based at Eglin AFB in Florida and an order was placed for a fourth UK aircraft in September 2013, which will be delivered early in 2016. These are for test and evaluation. The UK's first operational squadron will transition to RAF Marham in Norfolk in 2018, which will become their main operating base.

Braniff (and Eastern) Back!

Braniff International Airlines (1928) – the fourth attempted resurrection of the infamous Braniff name – is aiming to begin operations early in 2015. The subsidiary of Braniff Holdings Inc includes management drawn from last year's failed attempt to rejuvenate Pan American Airways. According to the new airline's business model it plans to provide services from the USA to domestic destinations in the Caribbean and Latin America, including casino travel packages.

Meanwhile, the new Eastern Air Lines is about to receive its first aircraft. The ex Kenya Airways B737-800 (5Y-KYB) is now N276EA and will be the first jet to join the Miami-based airline. The original Eastern Air Lines was formed in 1926 but ceased operations on January 19, 1991.

The original Braniff Airlines was launched in 1928, however, stiff competition brought on by the deregulation of the US airline industry forced it to cease operations in May 1982. Could it see a return in 2015?



MONARCH'S LAST BOEING

On November 15, Monarch Airlines retired its last three Boeing 757-200s (G-DAJB, G-MONJ and G-MONK) – leaving the British leisure carrier with an all-Airbus fleet of ten A320s, 27 A321s and two A330s. However, from 2018 the airline will begin phasing out its Airbuses and replace them with Boeing 737 MAX 8s

Neil Carlton



New CEO at RAFM

The Royal Air Force Museum has appointed Maggie Appleton MBE as its new Chief Executive Officer. Maggie has over 20 years' experience in the heritage sector and after beginning her heritage career at the Royal Armouries in the Tower of London, she focused her work in community museums at Stevenage and Luton.

Meanwhile the RAF Museum has announced a year on year double-digit growth in visitor numbers at both its London (Hendon) and Cosford sites between April and September. Visitor numbers for the museum's London site were up 69% on the same period last year; whilst visitor numbers at Cosford, excluding the Cosford Air Show, were up 20%.

HARRIER T.8 TO FLY

Former US Marine Corps pilot Art Nalls has added a second Harrier to his fleet of civilian jets. Already familiar as the owner/pilot of a former Royal Navy Sea Harrier FIA.2, Art has now acquired a two-seat Harrier T.8 in the UK and is in the process of shipping it to the USA. The new Harrier (ZD993) served both the RAF and the Royal Navy and it currently wears the gloss black colours it gained while flying with 899 NAS. Once it is certified, Art will be offering flight training in this unique aircraft, as well as providing airshow performances



via Art Nalls



A LIGHTNING DASH

On par with the Spitfire in terms of popularity, a select number of English Electric Lightnings have staved off extinction and continue to roar.

Jamie Ewan visits the protectors of two such jets and learns what it takes to keep a Lightning alive

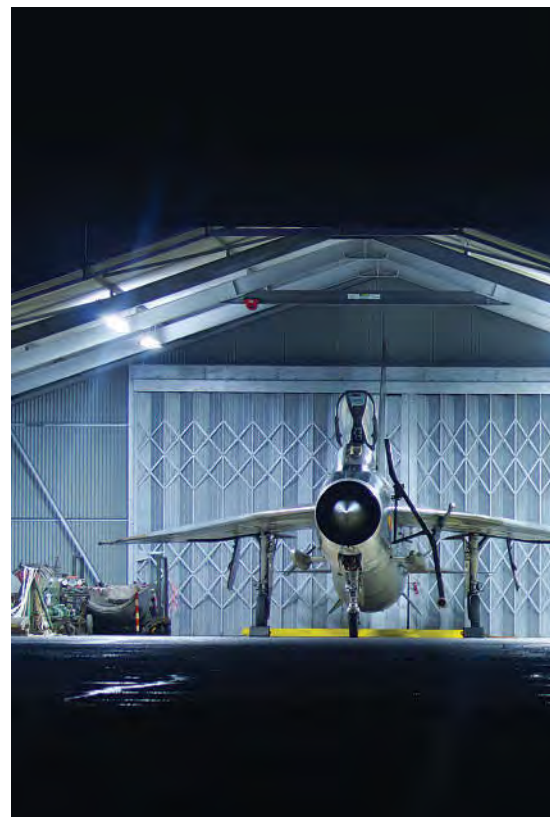
Prominently used by the RAF, the English Electric Lightning first flew (in P.1A form) on August 4, 1954 and entered service as the F.1 in December 1959. Culminating in the F.6, the type (still referred to as the 'Skyrocket') was operated by 12 squadrons in its 30-year career with the RAF – not bad for an aircraft expected to remain in service for maybe ten years at most!

A radical departure from the tried and tested designs of the time, the Lightning was the brainchild of WEW 'Teddy' Petter and was conceived to meet a specification issued by the Air Ministry in 1947 (Experimental

Requirement 103), becoming the only all-British Mach 2 fighter and the world's first aeroplane capable of supercruise.

Despite suffering from underdevelopment as well as a lack of both range and endurance, the type enjoyed limited export success and was employed by the Royal Saudi Air Force and the Kuwaiti Air Force, between 1967-1986 and 1968-1977, respectively.

Come retirement in the 1980s, the 337 Lightnings built survived extinction at the hand of the scrapman somewhat better than many other aircraft that served during the Cold War. Like the Spitfire, the Lightning holds a special place in the hearts and minds of those who



XR728 and XS904 return after another successful taxi run at Bruntingthorpe. XR728 has been resident at the Leicestershire airfield since 1988 and XS904 arrived in 1993

All Jamie Ewan



The taxi runs at Bruntingthorpe are phenomenally popular and help fund the aircraft's on-going survival



knew and admired her and this sentiment is just as strong today as it was 50 years ago. The type's popularity has seen a number of groups set up as guardians for Lightnings that escaped the smelter to preserve them in museums and private collections.

Protecting the protectors

One such group that has taken on the role of 'protecting the protectors' is the Lightning Preservation Group (LPG) based at Bruntingthorpe Airfield in Leicestershire. More than 20 years on from the last military flight by a Lightning, this band of Lightning fanatics, ex-Lightning Force members and dedicated aviation enthusiasts work tirelessly to keep the aircraft and atmosphere of the Cold War alive.

Formed with the objective of preserving a Lightning as a static exhibit, the LPG can trace its roots back to Crash Gate 2 at RAF Binbrook as the drawdown of the ultimate home-grown interceptor gathered pace.

At the time of its withdrawal from service

there appeared to be no known plans to preserve the Lightning and with that in mind the LPG pursued its dream of preserving one, preferably the shell of a spares recovered F.3 – the ultimate Lightning 'hot rod' – from the decoy line, in pristine condition.

However, a change in circumstances (more members and better finances) and a lot of behind the scenes work led to the group entering the Ministry of Defence (MoD) tender system and bidding for a 'live' F.6!

Soon after submitting the form, the LPG received word that its tender had been successful and the group was now the guardian of English Electric Lightning F.6 XR728/JS (sometimes known as 'Binbrook's Flagship') – the personal mount of Binbrook Station Commander Group Capt John Spencer! Thus beginning a new chapter in the Lightning's story and the UK preservation scene – the LPG now owned a 'live' Mach 2 interceptor!

Sacrilegious

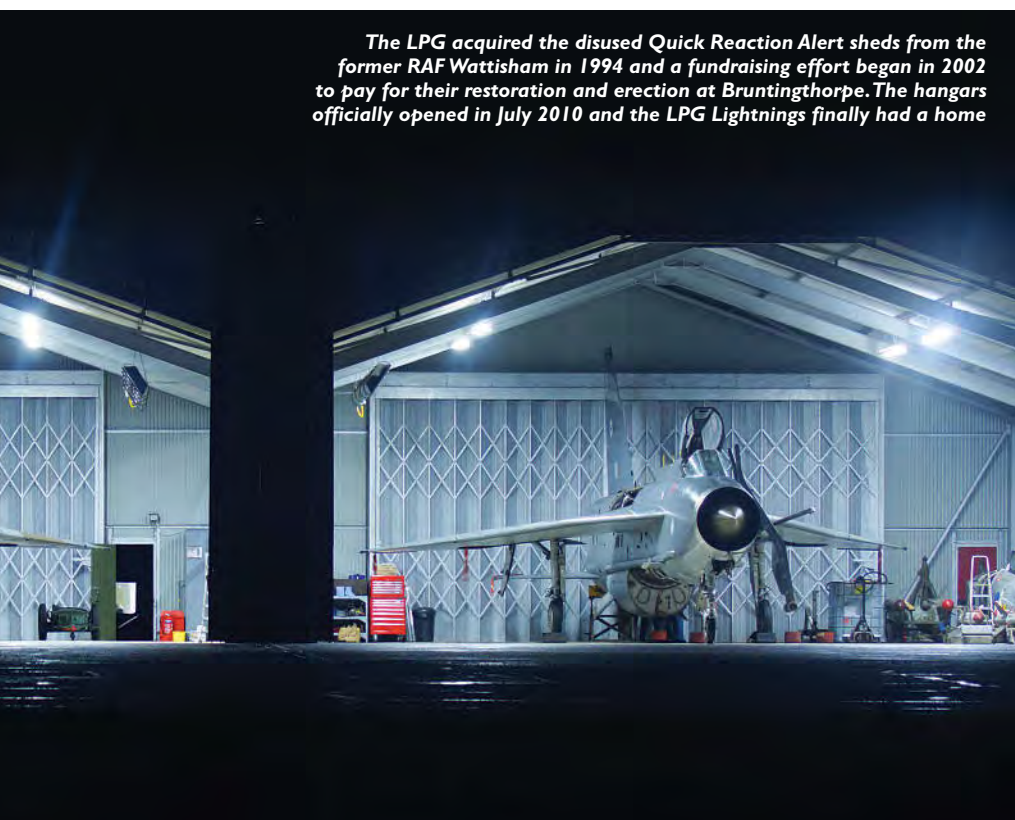
Arriving at Bruntingthorpe on June 24, 1988 in the hands of Flight Lieutenant Chris Berner-Price, the aircraft was destined to have her fuel tanks drilled to ensure there would be no further 'use' following delivery. Fortunately, the personnel tasked with this sacrilegious job were otherwise persuaded and the tanks were left intact.

With almost two miles of runway at Bruntingthorpe a decision was made to keep 'Juliet Sierra' serviceable in order to perform regular engine runs as well as slow and fast taxi runs. This was followed by static and rolling reheat runs in the hands of ex-RAF Lightning force personnel and before long the jet was taking part in bi-annual open days for the public.

One became two

Although the Lightning officially retired in 1988, British Aerospace had given a stay of execution to five Lightning F.6s which were flown as high speed targets during trials for the Tornado ADV's Foxhunter AI.24 radar.

The LPG acquired the disused Quick Reaction Alert sheds from the former RAF Wattisham in 1994 and a fundraising effort began in 2002 to pay for their restoration and erection at Bruntingthorpe. The hangars officially opened in July 2010 and the LPG Lightnings finally had a home



When the programme came to an end in 1992, the LPG again entered the tender system in hope of saving another Lightning from the scrapman.

Success soon followed and on January 21, 1993, XS904/BQ was delivered to Bruntingthorpe from BAe Warton by British Aerospace's deputy chief test pilot, Peter Ormer. As such 'Bravo Quebec' became the last of its type to grace British skies – skies it had mastered since infancy.

QRA

In 1994 the LPG's next major acquisition came in the shape of the disused Quick Reaction Alert (QRA) sheds from the former RAF Wattisham. Having secured these fantastic Cold War relics, the sheds were transported to Bruntingthorpe in kit form on six 40ft trailers. A fundraising effort was started in 2002 and the 'Q Sheds' were officially opened in July 2010 – having been stored in the open since their arrival, the LPG's Lightnings now had a home!

Now, more than 25 years after their first aircraft arrived, the LPG conduct around nine taxi runs per year, including three public open days. Additional runs can also be carried out to test any work completed on the jets.

"The LPG now owned its first 'live' Mach 2 interceptor!"

Sadly, due to Civilian Aviation Authority rulings, flying a Lightning in the UK is no longer approved, much to the dismay of avid fans of the aircraft. A rather dubious safety record while in service, the lack of a hydraulic back up and complex design authorities are all reasons cited by the CAA for its decision. Thankfully, through the work of groups such

as the LPG, enthusiasts can still see, hear and smell a live Lightning in the UK.

De-rated

Due to the very structured engineering plan that has been in place since delivery, both jets here at Bruntingthorpe are much as they were on delivery. However, two slight differences

come with the engines, which have been de-rated to 100% power (from the in-service 102.5%) and a 'No Slams' rule is in place.

Constantly aware that the age of the jets is creeping up, the team undertake a number of rolling inspections of various components. Conducted by the engineers, any work due/needed or completed is made note of in a

Above: XR728 during one of the popular night photographic events held at Bruntingthorpe. The aircraft was formerly the personal mount of Binbrook Station Commander Group Captain John Spencer

very detailed maintenance record for each jet. Other records include engine running time down to the minute, the number of starts carried out (820 authorised) and component life to aid a safe operation.

As with a number of preservation projects, spares are a constant issue, the majority of which quite rightly ended up at Thunder City in Cape Town to support its flyers.

The LPG engineering team therefore undertake the building and overhauling of many components that would have been 'off the shelf' when the aircraft was in service, developing new skills as a result.

Some of the required components are 'common' so can be obtained externally. For



With the power paralleled at 92% the brakes are released and the run begins

example, the team is currently overhauling a starter that requires a number of small seals that cost more than £40 each and come with a minimum order number of ten.

Ground work

Although the LPG Lightnings are firmly ground-bound, there is much to do in order to perform a safe ground run or fast taxi. Long before the pilot performs his walk-around (or 'Wing Counting Ceremony') the dedicated team of ground engineers go through the rigorous checks and replenishments needed for the run in question.

Using a system very similar to that which many of them learnt while serving across the Lightning Force, checklists are used to prepare the aircraft for start. In the RAF various checklists were used for Before Flight Checks, Quick Turn Rounds and After Flight Checks but adapted versions are used by the team depending on the type of run planned – be it 'static' or 'rolling'.

Checks cover some 40 or so points including removing the aircraft's covers and blanks, general external checks, oil, fuel and AVPIN (IsoPropyl Nitrate) replenishments as well as 'fail-safes' on the AVPIN starter systems for both engines. The latter were introduced due to the number of starter explosions when the type was in service and are completed with the igniters removed.

Other checks include inspecting the aircraft's tyres for wear or creep, the brakes for leaks or damage and ensuring the hydraulic accumulator skin gauges (eight in total) are all in limits.

Handover

With the paperwork complete and the aircraft prepared, it's time for the ground crew to hand the Lightning over to the pilot with a discussion to confirm status of the jet, with particular emphasis on any known engine or afterburner issues – all essential for a safe run.

If the jet will be conducting a taxi run (especially a high speed run, which is essentially a pre-determined rejected take-off), the runway is inspected to ensure it is clear of any FOD (Foreign Object Debris) or damage that may endanger the jet and pilot. With a large variety of users at Bruntingthorpe – both automotive and aviation related – this is a one of the most important parts of the run. Despite carrying out Non-Destructive Testing to the same regulations used in RAF service, the team are especially concerned about any tyre damage.

Final preparation

To ensure a safe run, the weather – in particular the wind strength, direction and headwind component – is assessed to determine the 'rejection' point. Any moisture on the surface is assessed due to its effect on braking – again a determining factor in the rejection point.



The cockpits of the LPG Lightnings remain unaltered since they were retired by the RAF



Power for the start comes from an auxiliary power unit



The No 2 engine reheat is lit during a static test run



Some jobs are more glamorous than others – the engine intake check being a perfect example!



Air brakes are checked during the pre-flight inspection as they're an essential part of slowing the Lightning after the rejected take-off



Despite carrying out Non-Destructive Testing to the same regulations used in RAF service, the team are especially concerned about any damage to the tyres which are highly pressurised



The two LPG Lightnings parade and pirouette for the spectators at the end of a fast taxi run



Both XR728 and XS904 (illustrated) are kept in live condition within the QRA shed

Although runs can be made as simulated 'scrambles' from the QRA Hangar, the aircraft are usually towed to the threshold along with fire cover – an extinguisher trolley and a fire truck/crew.

Upon completing the walk-round (often referred to as 'kicking the tyres and lighting the fires'), checks are made to ensure that panels are all secure, all blanks and safety flags are removed and that there are no leaks.

In the cockpit

Entering the cockpit is via an access ladder on the port side (a tight fit between the air-to-air refuelling probe extending out of the port wing and the bottom of the rear hinged clamshell canopy). The pilot is then greeted by the tight confines of a typical 1950s era cockpit dominated by the Martin Baker

Type 4BSC ejector seat. The cockpit features eleven panels and consoles brimming with dials, gauges, lights and switches.

With the ejector seat pins left in place (or 'safe for servicing'), the seat height and rudder pedals are adjusted and the pilot is strapped in securely – just in case!

While doing this, a number of essential emergency checks are run through. John Ward one of the LPG pilots explains, "I run through in my mind the essential actions in case of any emergency – engine fire, reheat fire, engine failure, tyre burst, brake failure, hydraulic failure, 'chute failure – better to rehearse them then, rather than when it's all going on! The runway at Bruntingthorpe has no overrun area, so in case of extreme emergency it would be best to steer the jet off onto the grass."

With reference to the Flight Reference

Cards, the aircraft is slowly brought to life. Selecting the battery, the voltage is checked (28 Volts), and a 'plug-in' signal given to the ground crew to apply external power. Now a swift left-to-right check is made, setting the numerous switches as required and noting the various indications. Both the INST (Instrument) and ENG (Engines) master switches are selected and both warning panels (standby and auxiliary or SWP & AWP) are tested. Both the fuel and power are checked to ensure they are adequate for the run – normally with 324 Imp Gal in each of the wing tanks.

QRA Scramble

In a Scramble situation, all the above checks would have been done when the jet was 'cocked' or placed on a state readiness.

Engine start for a QRA was straight

Taxiing with the canopy open is permitted below 65kts, dependent on headwind



forward. Once in the cockpit and confirmed cleared to start with the ground crew, the pilot would begin the start while strapping in. He would simply lift the 'scramble bar' (which selects the eleven switches needed all at once), turn 'Start Isolate' to on, set the throttle (HP Cock) to idle and push the No 1 start button for two seconds.

Outside the aircraft the air was filled with the scream of the AVPIN starter as IsoPropyl Nitrate ignited, releasing a gas which spun a small turbine which (through the use of a gearbox) turned the Avon engine up to start speed.

With the engine RPM beginning to wind up, quickly followed by the Jet Pipe Temperature (JPT), the pilot closely watched both to ensure they didn't rise too quickly. All being well the RPM settled around 36% while the JPT didn't climb above 800°C and sat at a maximum of 750°C at ground idle.

During a scramble, as soon as the pilot was happy that the JPT was below limits, the sequence was repeated for the No 2 engine, all the while keeping a wary eye on the fire warning lights.

Conventional start

Unlike a scramble launch, where only the bare essential checks can be conducted due to the time factor; a 'conventional' start sees the pilot's



In the time it takes just to glance at the nozzle indicators and a quick cross check of the airspeed indicator the speed is already screaming through 100kts!

Time to go!

The chocks are waved away and the throttles are paralleled before the power is brought up to 'max dry', giving 92% RPM. Looking down the runway through the three panelled windscreen, the brakes are released and the run begins.

The pilot then checks that the nozzles are closed and the JPT is showing a minimum of 650°C before rocking the throttles outboard and smoothly into maximum reheat. The

In just a few seconds the jet feels as if wants to lift off. Approaching the unstick speed (around 150kts), or at the predetermined rejection point, the power is chopped to idle, the airbrake selected out, the flaps are lowered and the drag 'chute streamed. Holding the stick back increases the pressure on the main wheels, creating better braking effectiveness and yet more drag. The reassuring tug from the 'chute tells the pilot he can relax a little and with gentle braking, the jet slows down comfortably within the remaining runway.

As John says: "That's the day's adrenaline fix taken care of... job done!" ●

"The canopy is closed and the Lightning is ready to run"

eyes darting around the cockpit to ensure everything is coming online as expected.

Checks include brake pressure (3,000psi +/- 100psi), services hydraulic pressure (3,000psi +/- 250psi) and ensuring the flaps and airbrakes operate correctly.

With both engines running they are set to 65% (no 1) and 50% (no 2) RPM, respectfully, before the canopy is closed and the Lightning is ready to run.

nozzles are now shown as fully open and the TTC (Top Temperature Control) lights up briefly, confirming a good afterburner light-up. If that wasn't enough of a confirmation, the jet leaps forward like a scalded cat!

The sheer power of the aircraft is so impressive that in the time it takes to glance at the nozzle indicators and a quick cross check of the airspeed indicator, the speed is already screaming through 100kts!

SPECIFICATION

ENGLISH ELECTRIC LIGHTNING F.6



Crew	1
Length	55ft 3in (16.80m)
Height	19ft 7in (5.97m)
Wingspan	34ft 10in (10.50m)
Wing area	474.5sq ft (44.08m ²)
Empty Weight	31,068lb (14,092kg)
Max Take-Off Weight	45,750lb (20,752kg)
Max Speed	1,130kts (1,300mph/2,100km/h/Mach 2.0)
Ferry Range	850 miles (1,370km)
Ceiling	70,000ft (21,336m)
Powerplant	Two Rolls-Royce Avon 301R turbojets (12,530lb/thrust each or 16,000lb/thrust each with reheat)
Armament	Two 30mm Aden cannon and two fuselage hard points for Firestreak or Red Top
First Flight	August 4, 1954 (P.1) April 17, 1964 (F.6)

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



Volunteer ground crew and engineers are the vital lifeblood for organisations such as the LPG

“A Wa



Andy Hay / www.flyingart.co.uk

nton Attack''

THE RAF'S FIRST COLD WAR LOSS

*That was how a furious Winston Churchill described the shooting down of an RAF Avro Lincoln B2 bomber by Soviet MiG-15 jet fighters in March 1953. But, over 60 years on, mystery still surrounds the tragic final flight of Lincoln RF531. **Steven Taylor** investigates*

On March 12, 1953 the Cold War suddenly turned very hot for the RAF. For it was on this day that Soviet fighters finally brought down a British aircraft, in an uneven contest between an ageing Avro Lincoln and a MiG-15 jet.

The first months of 1953 were a particularly tense time in the history of the undeclared conflict between the Soviet Union and the West. The nuclear arms race was at its most intense, the Korean War was still raging and the death of Stalin in early March had plunged the Kremlin into a leadership crisis. Meanwhile, the air forces of the West, primarily – but not exclusively – the USAF and RAF, were regularly conducting clandestine spy flights over Soviet territory, photographing sensitive military installations, testing response times of scrambled Soviet fighters and gathering electronic intelligence (ELINT), such as recording Russian radar emissions.

The Soviet Air Force reacted forcefully to these intrusions. In June 1952 a DC-3 of the Swedish Air Force, believed to be on a secret ELINT mission, was intercepted and shot down by a MiG-15 fighter over the Baltic, with the loss of all eight crewmen. Then, on March 10, 1953 a USAF F-84 Thunderjet was also shot down, again by a MiG fighter, this time after apparently breaching Czech airspace.

Nor were these incidents confined to military aircraft. On April 29, 1952 an Air France C-54 en route to West Berlin was badly damaged by two MiG-15s, necessitating an emergency landing at Tempelhof airport. It was later found to have been struck by no fewer than 89 cannon shells, though miraculously none of the passengers or crew were seriously injured.

Dire warning

It was against this backdrop of high tension in the skies over Central Europe that a 192 Sqn Avro Lincoln, attached to the

Central Gunnery School at RAF Leconfield in Yorkshire, set out on what was later described by the British government as a "routine flight" to West Germany.

Piloted by 29-year-old Flight Sergeant Peter Dunnell, the big four-engined aircraft was the second of two Lincolns to take part in a fighter affiliation sortie across north-west Europe that day, testing NATO's air defences. The first, flown by Flight Sergeant Denham, had already been subjected to aggressive buzzing by a pair of MiG-15s, even though it was flying within the British zone. The crew returned to Leconfield, shaken though unhurt. But the tense situation was about to escalate dramatically.

Two hours after Denham's Lincoln took off from Leconfield, Dunnell's aircraft (RF531), carrying a crew of seven – including Squadron Leader Harold Fitz, the newly appointed commander of 3 Sqn – set out, following the same route.

Whilst flying between Hamburg and West Berlin in Soviet-controlled East Germany, along the designated 20-mile wide air corridor allocated to British aircraft, RF531 apparently veered accidentally out of the air corridor and into East German airspace.

Two MiG-15s soon appeared and fired a

warning burst at the aircraft. Realising their mistake, the crew immediately changed course and headed back to the British zone. But one of the Soviet pilots followed up the warning shots by raking the lumbering Lincoln with cannon fire.

Mortally damaged, the burning Lincoln went into a spiral. Of the three crewmen who succeeded in bailing out of the stricken

"All seven men aboard the Lincoln perished"

aircraft, the parachute of one failed to deploy while the other two, according to the testimony of several German eyewitnesses on the ground, were shot in a firing pass by one of the MiG pilots whilst drifting helplessly down on their parachutes. The wreckage of the Lincoln was scattered over a wide area, much of it landing just inside the Soviet zone. All seven men aboard the Lincoln perished.

Political reaction

The downing of the Lincoln, apparently whilst legitimately flying within West German airspace, sparked a major political storm in Britain. In the House of Commons an incensed Winston Churchill condemned the Soviet action as "a wanton attack" and gave authorisation for British aircraft to open fire if they were again threatened by Soviet aircraft.

A bitter war of words between London and Moscow ensued, the Government immediately firing off a furious note of protest: "[The British Government] protests in the strongest possible terms against this deliberate act of aggression, involving the murder of British airmen." The note went on to call for "those responsible for the outrage [to] be punished."

This was followed by a statement in Parliament by Foreign Secretary Anthony Eden, who said, "Her Majesty's Government takes a grave view of this serious event. Deliberate and unprovoked attacks of this kind by what are supposed to be friendly forces can only be called barbaric."

Moscow responded by insisting that the

An Avro Lincoln B.1, similar to RF531, peels away from the camera. The Lincoln was developed from the wartime Lancaster and was the last piston-powered bomber to serve with the RAF



The Lincoln entered RAF service in 1945 and the last examples – five operated by 151 Sqn at RAF Watton – were finally retired on March 12, 1963

One of the MiGs allegedly strafed the open parachutes of those escaping the stricken Lincoln



A trio of Avro Lincolns captured aloft in a rare colour photograph



British aircraft was in Soviet airspace and that their pilots were forced to open fire only after they themselves had been fired on by the Lincoln's gunners.

"The Soviet planes demanded that the trespassing plane should follow them and land at the nearest airfield," read the Soviet statement. "The trespassing plane not only failed to submit to this lawful demand but opened fire on the Soviet planes. A Soviet plane was obliged to answer with a warning shot. The trespassing plane, however, continued firing. The Soviet planes were obliged to open fire in return after which the British aircraft began to lose height and fell south-west of Schwerin, on East German territory."

The truth

But Moscow's version of events was swiftly contradicted by the RAF, who pointed out that the Lincoln's guns were not loaded at the time and refuting Soviet claims that it had

"Moscow did issue an 'expression of regret'"

been flying in the Soviet zone when the MiGs attacked. Spent ammunition links from the MiG's guns recovered by RAF investigators within the British zone backed up that position.

However, in a statement in the House of Lords on March 17, 1953, Secretary of State for Air William Sidney did concede that the Lincoln had violated Soviet airspace during the course of its flight. "A study of the information now available indicates that the aircraft may, through a navigational error, have accidentally crossed into the Eastern Zone of

Germany at some point," he admitted.

"But," he went on, "the evidence of ground observers and the spent cannon shell links from the Russian fighters picked up in our Western Zone prove that the Russians repeatedly fired on the Lincoln and mercilessly destroyed it when it was actually west of, and within, the Allied zonal frontier. The wreck of the aircraft followed in its descent a track which caused it to fall just within the Russian Zone."

Thus it was actually over our zone when first and mortally fired on, and the lives of seven British airmen were callously taken for a navigational mistake in process of correction which could have been dealt with by the usual method of protest and inquiry."

Tragic exercise

There have long been rumours that the Lincoln – a type often used at the time by the RAF on ELINT flights – was possibly on an intelligence-gathering mission, perhaps testing Soviet air defences, when it was intercepted and shot down. But according to Intelligence historian Richard Aldrich this was probably not the case. "...The RAF Lincoln lost on March 12, 1953 was not directly involved in radio warfare or special duties," he stated. "It was merely on exercise, and wandered out of one of the defined twenty-mile air corridors over the Soviet Zone between West Germany and Berlin."

He adds, however, that "while the Lincoln had not been on an intelligence flight, its progress was being carefully tracked by a British SIGINT unit on the ground at RAF Scharfoldendorf in the British zone of Germany."

While refusing to accept full responsibility, Moscow did issue an 'expression of regret'



The Avro Lincoln operated with a crew of seven consisting of pilot, flight engineer/co-pilot, navigator, wireless operator, front gunner/bomb aimer, dorsal and rear gunners. All seven aboard RF531, including Squadron Leader Harold Fitz, the newly appointed commander of 3 Sqn, perished in the "wanton attack"

upon returning the bodies of the crew to RAF Celle. Six of the crew – Squadron Leader Fitz, Flight Lieutenant Stephen Wyles and Sergeants Ronald Stevens, George Long, William Mason and Kenneth Jones – were repatriated to the UK and buried with full military honours on March 19, 1953 in St Catherine's Churchyard, close to their base in Leconfield. The pilot, Peter Dunnell, was buried in Colton Churchyard, Norfolk.

But other RAF aircraft certainly were engaged in intelligence-gathering flights around – and indeed over – the Iron Curtain at the time. Just five months after the Lincoln shoot-down a Canberra of 540 Sqn was reportedly intercepted and slightly damaged by MiG fighters while apparently on a photo-reconnaissance mission over the Soviet Union.

Thankfully, however, never again would the RAF lose an aircraft to Soviet fighters over the Iron Curtain. ●



SUPER DROOPER

The Duxford Aviation Society's Concorde has emerged from a meticulous restoration and, as *Steve Bridgewater* reports, visitors are able to look down its nose once again!

Friday October 24 marked the eleventh anniversary of the last commercial Concorde flight, but it was also a much happier day for fans of the iconic supersonic transport (SST) as one of the most important survivors came back to life for the first time in many years.

Pre-production Concorde G-AXDN arrived at the Imperial War Museum at Duxford on August 8, 1977 in the hands of Brian Trubshaw and John Cochrane. Since then the aircraft has been impeccably maintained by members of the Duxford Aviation Society (DAS) although complex items such as the electric and hydraulic systems soon began to show their age.

Now, almost four decades after it arrived at Duxford, the SST has undergone a painstaking restoration programme and boasts fully functioning cockpit lightning once

again. The restoration programme has also focused on Concorde's famous droop nose.

An unusual problem

The unusual drooping nose was one of the most unusual and instantly recognisable aspects of the SST's design.

In order to break through the sound barrier and maintain supersonic flight Concorde needed to be extremely streamlined, with a very long pointed nose to reduce drag and improve aerodynamic efficiency. However, in order to provide enough lift for take-off or to create lift at slow speed during landing the large delta wing needed to fly at a very high angle of attack, thus giving the aeroplane a very nose high attitude.

At these high angles of attack the streamlined nose would mean the pilots could not see ahead, so a unique solution was found.

Engineers at Marshalls Aerospace at

Above: "Down she goes..." Although in service Concorde could droop their noses to 12.5 degrees, the pre-production G-AXDN could lower it to a full 17.5 degrees. Today the aircraft is the only Concorde in the UK to retain its drooping ability and the only one in the world to reach 17.5 degrees



"It was totally different to the normal subsonic experience. It was magical, beyond any words I can use." John Hutchinson on flying Concorde, October 24, 2014 Darren Harbar via IWM

Cambridge Airport realised that a 'drooping' nose could be configured differently during the various stages of flight. A heat resistant visor deployed to protect the nose from the aerodynamic loads and high temperatures at supersonic speeds, while the nose could be lowered in four stages for taxi, take-off, slow speed flight and landing.

The nose and visor mechanism is hydraulically controlled via a locking lever in the cockpit next to the first officer and a series of lights tell the crew which position the nose is in. A back up system is located on the

centre pedestal that allows the nose and visor to be lowered using an alternative hydraulic system if the original should fail. A manual 'uplock release' system also allowed the nose and visor to 'freefall' to the five-degree position should all the hydraulic systems fail!

Restoration

After a long-term restoration programme, the Duxford Aviation Society Concorde is now the only example in the UK with the ability to operate its nose mechanism. DAS Chairman, David Garside, takes up the story: "It is 37 years since Concorde G-AXDN was flown to IWM Duxford and since the hydraulic and electrical systems were last in operation. The restoration projects have required the servicing and overhaul of many intricate components and considerable patience and determination has been required over a two-year period to ensure their successful completion."

DAS has been fortunate to benefit from the help of Heritage Concorde, a group of ex-Concorde engineers and enthusiasts who generously gave their time and expertise to help complete this ambitious restoration project. Speaking at the special event held on October 24 to debut the restored capability Graham Cahill, projects co-ordinator and head of Heritage Concorde, said: "G-AXDN is one of the most important Concorde development aircraft; it was the fastest and was the first to be fitted with the clear glass visor that we see on all the following Concorde. It was a pioneer of the digital age, having the first digital computers ever fitted to a commercial aircraft, to control her intakes – one of the most important features of Concorde."

He continued: "We thought it was appropriate that it should therefore also be the first British Concorde to have a fully-operational nose since Concorde's retirement in 2003. Our team of ex-British Airways engineers have been working for many months with Duxford Aviation Society and Hydraulics Online Ltd to bring this project to a successful close."

Activation of the nose also required the installation of a pump to supply the hydraulic power. One was generously donated by Hydraulics Online, from Cheshire. Mark Tonks, Hydraulics Online's

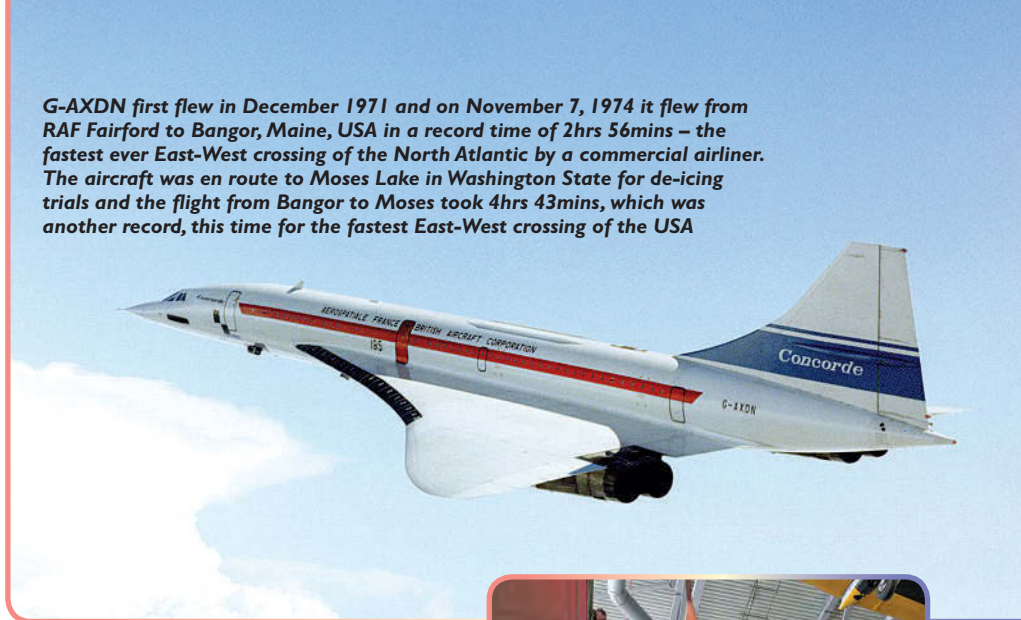
G-AXDN first flew in December 1971 and on November 7, 1974 it flew from RAF Fairford to Bangor, Maine, USA in a record time of 2hrs 56mins – the fastest ever East-West crossing of the North Atlantic by a commercial airliner. The aircraft was en route to Moses Lake in Washington State for de-icing trials and the flight from Bangor to Moses took 4hrs 43mins, which was another record, this time for the fastest East-West crossing of the USA

managing director, said: "We were absolutely thrilled when the Heritage Concorde team approached us for our help. Our customer-base is truly global, the projects we are involved with are incredibly varied and we deal with some big household names... But Concorde is in a different league; one of the most iconic brands of all time. To see G-AXDN's nose and visor moving again, knowing that we were part of the team that made it happen, is very special indeed."

Degrees of droop

Early Concorde models, such as G-AXDN, could only lower the nose to 17.5 degrees for landing, or five degrees for take-off. The former was found to be too steep, as pilots could not see the nose at all, and this aircraft was therefore fitted with an experimental system to test an intermediate 12.5 degrees, which was later adopted on all production aircraft for landing. The DAS Concorde at Duxford is unique as the only Concorde capable of all three angles.

The aircraft is displayed in the Imperial War Museum's award-winning AirSpace exhibition at Duxford and will now be accompanied by a spectacular six-metre-long model of a production Concorde in British Airways service livery, which has been generously loaned by the British Airways Heritage Collection. The model is cutaway so that visitors can see the minute detail of the interior, including the seating. It is the perfect partner to DAS's developmental Concorde.



With dramatic lighting and much fanfare G-AXDN's nose is retracted to the supersonic position at Duxford on October 24

Paul Jarvis, curator of the British Airways Heritage Collection explains why this model has been moved to Duxford: "This splendid model graced the foyer of British Airways' Waterside headquarters building for many years, but following Concorde's retirement, it needed a more appropriate home where its place in history could be more widely acknowledged by the general public. IWM Duxford, with its collection of iconic aircraft, was the obvious choice, not least because the developmental Concorde maintained by DAS and the model complement each other."

A large crowd turned out to see Concorde exercise her nose for the first time in many years, including former pilots such as John Hutchinson. Recalling his time on the Concorde fleet Mr Hutchinson said: "It was quite an extraordinary feeling. You had no sensation of speed at all. Other aircraft looked as if they were going backwards. You were hanging motionless, suspended in space, it was Mother Earth doing all of the work. It was totally different to the normal subsonic experience. It was magical, beyond any words I can use."

The restored Concorde is open for internal inspection at Duxford and a programme of public droop nose demonstrations is planned for the near future. ●

The DAS Concorde has been restored with fully functioning cockpit lighting
All via IWM unless stated



Iranian Air

In fifteen years Iran Air succeeded in becoming the largest airline of the Middle East, but not without incident and controversy. Babak Taghvaei recounts the challenges faced by Iran Air's stalwart fleet of Airbus A300s



Iran Air was formed in 1962 after a merger between Persian Air Services and United Iranian Airways. The founding fleet included six DC-3s and three Vickers Viscounts including EP-AHA Neal Carlton



Iran Air ordered Boeing 747-100s for international flights, but opted for the Airbus A300 for domestic routes Neal Carlton

Iran Air was officially formed on February 24, 1962 by the merger between Persian Air Services and United Iranian Airways and began with 374 employees and a small fleet of six DC-3s and three Vickers Viscounts. The airline embarked on a challenging task to gain itself a good international reputation by introducing a convenient schedule on an all-jet fleet, with excellent cabin service, supported by one of the best safety records in the world.

With constant and speedy progress, not only did the company meet all of its goals in less than a decade, it was also selected by IATA in the late 1970s as the fastest growing airline in the world.

This significant success can be attributed to formidable management, backed by the Iranian government.

In 1977, Iran Air management and experts negotiated with Boeing and Airbus regarding the acquisition of widebody airliners. Boeing 747s were procured for international flights, but Iran Air managers needed to find a solution for domestic routes too – and for this they looked towards Airbus.

In October 1977, Airbus president Bernard Lathiere visited Tehran to negotiate Iran Air's purchase of the Airbus A300B2K. Following the agreement, two Airbus A300B2Ks were prepared for a long-term leasing arrangement, with their deliveries to Iran Air scheduled for March 1978. The airline's eventual requirement was for ten to twelve A300s.

The A300B2K was the hot-and-high version of Airbus' A300, combining the lighter structure of the B2 with the wing-root Kruger flap of the B4 version. It was specifically

bus

**IRAN AIR
A300s**



Today just one A300B2 variant is operational with Iran Air. Registered EP-IBS it was the second A300 delivered to the airline by Airbus and has had an eventful career. On August 28, 1984 it was hijacked while en-route from Shiraz to Tehran and it headed to Iraq where the passengers were freed and the hijackers claimed asylum. It is expected to remain in service until 2016

All via Babak Taghvaei unless stated

developed for South African Airways.

Finally, Iran Air decided to order ten A300B2Ks in November 1977, and their deliveries were expected in 1978-80.

The two leased A300B2Ks – F-ODHY (c/n: 49) and F-ODHZ (c/n: 51) – were delivered on March 7 and 16, 1978 respectively and were quickly introduced onto domestic and even international routes. Two months later, Iran Air selected 52,000lb/thrust CF6-50C2 turbofan engines for its future A300B2Ks; the new variant of this General Electric engine had made its first flight beneath an A300 on May 10, 1978.

Revolution

The riots of 1979, later termed the Islamic Revolution, changed the government of Tehran.

One of the primary goals of the Mullahs,

who now had the power, was purging all signs of the Pahlavi government and the Iranian aviation industry, a great symbol of Iran's achievement in the Golden Pahlavi era, was a prime target.

Iran Air's authorities were dismissed or even imprisoned. New authorities

“Iran Air’s authorities were dismissed or even imprisoned”

accused the former Iran Air managers of co-operating with the West, citing the fact that they bought American-made aircraft as an act of Imperialism!

Contracts for more two Boeing 747-186Bs were cancelled and a recently delivered Boeing 747-186B (EP-1AM) and

a Boeing 747SP86B (EP-IAD) were put up for sale. Ayatollah Khomeini, the head of the Mullahs, believed that Iranian people could travel with pack animals and there was no need for modern aircraft.

Three months before the end of the A300B2K lease, they were returned back to

Airbus and the order for ten A300B2Ks was reduced to six by the new revolutionary authorities at Iran Air.

The first of these A300B2K-203s was delivered on March 17, 1980 and was registered EP-IBR. It was followed by the delivery of EP-IBS on April 16. In the same



EP-IBG began life as TC-OBB with Onur Air and became EP-MDA when in service with Iran Air Tours. In 2009 it was re-registered as EP-IBG and remains in service with Iran Air providing regional flights between Tehran and Najaf



Airbus A300B4-605R EP-IBA first flew in December 1993 as F-WWAL and was delivered to Iran Air a year later on December 27, 1994. It is seen here visiting Amsterdam on July 3, 2004. It was last noted in Tehran, but in all probability will never fly again Caz Caswell

year Airbus sold the previously leased aircraft to Eastern Airlines for \$28 million apiece.

On April 30, the third and fourth A300B2Ks were delivered to Iran Air and registered EP-IBT and EP-IBU respectively. The final two machines were delivered on December 12, 1982 and January 31, 1983 becoming EP-IBV and EP-IBZ.

Terrorist hijackings

The MKO (People's Mojahedin Organisation) Islamic-Marxist terrorist group had a very important role in the 1979 Islamic Revolution. This group had become famous amongst religious and Marxist young revolutionary people in Iran because of its assassination of American citizens and governmental authorities in Iran during the 1970s. After the Islamic regime had gained power the MKO's political influence and activity was restricted by the Mullah's in 1980. However, the group continued its terroristic activities and began a bloody war against the new regime.

MKO terrorists were known to follow the tactics of Palestinian terrorists which included suicide bombing and hijacking

aircraft. Between July 6, 1983 and January 26, 1990, MKO terrorists attempted to hijack 15 Iran Air passenger aircraft and they were successful during more than half of their attempts. Three such incidents occurred on A300B2Ks en-route during domestic routes.

On June 26, 1984 MKO hijackers diverted Iran Air Boeing 727-286C EP-IRP from its Shiraz–Tehran route towards Saddam

The hijackers, a young man and a woman claiming to have explosives, diverted the aircraft towards Kuwait, but Kuwaiti officials didn't permit them to land and therefore they diverted the aircraft towards a military airport located in the south of Iraq. The hijackers claimed asylum and all 195 passengers and eleven crew members were later returned to Iran.

“Ayatollah Khomeini believed there was no need for modern aircraft”

International in Baghdad, and on August 7 of the same year terrorists hijacked an Airbus A300B2-203 en route from Tehran–Shiraz. Two hijackers, one armed with a knife and the other with a fake bomb commandeered the aircraft while it was carrying 304 passengers and eleven crew members and redirected it towards Bahrain. They refuelled there and also at Cairo before landing in Rome. Thwarted by French officials, the hijackers were arrested in Italy and then sentenced for air piracy.

On August 28, the MKO took control of EP-IBS en-route from Shiraz–Tehran.

After these incidents, the Islamic Revolutionary Guard of Corps (IRGC) established the Aircraft Protection Corps (similar to US Air Marshals) for guarding passenger aircraft against hijacking.

When on September 12, 1984 four MKO members attempted to take control of another Airbus A300B2K on the Tehran–Shiraz route, IRGC security guard prevented the hijack and two of the terrorists were wounded.



A300B2-203 EP-IBV first flew in March 1982 as F-WZMD and was built specifically for Iran Air. It joined the airline two months later as the penultimate A300 from its initial order. The airframe was plagued with problems in latter years and on September 14, 2007 it had to perform an emergency landing due to a flaps failure. On January 20, 2008 its yaw dampers deactivated due to a technical problem and on August 9 the same year the aircraft's right landing gear tyres exploded. EP-IBV was retired from service on April 9, 2014

Iran Air Cargo A300B4-203 Freighter EP-ICE on approach to land. This aircraft was built in 1981 for Kuzu Air as TC-KZT and joined Iran Air in May 2008. Recently overhauled and repainted into standard Iran Air colours, the on-going effect of sanctions caused its grounding and the removal of its engines for use in other aircraft. However, it returned to the skies on October 6, 2014 following a relaxing of sanctions and new engine deliveries



The aircraft made an emergency landing at Isfahan and all of the hijackers were arrested.

On November 10, 1986 two members of MKO received an order to hijack another A300B2K and route it towards Iraq. Two well-trained terrorists returned to Iran and hijacked another Airbus A300B2K en-route from Tehran–Tabriz. However, both attempts were thwarted by security officers and the aircraft returned to Tehran.

Below: In February 2005 Iran Air acquired A300B4-605Rs SX-BEK and SX-BEL from Olympic Airlines and the two aircraft quickly became EP-IBC and EP-IBD. The former is seen here at Frankfurt in August 2005 *Caz Caswell*



Iran Air Flight 655

On July 3, 1988 the US Navy Cruiser USS Vincennes shot down an Iran Air Airbus 300B2-203, killing all 274 passengers and 16 crewmembers. This catastrophic incident caused the Tehran regime, headed by Khomeini, to accept a ceasefire and UN Resolution 598 to end the Iran/Iraq War.

The aircraft (EP-IBU) had departed Bandar Abbas airport at 10.17am local time heading towards Dubai International. While climbing two RIM-66A Surface to Air Missiles (SAMs) were fired towards the airliner hitting its right wing and vertical stabiliser.

The US Navy cruiser's personnel and commander later claimed that they had mistakenly identified the Airbus as a hostile Iranian Air Force F-14 Tomcat. They also claimed to have issued seven challenges on the military air distress frequency 283 MHz, addressed to "Iranian Aircraft", "Iranian fighter" or "Iranian F-14." These messages were followed by three challenges on the International Air Defence

radio frequency, but the crew of the civilian EP-IBU were not able to hear them.

In 1996, America and Iran reached an agreement over Iran Air Flight 655 at the International Court of Justice. The US paid \$61.8 million in compensation to the families of the Iranian victims. However, America has never admitted responsibility.

Maintenance Support under the sanctions

Before the Islamic revolution of 1979, Iran Air had a significant maintenance capability, making periodical inspections and checks on all aircraft except overhauls, which were usually done by Lufthansa Technic.

This facility was reduced following several political purges, the retirement of highly skilled technicians and also the dismissal of German and American technicians.

The A300 fleet 'C checks' were then conducted out at aircraft Maintenance Repair & Overhaul (MRO) centres such as the GAMCO Centre in Abu-Dhabi or other centres in Turkey and Europe. In the late 1990s Iran Air's technical unit established its third maintenance hangar in order to do all A and B checks on the airline's A300s on site in Tehran.

On March 8, 2002 the Fajr-Ashian Aircraft MRO Centre was officially established with help and support provided by EADS Sogerma Services in France as well as Mahan Air and the Iranian Ministry of Defence. In 2003 the company conducted its first domestic overhaul of an A300 and soon gave Iran Air the ability to do A, B, C and S checks on its A300s.

Risky business

In the 2000s, Iran Air authorities were struggling with sanctions which caused the full suspension and then cancellation of Iran Air orders for five A330 aircraft in 2003 as



Iran Air acquired Airbus A300B4-204s TC-FLK and TC-FLL from Fly Air of Turkey in 2007. The Iranian Civil Aviation Organisation initially refused to issue civil registrations to the aircraft but after much legal wrangling the aircraft became EP-IBI and EP-IBJ - the latter seen here landing at Mehrabad International Airport after a flight from Tabriz in December 2011

well as an initial embargo on the airline's attempt to buy two second-hand A300s from Olympic Airlines.

However, two years later in February 2005, Iran Air was successful in acquiring A300B4-605Rs SX-BEK and SX-BEL from Olympic and the two aircraft quickly became EP-IBC and EP-IBD. They were introduced onto European routes in March and April 2005 to fill the gap left by the ex-Turkish Airlines Airbus A300-203s which had been grounded due to the inability to

After clearance of both aircraft by Mehrabad Intl Airport's Customs, they went to the Iran Air maintenance hangar where technicians found two worn-out engines had allegedly replaced the original engines previously fitted to TC-FLK! The Iranian Civil Aviation Organisation (ICAO) refused to issue Iranian civil registrations to the ex-Fly Air aircraft and a few days later Iran Air apparently realised that the aircraft couldn't even be flown because they were bank foreclosures and their relocation to Iran was illegal.

“The USS Vincennes shot down an Iran Air Airbus 300B2-203”

find spare parts for their engines.

In 2007, Fly Air of Turkey, which was near bankruptcy, put its small fleet of aircraft up for sale. Authorities of the ailing airline found a solution to pay their debts to the bank and offered Airbus A300B4-203s TC-FLK and TC-FLL to Iran Air. Representatives went to Turkey to check TC-FLK and its documents. At that time the aircraft was equipped with two CF6-50C2R turbofan engines, which were a year overdue for an overhaul. TC-FLL was in a similar condition. Both aircraft were bought and relocated to Iran in September 2007.

For several months Iran Air authorities and Fly Air's creditors negotiated, and eventually Iran Air paid a part of Fly Air's debts and both aircraft entered Iran Air service, registered as EP-IBI and EP-IBJ.

The flight crew detected several technical problems during EP-IBJ's first test flight on December 22, 2008 which took a month to solve. Finally, both EP-IBI and EP-IBJ entered service in January 2009.

In 2007, two other Airbus A300B4-203s were procured for Iran Air Tours. Formerly TC-OBB and TC-OBC with Onur Air these became EP-MDA and EP-MDB in Iran. These



aircraft were handed over to Iran Air in April 2009 and in August of that year EP-MDA was re-registered as EP-IBG. EP-MDB was re-registered as EP-IBH two months later.

Unsafe?

Iran Air's A300 fleet was always faced with unexpected accidents and incidents. On February 2, 2000 the airline lost EP-IBR when it collided with an Iranian Air Force C-130E Hercules (5-8504) while being towed from the Iran Air yard towards the domestic ramp of Mehrabad International Airport. According to the crash report, the C-130's No 3 engine had been throttled back during a training sortie and the instructor decided to abort the take-off. The pilot lost control causing the Hercules to veer off the runway and collide with EP-IBR. Both aircraft exploded and eight crew members on the C-130 were killed.

The age of the Iran Air A300B2K fleet was also having an adverse effect on their safety. Air France and Lufthansa Technik had responsibility for the fleet's CF6-80CR and CF6-50C2 engines, but only three or four engines were being sent to Germany or France for overhaul each year. In 2004, due

The final A300B2 to join Iran Air was EP-IBZ, which arrived on January 31, 1983. In October 2013 it was also the first member of the A300B2 fleet to be retired and was cannibalized for parts at Mehrabad. The aeroplane was named Persian Gulf in Iran Air service



Fourteen A300s have been owned by Iran Air and two additional examples leased from Airbus. Today just seven remain operational



In 2007 Iran Air Tours acquired TC-OBC from Onur Air and the aircraft became EP-MDB (illustrated). It was handed over to Iran Air in April 2009 and in October of that year EP-MDB was re-registered as EP-IBH

Flying domestic routes in and out of Tehran the A300 fleet was frequently seen passing the Alborz Mountain range. EP-IBI is the second of two A300B4s obtained from Fly Air and is now used for flights from Tehran to Mashhad, Zahedan and Bushehr as well as the Mashhad-Ahwaz route. During one such flight, on October 1, 2014, the aeroplane's arrival was delayed by a few minutes leading to internet rumours that it had crashed! Iran Air expects to keep the aeroplane in active service until 2016



to US pressure, these companies refused to overhaul Iran Air engines and the number of operational A300s was subsequently reduced.

US sanctions also meant using non-standard and expired spare parts on the CF6 engines, leading to several engine failures and subsequent emergency landings during A300 flights in the years after 2004.

In 2007, Iran Air's A300 fleet suffered at least one technical failure per month. To take just one example, on September 14, 2007, EP-IBV had to perform an emergency landing only seconds after its take-off from Zahedan airport due to failure in the aircraft's right wing flaps. Several weeks later on January 20, 2008 whilst the aircraft was en-route Tehran-Dubai, its yaw dampers deactivated due to a technical problem and its crew performed an emergency landing at Shiraz International Airport. The same year, on August 9, 2008, when EP-IBV was taking off from Jeddah International Airport in Saudi Arabia, a foreign object caused the aircraft's right landing gear tyres to explode. The pilot aborted the take-off and due to heavy braking the aircraft's landing gear burned out and it was grounded for several days in Jeddah.

The list of incidents continued until 2012, when aircraft EP-IBS and EP-IBV suffered tyre issues and engine failure, respectively.

Retirement

Due to US sanctions and the Anti-American politics of the Mullahs' regime, Iran Air was faced with massive bankruptcy and economic loss and only governmental subsidies kept the airline alive.

Airline managers had been (ineffectually) selected for their loyalty to the Islamic regime rather than their aviation knowledge and unlike Mahan Air, Iran Air was unable to circle US sanctions to buy new aircraft.

Its ageing fleet of A300s was suffering from both a lack of overhaul and a deficit of spare parts, causing many to be grounded.

The official retirement of the airline A300B2 fleet began in October 2013, when EP-IBZ was withdrawn from service. EP-IBV, the airline's ill-fated controversial A300B2K was retired from service on April 9, 2014. The aircraft had received its last C Check at the Fajr Ashian MRO centre in 2009.

By late 2013, another A300B2K, EP-IBT, had been cannibalised for its parts. EP-IBT had been overhauled for the last time in 2008 and had been returned to Iran Air in July 2009. This leaves just one A300B2 (EP-IBS) operational with Iran Air and this aircraft is expected to remain in service until 2016.

As of 2014, Iran Air had just seven operational A300s in its fleet. EP-ICF and EP-IBG are both A300B4-203 variants with the former used by Iran Air Cargo and the latter to provide regional flights between Tehran-Najaf. EP-IBS is the sole remaining B2 variant; EP-IBI and EP-IBJ (the two ex-Fly Air A300B4s) are mainly used for flying the Tehran-Mashhad, Tehran-Zahedan and Tehran-Bushehr routes whereas A300B4-605Rs EP-IBB and EP-IBD generally fly to the airline's European destinations. ●



The A300B2K was the hot-and-high version of Airbus' A300, combining the lighter structure of the B2 with the wing-root Kruger flap of the B4 version. It was specifically developed for South African Airways

Below: As of 2014, Iran Air had just seven operational A300s in its fleet, including A300B4-203 IP-ICF, which is used by Iran Air Cargo. It was previously operated by Kuzu Air as TC-KCU and was acquired in May 2008. This picture, taken in 2008, shows the aeroplane in its old colour scheme which had been designed and applied in Germany. This scheme was replaced with standard Iran Air livery during its last overhaul in 2011





PERSIAN CATS



THE IRANIAN F-14 STORY

Babak Taghvaei speaks to Iranian Tomcat pilots and provides a detailed look at the role the F-14 continues to play in the Iranian military

Almost 40 years after the delivery of the first of 80 Grumman F-14A Tomcats to its air force, this legendary fighter aircraft is still soldiering on as the backbone of Iran's air defence.

Around 62 F-14As are still in service with the Islamic Republic of Iran Air Force (IRIAF) and almost 42 of them are being kept in operation or mission-ready. These Tomcats have seen eight years of attrition war with Iraq and they have scored tens of kills against Iraqi Air Force fighters.

In the 1970s Iran, as an important ally of the US and the west, was under the leadership of Mohammad-Reza Shah Pahlavi – a skillful military expert and pilot as well as a politician. High-intensity threats to Iran were coming from the USSR and Iraq and low-intensity threats included Omani separatism and terrorism.

Iran shares a 1,250-mile border with the Soviet Union, a visible reminder of the danger of a USSR invasion, and Iranians had still not forgotten the USSR intervention in

the Azerbaijan province: a failed separation attempt with Communist motives.

In the early 1970s Iran was attempting to procure an air superiority fighter to defend its country's airspace. In the second half of 1972, the Imperial Iranian Air Force (IIAF) had 31 McDonnell Douglas F-4E Phantoms, 28 F-4D Phantoms, 4 RF-4E Phantoms, 125 Northrop F-5A/B Freedom Fighters and 13 RF-5A Freedom Fighters in service with 14 Tactical Fighter Squadrons and 1 Tactical Reconnaissance Squadron. Ten more F-4Es and

Iranian F-14As before receiving fuel from a KC-707 tanker aircraft during an exercise in 2008 Babak Taghvaei



new F-5E/Fs were on order but the Iranian Government had a widespread plan for the progress of the IIAF to convert it into one of the undisputed air powers of the world.

Prized purchase

During his visit to Tehran in May 1972, President Nixon, a great friend of the Shah, agreed to sell the F-14 and/or F-15 Eagle to Iran. The Iranian Government decided to purchase the F-14, primarily because of its ability to carry the AIM-54A Phoenix weapons system which was the only system capable of reaching the high flying Soviet MiG-25s that had been reported to periodically overfly Iran (see p36).

In January 1974 and June 1974, the Iranian Government signed letters of offer for the acquisition of 80 F-14As and its Phoenix weapon system for a total of \$2.33 billion. Initially the IIAF planned to have its three F-14 Tactical Fighter Squadrons at three Tactical Fighter Bases in Khatami and Shiraz



Taken in Iran in 1978 this charismatic photograph shows eight Iranian F-14A pilots posing in front of the Tomcat 3-6030 (USN BuNo: 160328). Standing (from left to right) are Jalil Zandi (ACE pilot), Gholam Hashempoor, Asadollah Adeli, Ahmad Moradi and Gholam-Reza Nezam Abadi. Seated from left to right are Zahedi, Alireza Geran-Payeh and an unknown pilot. Ahmad Moradi was later branded a traitor when he fled to Iraq with his Tomcat during the Iran/Iraq War Babak Taghvaei Collection



F-14A 3-6067 retained its old colour scheme until it underwent renovation work at the IACI Tomcat overhaul centre in 2003. The aeroplane was later sprayed in Air Defence Blue/Grey camouflage in keeping with the rest of the current Tomcat fleet Babak Taghvaei Collection

and probably Mehrabad, but in the end the number of bases was dropped to two: the 7th TFB at Shiraz and 8th TFB at Isfahan.

Later 70 more F-14As were ordered, to be configured as multi-role fighter aircraft with the ability to use and launch Condor AGMs and LGBs.

In December 1976, after negotiations between the Iranian Government, IIAF's commanders and JSOP (Joint US Military Advisory Group) objectives were reached for the formation of 37 fighter squadrons, consisting of eight F-14 (150 aircraft), sixteen F-16 (300 aircraft), and thirteen F/A-18L (250 aircraft) from 1979 until 1986.

Iranian F-14 pilots

The first Iranian Tomcat pilots selected were Brigadier General Abdolhossein

Minu-Sepehr; Major Mojtaba Zangeneh, Major Mohammad Farah Avar and Captain Kazem Heidar-Zadeh. They were sent to the Miramar Naval Base for training. The second group consisted of eleven other pilots, who were sent to Oceana Naval Base at Virginia.

Retired F-14 pilot Brigadier General Shahram Rostami tells Jets about the training procedure of the second group pilots:

"In 1974, I was one of first group of F-4E pilots to join the 3rd TFB. After six months, I was chosen to undertake the F-4 Instructor Pilot (IP) training course. After that, I was detached to the 11th CCTS at the 1st TFB Mehrabad and continued my career there as an F-4 Instructor Pilot [IP] and F-4 Weapon System Operator Instructor for two years.

"Then in 1976, I, Jamshid Afshar and Taghdis (All F-4E IPs of 11th CCTS) were selected to become future IIAF F-14 IPs. We were sent to Virginia and passed the flight transition training course and also the RIO training there and then returned Iran as F-14 IPs.

"After our return, we, together with American F-14 IPs, started flight training Iranian F-14 pilots from the 81st TFS. (There was a plan for establishing the 83rd TTS in 1978). Nearly all of our students were F-4 and F-5 veterans."

Another retired F-14A pilot, Brigadier Fazlollah Javid-Nia, remembers an incident during a training flight:

"...I was on a training sortie on Sunday August 27, 1978. I was in [the] front seat and my IP was Mr Holomberg in the aft seat, I was flying as wingman of another F-14A piloted by Mr Livos and Mr Oghbaiee. During an ACM (Air Combat Manoeuvring) exercise over Yazd, while I quickly performed a High-G climb with excess angle of attack, my left engine flamed out due to compressor stall.

Below: F-14A 3-6030 was one of last 62nd TFS Tomcats and retained its 6th TFB number on its vertical fin when this picture was taken in 2012

Babak Taghvaei



This F-14A was restored and overhauled by 8th TFB's Tomcat Overhaul Centre in 2012 Babak Taghvaei





F-14AM 3-6049 was the first Tomcat upgraded through Project Babaiee between 2009 and 2012. The aeroplane is painted in the short-lived Splinter Asian Minor II colour scheme Babak Taghvaei



Tomcat 3-6002 suffered fuselage damage after a belly landing in the summer of 2008 while in service with the 8th TFB. The aeroplane was later repaired and returned to service Suleiman Tahmasbi via author

"The IP requested ejection, but I recovered the aeroplane during a breathtaking process while we lost altitude from 35,000 feet to just 5,000 feet. I recovered the aeroplane and we successfully returned to our base on one engine. Before this accident two F-14As (serialised 3-6013 and 3-6048) ... [experienced a] similar engine compressor stall."

Persian 'cats'

The IIAF's F-14s took part in their first exercise, *Shahbaz 77*, in 1977. On June 19, a mixed flight of 24 IIAF/USAF F-4Es conducted a simulated attack against the Imperial Iranian Navy (INN) destroyer *Babr* (DDG-7). The fighters were under the control of airborne commander Lt General Kamyabipour aboard a KC-707 airborne command and control centre. However the IIN *Babr* was defended by four of the IIAF's F-14As which, for the first time, were under the operational control of the ship's captain. The training mission was most realistic and successful for both the IIAF and the IIN.

After *Shahbaz 77* another exercise, *Midlink 77*, was conducted and again the Tomcats played a key role.

Due to the Iranian Tomcat fleet's programme of expansion the IIAF HQ had planned to establish the 83rd Tactical Training Squadron dedicated to pilot training of 100 Tomcat crews - both pilots and Radar Intercept Operators (RIOs) - by 1981. However all plans for expansion of the air force were cancelled by the new regime. By the time of the Iranian revolution in February 1979 just 60 pilots and 24 RIOs had completed their training although the 81st TFS's pilot school was performing 24 training sorties per day at Isfahan.

After the war

When the Iran-Iraq War ended in 1988 (see p36) a large proportion of the F-14 fleet was awaiting overhaul at Iran Aircraft Industries (IACI) so during the early 1990s, the 8th TFB's F-14A overhaul centre was established to boost capacity. This increased the number of Tomcats that could be overhauled in Iran from four to six aircraft per year.

Following the lessons learnt in the Tanker War element of the Iran-Iraq War, it became evident that the F-14As were necessary for protecting the Iranian oil infrastructure in the Persian Gulf. Therefore, Brigadier General Mansour Sattari instructed the 8th TFB to deactivate the 83rd TFS and relocate all of its 16 Tomcats to the 6th TFB at Bushehr. The 62nd TFS was reformed there, primarily to protect the Khark Island oil region and for air defence along the whole Persian Gulf.

Due to bad maintenance support at this

Attrition

Since the end of war, until the present day, five more F-14As have been lost: one due to human factors and four others due to technical failure including 3-6062 (US Navy BuNo 160360) which crashed due to an unknown reason on January 26, 2012.

On that day, the IRIADF (Iranian Air Defence Force) early warning radar sites detected an unknown flying object. Quickly the 6th TFB was scrambled and Major Alireza Karimaiee and

"Early warning radar sites detected an unknown flying object"

humid air base, nearly all of the Tomcats suffered from inadequate measures to prevent corrosion. They were all grounded but after several years of extensive work by the 8th TFB, all were returned to the sky.

In 2007, the 62nd TFS was deactivated again; its Tomcats were returned to Isfahan and the 83rd TFS was reformed. Just three F-14As remained in Bushehr (alongside fifteen F-4Es of the 61st TFS) to protect the area, especially the city's Nuclear Reactor.

Captain Mostafa Fasihi (RIO) launched in their AIM-9J and AIM-7E-2 armed F-14A at 16.30 local time. Just two minutes after take-off the aircraft exploded in the sky and no reason for the accident was ever found. At that time a US Navy cruiser was in the Persian Gulf within 40 miles of Bushehr; but the IRIAF crash investigation team believed its presence had no connection with the crash.

After that accident, the IRIAF's Deputy of Inspections and Safety ordered the 8th TFB

A line up of F-14As on the 8th TFB's main apron in 2005

Rahim Sharafi via author



to withdraw its F-14As from Bushehr to Isfahan, because problems with the aircraft's electrical systems was one of the most likely reasons for the explosion of its fuel tanks.

F-14s vs UFOs

In early 2003, soon after the revelation of Iran's Nuclear Programme and accusations that the IRI regime was attempting to build nuclear weapons, CIA unmanned aerial vehicles (the so called 'spy drones' dubbed "UFOs" or "luminous objects" by the Iranian news media) appeared over Iranian nuclear sites including the IR-40 heavy water reactor under construction near Arak.

This continued in 2004 and 2005 with 'UFOs' sighted over nuclear facilities in Arak, Qom and Bushehr and even during Iranian Aerospace Industries' ballistic missile tests over Semnan Missile Test Centre.

It was the duty of the Iranian Tomcats to protect the security of the airspace in these regions, especially when important jobs such as loading nuclear fuel in the reactors were being conducted.

It was common for the SAM (Surface to Air Missile) operators in the area to observe the 'UFOs' over the sites at night. The only aircraft keeping these Mach 7-10 capable UFOs at bay was the F-14A. The drones were protected by means of their unexplainable flight characteristics and



A group of 81st and 82nd TFS Pilots and RIOs in Isfahan - possibly in 1981 or 1982. Babak Taghvaei Collection

advanced jamming system, but the F-14's mere presence was effective enough to disrupt their missions, especially in two cases

"The only aircraft keeping these Mach 7-10 capable UFOs at bay was the F-14A"

in daylight over Semnan Missile Test Centre in 2007 and 2008.

"Luminous object"

In another case in November 2004, a flight crew of an F-14A armed with two AIM-9Js and two AIM-7E-2s belonging to the 82nd TFS observed a luminous object over Khandab near Arak. They reported it to the Electronic Warfare and Electronic Intelligence (ELINT) elements of the

Iranian Army Command of Intelligence and Reconnaissance, but nobody could see the object on radar. Therefore the F-14 pilot was given permission to close in to identify the object. Quickly it started high-G maneuvering and when the F-14A pilot decided to shoot the drone down with its AIM-7E-2s, the Tomcat's radar was disrupted by the object's high-power jamming system. Finally, it disappeared like a meteor and the F-14A returned safely to Isfahan.

That night ground observers of IRIAF AA gun sites accused Iran's Revolutionary Guard Corps (IRGC) of operating an unmanned aerial vehicle (UAV) over Khandab. The next day when the IRGC

announced that it wasn't their drone, they realised it belonged to the US.

In 2005, Russia and Iran signed a contract for a study about the spy drones or luminous objects that had been appearing over Iran. The first sighting came about a month after the US Embassy hostage crisis in 1979, then another was spotted a month before Iraq's invasion of Iran in August 1980. Further sightings occurred in 2003 and 2004 and in one case a drone crashed in Iran and was delivered by Russian experts for investigations into its technology. Because of the IRIADF's SAM sites and IRIAF's F-14As' inability to shoot down these drones, the Iranian governmental media have always attempted to cover up the story.

Upgrade programmes

In 2004, the IRIAF had 63 F-14As on charge but just 16 of these were operational and only five were fully mission capable with the ability to participate in real combat missions. The situation was catastrophic and 29 aircraft were awaiting parts in order to fly again, and others were being cannibalised or under overhaul.

However, when the US Navy retired its fleet of F-14s in 2006 it enabled hundreds of spare part shipments to be smuggled into

Former 62nd TFS F-14A Tomcat 3-6058 takes on fuel during using the Beech Model 1080 system during an exercise in 2008 Rahim Sharafi via author



3-6021 was one of the last operational F-14As of the 62nd TFS. Babak Taghvaei



A formation flight of five F-14As during Iran's Military Day parade over the south of Tehran on April 18, 2011 Babak Taghvaei



3-6002 aloft during Iran's Military Day parade 2013 Babak Taghvaei

Iran via brokers or middlemen.

In 2008, the number of operational Tomcats reached 22 in Isfahan and six in Bushehr. Between 2008 and 2010 the situation improved again when six more Tomcats were returned to the skies, and by 2011 the IRIAF had a fleet of 42 operational F-14s.

In 2008, the IRIAF signed a contract with the Iranian Defence Industries Organisation (IDIO) for restoration and upgrade of 50 AIM-54As missiles during a five-year process. The first restored missile was successfully used against a drone during an exercise in 2009.

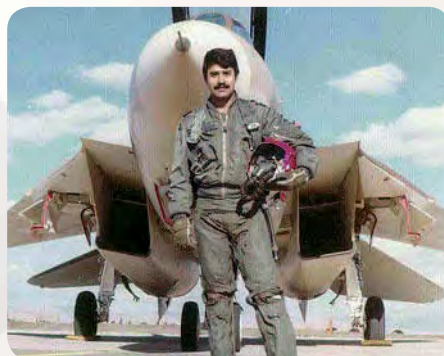
In the same year Babaiee Missile Industries launched its Fakkur 90 air to air missile programme which was based on the AIM-54A aerodynamic skin and uses a Shahin SAM warhead and seeker. The IRIAF signed a contract with the IDIO for production of 150 of this missile by 2016, and the first successful launch was performed against a Karrar Target Drone in 2013.

Project Babaiee

In 2008, the IRIAF's Department of Operations defined a roadmap for the modernisation of all its Tomcats by 2020. The IRIAF's Department of Self-Sufficiency and Industrial Research was tasked to perform the job by means of several civil contractors, which had responsibility to provide the

required systems, technology and spare parts for this project.

The operation was dubbed Project Babaiee and the first aircraft (3-6049 ex BuNo 160347) was allocated in January 2009. Work was started in the F-4 overhaul



Jalili Zandi was the leading IRIAF Tomcat pilot (nine kills including three Mirage F.1s). Later he was accused of disobedience by Lt Babaiee and sentenced to death by the Islamic Revolutionary Court. In fact Babaiee, who was a low-skilled F-14 pilot, had asked him to fly in a Beechcraft Bonanza in low visibility and Zandi didn't accept because of the aircraft's lack of avionics. Babaiee accused him of acting against the Islamic Revolution but fortunately the regime later released Zandi and after the war he was promoted to Brigadier General. He retired in 1990s but was later killed in a car accident Babak Taghvaei Collection

hangar at Mehrabad and after almost 36 months the aircraft (by now designated F-14AM) performed its first 30-minute check flight on January 18, 2012.

Three more functional check flights were performed and then the Tomcat was delivered to the 82nd TFS in April 2012. The aircraft had received a major avionics upgrade with a fully improved AN/AWG-9 radar set, new INS system and an improved RWR system with the facility to use new Air to Air Missiles including the Fakkur 90.

The aircraft also received an edged three-tone Asian Minor II camouflage after the modernisation, which was later evaluated as an unsuitable colour scheme for the IRIAF's other F-14s.

In 2013, three more F-14AMs were delivered to the IRIAF's 82nd TFS following modernisation in the 8th TFB's F-14 overhaul centre. They are now being used as Quick Reaction Alert (QRA) aircraft for the airbase.

In September 2014, the 8th TFB's F-14 overhaul center delivered the sixth F-14AM but this time to the 81st TFS.

According to the IRIAF's current programmes, the fleet of 62 F-14As will be kept in service until 2030. ●

SPECIFICATION GRUMMAN F-14AM TOMCAT



Crew	2
Length	62ft 9in (19.10m)
Height	16ft 0in (4.88m)
Wingspan (Spread)	64ft 70in (19.55m)
Wingspan (Swept)	38ft 0in (11.58m)
Wing area	565sq ft (54.5m ²)
Empty Weight	43,735lb (19,838kg)
Max Take-Off Weight	74,350lb (33,720kg)
Max Cruise Speed	475kts (547mph/880km/h)
Ferry Range	1,840 miles (2,960km)
Service Ceiling	50,000ft (15,200m)

Powerplant

Two General Electric F110-GE-400 afterburning turbofans (27,800lb/thrust with afterburner)

Armament

One 20mm M61 Vulcan Gatling cannon plus ten hard points capable of carrying AIM-54 Phoenix, AIM-7 Sparrow, AIM-9 Sidewinder and Fakkur 90 missiles

First Flight

January 18, 2012 (F-14AM)

December 21, 1970 (F-14 Prototype)

PART
TWO

TOMCAT TRIUMPH

Dr Dave Sloggett explores the history of the iconic Grumman F-14 Tomcat and shows how its use in the Iran-Iraq War of 1980-1988 provided a test bed for the Cold War

The Grumman F-14 Tomcat can thank the film industry for making it a household name.

Tony Scott and his team went where no filmmakers had really gone before: into the heart of jet age air-to-air combat. *Top Gun* redefined the public's knowledge and awareness of fighter jets and showed specifically how contemporary naval aviators are trained to engage and destroy the enemy.

The F-14 Tomcat had a chequered start to its career. It came to be the US Navy's choice to replace the long-standing and brilliant F-4 Phantom aircraft only after the original plan to develop a carrier-based variant of the General Dynamics F-111 (the F-111B) failed.

Whilst the F-111B's swing-wing capability

was ideal for the range of missions naval aircraft have to perform, the design was simply too heavy for carrier-based operations. An alternative solution was needed and Grumman had a design that provided a similar but lighter-weight option. This was the F-14 Tomcat.

Taking it from the drawing board into full-scale production however was really difficult. As costs overran and heated debates between Grumman and Pentagon officials failed to reconcile their differences, the company almost came close to going bankrupt. Ironically, given the way things have since panned out, it was an initial order from Iran which was signed in January 1974 for thirty F-14A-GR variants worth \$300

million that proved crucial in allowing the F-14 to become operational. A further fifty would be ordered later in the year.

Tomcat vs Eagle

The selection of the F-14 over the McDonnell Douglas F-15 Eagle by the Imperial Iranian Air Force (IIAF) was a decision hugely influenced by the Shah of Iran. One of his concerns was the number of high-flying Soviet reconnaissance aircraft (including the MiG-25 Foxbat) that were regularly intruding into Iranian airspace. In truth these overflights were part of a tit-for-tat series of intelligence gathering flights that were being made by both sides of the Cold War divide.

The possibility that Iran might end up being

Left: The Grumman F-14 was not the US Navy's first choice for an F-4 Phantom replacement. However, with the failure of F-111B project the swing-wing Tomcat came to the fore. It first flew on December 21, 1970 and three prototypes are seen here aloft in 1972 US Navy



The apparent short take-off of the F-14 was a huge factor that influenced the decision to go ahead with the contract. The crew of the F-14 also benefited from an unusual wind shear effect over the airfield during their demonstration which made their slow speed pass over their Iranian guests look even more impressive. By the end of the two flights the Shah was convinced. For the Iranian Air Force officers, the decision was made. The contract for the supply of 30 F-14s was signed. Grumman was saved from bankruptcy.

There were other factors that helped the Iranians decide in favour of the F-14. The aircraft's design included some important lessons that had been learnt from past

involved in a conflict with the Soviet Union informed the Shah's decision to buy a fighter that could challenge the high flying and very fast MiG-25, which, in the early stages of its career, had been collecting records at a rate that caused huge concerns in the west.

“Two Tomcats managed to shoot down two Libyan Sukhoi Su-22s”

In the initial stage of negotiations some members of the IIAF made it clear they were not amused at the idea of being sold a navy fighter. It would seem that inter-service rivalries are not just a matter for western forces. So unconvinced were the Iranians that a visit to the USA was hurriedly arranged to witness a fly-off between the F-15 and the F-14. The Iranian team that arrived in America was led by the Shah, who wanted to see the performance of both aircraft at first hand.

At the fly-off the naval pilots engaged in a little skulduggery. They flew after the F-15 and whilst the Eagle was doing its demonstration the F-14 waited at the end of the runway on full power, burning fuel and reducing the overall weight of the aircraft. On its take-off run the F-14 lifted around half the distance of the F-15. It then conducted a series of high and low speed manoeuvres designed to show off the full potential of the aircraft.

conflicts. It was a twin-jet, variable swept wing, supersonic fighter. Its two seat configuration and drop-shaped glazing of the canopy gave the pilot good all-round vision.



The US Navy's F-14 came into service at the height of the Cold War, but were not to fire their weapons in anger until 1982. That said, the type often shared the skies with Soviet bombers during their escort missions – as evidenced by this VF-114 example seen intercepting at Tupolev Tu-95RT Bear-D maritime reconnaissance aircraft US Navy

Above: Tomcat 3-6061 was one of sixteen F-14As in service with the IIAF's 72nd TFS between 1978 and 1986 Babak Taghvaei

Below: The Tomcat entered US Navy service in September 1974 but had it not been for the injection of \$300 million in funding resulting from the Iranian order for 30 aircraft it may never have been produced at all US Navy

Below right: The US Navy Tomcats entered service in bright colour schemes but by the time they retired in 2006 they had been adorned with all-over grey markings. In 1983 this VF-2 example gained an experimental 'Ferris' camouflage scheme and is seen at NAS Miramar in March of that year Caz Caswell Collection





F-14A 3-6056 equipped with rarely seen dual LAU-7A missile launchers on each one of its pylons – these capable of carrying four AIM-9Js simultaneously. In 1987 the aeroplane crashed killing pilot Alireza Bitaraf and RIO Asl Davtalab (RIO) Babak Taghvaei Collection

The original configuration of the F-14 Tomcat included two Pratt and Whitney TF30-412A turbo-fan engines with 20,929lbs/thrust. On full afterburner these could generate 41,813lb/thrust. The F-14's thrust to weight ratio was 0.92 and its wing loading was 113.4 lbs/ft². Encouraged by this level of performance, the Shah was determined to have in his arsenal an aircraft capable of shooting down a Soviet MiG-25 on reconnaissance over Iran.

Tomcat in combat

The US Navy's F-14 came into service at the height of the Cold War. As a result its capabilities were only tested twice in combat over the Gulf of Sirte in the Mediterranean Sea over the coast of Libya and once during the First Gulf War. During the 1981 'Gulf of Sidre Incident' two F-14 Tomcats managed to shoot down two Libyan Sukhoi Su-22 Fitter aircraft using AIM-9 Sidewinder missiles. One of the Libyan jets had managed to fire an AA-2 missile at one of the F-14s at a range of around 300 metres but it failed to bring down the F-14.



Colonel Kamal Jamshidi was the pilot of the first F-14A to down an Iraqi helicopter during the Iran-Iraq War. He used the Tomcat's M61 Vulcan cannon to make the kill and went on to make three confirmed kills during the war while serving with the 7th and 8th TFB. This picture is taken after the 8th TFB deployed a detachment of eight F-14As to the 6th TFB at Bushehr Babak Taghvaei Collection

The 1980-1988 Iran-Iraq War provided huge insights into what might have happened had the Cold War ever crossed the threshold of deterrence. On September 22 at 12:30 Baghdad time nearly every operational aircraft available to the Iraqi Air Force was thrown into a series of pre-emptive strikes against targets in Iran. Using

knowledge of where the radar coverage of the Iranian air defence systems was weak, the inbound jets easily managed to get through to their targets. Eight Iranian air bases were targeted alongside five airports and at least four army bases.

The aim was to cripple the IRIAF in a single strike – mirroring the Israeli attack at the start of the Arab-Israeli War in 1967. It was to be a total failure.

For the Iranian F-14s, however, it was to be a quiet day despite the surrounding mayhem. The air defence radar systems on which they depended to get airborne and interdict incoming strike packages from Iraq had been found wanting. It was not an auspicious start. Nevertheless the Iranians did claim a total of 13 Iraqi aircraft shot down on the first day, many of those falling to the F-14 Tomcats. As far as the rest of the IRIAF was concerned their initial revenge was swift, lifting off between 16:00 and 18:00 over 60 aircraft flew westwards to attack targets across Iraq.

Engaging the enemy

Over the coming days the F-14s were to be involved in a number of air-to-air engagements using their Phoenix (AIM-54), Sidewinder (AIM-9) and Sparrow (AIM-7) missile systems. This combination proved to be very effective. Whilst some debate still surrounds the exact numbers of aircraft shot down by both sides in the course of the war, research by Tom Cooper and



Taken in 1978, prior to the war, this photograph shows Iranian F-14A pilots in front of Tomcat 3-6033 at Isfahan

Babak Taghvaei Collection



Eleven of the 24 F-14As that participated in first Iran's Holy Defence Week parade on September 22, 1988. The parade indicated to western analysts that the Tomcat had survived the war in large numbers Babak Taghvaei Collection)



Farzad Bishop, both authorities on the IIAF, has established an excellent analysis of its performance during the war:

One role for the F-14 was to maintain station over the Iranian border escorting

23 Flogger; MiG-25 Foxbat and Su-22 Fitter flown by the Iraqi Air Force were simply no match for the F-14 Tomcat. Of all the aircraft in the Iraqi Air Force inventory it was the MiG-23s that suffered most at the hands of

“The F-14’s AWG-9 radar gave its crew a distinct advantage”

the small force of Boeing 707 tankers that would provide a re-fuelling capability for the F-4 Phantoms returning from bombing raids deep inside Iraq and also conduct Combat Air Patrols over the border area. In the initial period of the war from September to the end of January 1981 the F-14s would claim over 40 kills. Over the course of the war this would grow to a total of 150 confirmed kills and a further 47 probable or unconfirmed Iraqi Air Force aircraft destroyed.

MiG kills

The F-14 was easily able to outclass many of the fighters against which it was pitted in the Iran-Iraq War. The MiG-21 *Fishbed*, MiG-

the F-14. A total of 48 MiG-23 were shot down by F-14s, with 15 of these by the AIM-54 and 13 using the AIM-9. During the initial phases of the war, when the paucity of the electronic equipment in the Iraqi MiG provided little warning of an incoming missile,

Below Left: Tomcat 3-6068 is seen at the Dezful Airshow in 2013. The area around the left intake was damaged by an Iraqi SA-2 SAM over Karkheh in 1981. This aircraft was later refurbished at IACI in 2002 Babak Taghvaei

Below: Tomcat 3-6020 is one of the most famous F-14As in IRIAF service as it was modified as a ‘Bombcat’ during the latter stages of the war with Iraq Babak Taghvaei Collection

the pilots were often caught unawares as the inbound missiles appeared out of the blue.

The AWG-9 radar that was the main sensor system on board the F-14 gave its crew a distinct advantage that allowed them to undertake long-range engagements on the inbound Iraqi aircraft. Over time the Iraqis would receive new equipment from the Soviet Union that would enable them to know when they were being illuminated by an AWG-9.

Such was its fearsome reputation that, knowing they faced certain death, Iraqi pilots would immediately abandon sorties if they were at any point ‘painted’ by a AWG-9 radar system – the sensor system that drove the Phoenix missile system.

Over the full duration of the war the Iranian Air Force saw at least 34 confirmed kills with the AIM-9, 17 with the AIM-7 and 59 with the AIM-54. The reputation of the AIM-54 was well deserved.

Mirage F-1 kills

The second highest number of kills achieved by the F-14 was against the Iraqi Air Force's Dassault Mirage F.1s, a total of 32 of which fell to the Tomcat. The F-14 also took its toll of Iraqi MiG-21s with a total of 23 confirmed kills.

Worthy performance

Over the lifetime of the F-14, American Navy pilots accounted for a total of five of the combat kills analysis has attributed to the aircraft. The remaining combat kills are claimed by Iranian pilots in the Iran-Iraq War. This theatre was also where a reported four to six F-14 were lost, with three being accidentally shot down by Iranian air defence systems. All-in-all the performance of the F-14 during the Iran-Iraq War is impressive, albeit against mediocre opposition. In the post-Vietnam era the aircraft is unsurpassed when it comes to looking at the combat kill statistics.

Even today choosing between the F-14 and the F-15 is difficult – despite the latter still being in service and receiving new orders. The F-14 is literally one of the greatest fighter jets of its era.

Whilst it will never get an Oscar for best supporting actor it does deserve its (unique) position amongst the Hollywood greats. ●



JETS

*In the cruise with their wings
fully swept this IRIAF Tomcat duo
consists of 3-6060 - the first F-14A
modified to carry MIM-23B HAWK
missiles - and 3-6079. The latter was
the last Tomcat delivered to Iran*
Babak Taghvaei Collection





Boeing/Bell Bombardier	787 Dreamliner	Jul/Aug	9
	787 Dreamliner (Air Canada)	Jul/Aug	7n
	787 Dreamliner (Air France-KLM)	May/Jun	11
	787 Dreamliner (Etihad)	Nov/Dec	7n
	787 Dreamliner (Royal Jordanian)	Nov/Dec	11p
	787 Dreamliner (Virgin Atlantic)	Jul/Aug	23p
	787-9 Dreamliner (Second Prototype)	Jan/Feb	7i
	787-9 Dreamliner (TUI)	Mar/Apr	9
	787-10 Dreamliner (Etihad)	Jan/Feb	11
	B-29A Superfortress	Mar/Apr	59p
	B-47E Stratajet	Mar/Apr	59p
	B-52B Stratofortress (NASA)	Mar/Apr	5p, 68n, 69p
	B-52H Stratofortress	Sep/Oct	6p
	C-17 Globemaster III (Kuwait AF)	May/Jun	6p
	E-3F (Armede de l'He)	May/Jun	11
	EA-18G Growler (US Navy)	Jul/Aug	8p
	F-15 Eagle (Japanese Air Self Defence Force)	Jan/Feb	10i
	F-15 Eagle (Prototype)	Sep/Oct	57p
	F-15A Eagle	Mar/Apr	62p
		May/Jun	11p
	F-15C Eagle	Sep/Oct	57p
	F-15E Strike Eagle	Jul/Aug	10p
		Sep/Oct	56p, 57p
		Nov/Dec	25p
	F-15SI Silent Eagle	Nov/Dec	26p
	F-15X Slam Eagle	Nov/Dec	26p
	F-15SG Eagle (Republic of Singapore Air Force)	Nov/Dec	25p
	F/A-18 Hornet (Prototype)	Jul/Aug	14p, 15p
	F/A-18 Hornet (Royal Australian Air Force)	Jan/Feb	48p
	F/A-18 Hornet (Spanish Air Force)	Mar/Apr	8i
	F/A-18 Hornet (Swiss Air Force)	Sep/Oct	49p
	F/A-18 Hornet (US Marine Corps)	Jul/Aug	16p, 17p
	F/A-18 Hornet (US Navy Blue Angels Display Team)	Jul/Aug	50p
	F/A-18 Hornet (US Navy)	Jul/Aug	4p, 15p, 16p, 17p, 17a
	F/A-18 Super Hornet (US Navy)	May/Jun	6p, 11
		Jul/Aug	17p
		Sep/Oct	58p
	KB-29	Sep/Oct	68p
	KC-46 (Republic of Korea Air Force)	Sep/Oct	8p
	MD-11BCF (Air Cargo)	Jan/Feb	9i
	P8 Poseidon (Indian Navy)	Nov/Dec	8p
	P-8 Poseidon (US Navy)	Sep/Oct	51p
	RC-125W Rivet Joint (BAF)	Jan/Feb	8i
		Nov/Dec	48p
	VC-25 'Air Force One'	Nov/Dec	8i
	X-1 Experimental Spaceplane	Sep/Oct	9
	MX-12 Osprey (USAF)	Sep/Oct	47p
	O Series (Prototype)	Jan/Feb	52p, 53p, 55p, 52p
	O Series (Swiss)	Jan/Feb	52p
	Challenger 350	Sep/Oct	8p
CRJ1 (American)	May/Jun	1p	
CRJ1 (Eritorian Air)	May/Jun	5p	
CRJ300 (Air France)	May/Jun	75p	
CRJ300 (QAC Air)	May/Jun	75p	
CRJ300 (Doria Regional)	May/Jun	75p	
CRJ200 (Prototype)	May/Jun	75p	
CRJ700 (Lufthansa)	May/Jun	76p	
CRJ900 (America West Express)	May/Jun	76p	
CRJ900 NextGen (Adria Airways)	May/Jun	74p	
CRJ900 Next Gen (Prototype)	May/Jun	76p	
Leapjet1 (Prototype)	Jan/Feb	75p	
	Jul/Aug	55p	
Leapjet 23	Jan/Feb	74p	
Leapjet 23 (NUSFS/Frank Sinatra)	Jan/Feb	73p	
Leapjet 23 (Prototype)	Jan/Feb	73p	
Leapjet 24	Nov/Dec	54p, 55p, 56p	
Leapjet 31A	Jan/Feb	74p	
Leapjet 32 (Lufthansa)	Jan/Feb	72p	
Leapjet 35	Jan/Feb	1p, 5a, 73p, 77a	
Leapjet 35 (USAF)	Jan/Feb	73p	
Leapjet 45	Jan/Feb	74p	
	May/Jun	82p	
	Sep/Oct	82p	
Leapjet 85	Jan/Feb	74p	
(M40) (ReandaAir)	May/Jun	6p	
Borussia Dortmund	Sep/Oct	17p	
Borussia Mönchengladbach	Sep/Oct	16p	
Borham, Sir Ian	Jul/Aug	19p	
Doutton & Paul	Sep/Oct	67p	
Bournemouth Air Festival	Nov/Dec	52p	
Bowden, Aemette	Mar/Apr	3p	
Branson, Sir Richard	May/Jun	82p	
	Jul/Aug	18p, 19p, 22p, 23p	
Brazilian Air Force	Jul/Aug	75p, 44p	
Breitling Jet Team	Civilian Jet Display Team	Jul/Aug	51p
		Sep/Oct	10p
Bromsted Horsemen	Civilian Jet Display Team	Jul/Aug	60p
Bromsted Aerojumble		Jul/Aug	9
Bridgewater, Steve (Author)		Jan/Feb	3.3, 28, 31, 50, 52, 56, 57, 58, 62
		Mar/Apr	3.3, 28, 31, 48, 49, 60, 61, 62, 63
		May/Jun	3.3a, 24, 25, 28, 29, 44, 51, 56, 57, 58, 59, 62, 64, 69
		Jul/Aug	
		Sep/Oct	3.3p, 46, 47, 52, 54, 55, 74, 75
		Nov/Dec	3.3p
Bristol	Britannia (BOAC)	Mar/Apr	75p
	Britannia (Prototype)	Jan/Feb	57
		Mar/Apr	75p
Bristow		Mar/Apr	53p
Britannia Airways		May/Jun	27p
British Air Ferries		Jul/Aug	71p
British Airways		Mar/Apr	10, 35p
		May/Jun	7p, 8p
		Jul/Aug	9p, 10p, 11, 58p, 82p
		Sep/Oct	4p, 9p, 18a, 19p, 20p, 21p, 22p, 23p
		Nov/Dec	48p
British Airways/BOAC		Sep/Oct	20p
British Airways/British European Airways		Sep/Oct	20p
British Airways/Cambrian		Sep/Oct	20p

British Airways/ Northeast Airlines		Sep/Oct	20p
British Eagle International		Mar/Apr	49
British European Airways		Mar/Apr	76p, 78p
		Sep/Oct	54p, 55p, 75
		Nov/Dec	47p
British European Airways/ British Airways		Nov/Dec	20p
British Island Airways		Jul/Aug	21p
British Midland		May/Jun	27p
		Nov/Dec	18p, 19p, 20p, 21p, 22p, 23p
British United		Sep/Oct	75p
		Nov/Dec	47p
British West Indian Overseas Airlines		Mar/Apr	44a
Britten Norman	Islander (Brynmor Airways)	Mar/Apr	50p
Brooklands Museum		Jul/Aug	7p
Bruce, 'Jack'		Jul/Aug	6p
Bruntingthorpe Airfield		Jan/Feb	6, 9
Bruntingthorpe Open Day		Jan/Feb	61p
Brussels Air Museum		Jan/Feb	30p
Brynmor Airways		Jan/Feb	82p
		Mar/Apr	1p, 50p, 51p, 52p, 53p, 54p, 55p
Brynmor European		Mar/Apr	53p, 54p
Burn	Orbiter	Jan/Feb	19p
C			
Caernarfon Air Museum		Sep/Oct	20p
Cambrian/British Airways		Sep/Oct	9p
Canadair	Argonaut (British Midland)	Nov/Dec	19p
		Jan/Feb	44p
	CF-114 Tutor (Canadian Air Force Snowbirds)	Jul/Aug	6p
	Sabre F4 (RAF)	Sep/Oct	78p
Canadian Air Force		Jul/Aug	44p
Capital Airways		Mar/Apr	49
Cartledge, Marilyn (Author)		Mar/Apr	32, 35
		Sep/Oct	16p
Carrouche Dore	Armee de l'Air Display Team	Jan/Feb	45p
CASA	C-101 Aviojet (Spanish Air Force Patrulla Aguila Display Team)	Jan/Feb	49p
Cessna	A-37B Dragonfly (North Vietnamese AF)	Jan/Feb	48p
	C-208 Caravan (Thai Bureau of Rainmaking & Agricultural Aviation Green Hawks Display Team)	Jul/Aug	50p
	Citation C3	Jan/Feb	72p
	Citation II (Prototype)	Jan/Feb	75p
	Citation II	Jan/Feb	75p, 77a
	Citation Latitude	Jan/Feb	77p
	Citation Mustang V-LJ	Jan/Feb	75p
	Citation Sovereign	Jan/Feb	76p
	Citation XLS	Jan/Feb	76p
	CitationJet	Jan/Feb	77p
	Fairjet 500 (Prototype Citation)	Jan/Feb	75p
	T-37A	Nov/Dec	32p, 33p, 34p, 35a
	T-37B	Nov/Dec	34p, 35p
	XI-37	Nov/Dec	30p, 31p
Chengdu	J-10 Vigorous Dragon (Chinese People's Liberation Army Air Force August 1st Display Team)	Jul/Aug	45p
	JF-17 Thunder	Jul/Aug	31
Chicago O'Hare Airport		May/Jun	11
Chiklan Air Force		Jul/Aug	45p
China Eastern Airlines		Nov/Dec	9, 45p
Chinese People's Liberation Army Air Force		Jul/Aug	45p
Chimney, Phil (Author)		Mar/Apr	58-59
Chorlton, Martyn (Author)		Sep/Oct	18, 23
Cirrus	SR22	Mar/Apr	29p
	Vision SF50	Jan/Feb	82p
		Mar/Apr	4p, 28p, 29p, 30p, 31p, 31a
		May/Jun	7p
		Sep/Oct	46p
City of Norwich Aviation Museum		Sep/Oct	11p
CityJet		Jul/Aug	21p
Classic Air Force		Jan/Feb	11
		May/Jun	6p, 9
		Sep/Oct	11p
		Nov/Dec	11p
Classic Airline (Feature)	British Midland - Half a Century of Challenge & Innovation	Nov/Dec	18, 23
	Brynmor Airways - London City Pioneer	Mar/Apr	50-55
	Delta at Ninety	May/Jun	18, 23
	Eastern's Silver Fleet (Eastern Airlines)	Jan/Feb	12-17
	The Thirty Year Old Virgin	Jul/Aug	18, 23
	The World's Favourite (British Airways at 40)	Sep/Oct	18, 23
Classic Airliner (Feature)	Avions de Transport Regiona (The ATR Story)	Mar/Apr	22, 26
	King of the Air (Boeing King at 50)	Nov/Dec	58-61
	Supersonic Campaigns (The Concorde Story)	Sep/Oct	24-27
	The Long & the Short of It (Bombardier CRJ)	May/Jun	74, 76
Classics Compared (Feature)	Boz-Jet Biographies (Learjet vs Citation)	Jan/Feb	72-77
	Gloster C.28/39 vs Heinkel He 108 (The True Pioneers)	Jul/Aug	76-81
	Guppy vs Beluga	Nov/Dec	76-81
	Hunter vs Swift	Sep/Oct	76-81
	Lightning vs Lightning II	Jan/Feb	62-67
	Pioneering Airlines Assessed - Comet vs Caravel	Mar/Apr	76-81
Coanda	Coanda-1910	Sep/Oct	52p
Coleman, 'Skeets'		Jul/Aug	6p
Commercial Aviation (Feature)	Maltese Retro Jet	Jul/Aug	56-57
	Retro Jets	Jul/Aug	58-59
	Trans-Polar Aviation	Jul/Aug	74-75
Commonwealth Aircraft Corporation	CAC 18 Mustang (NH577/VH-JUC)	Jan/Feb	48p
	Sabre 32 (VH-RPN/RAAF)	Jan/Feb	48p
Condor		Jul/Aug	58p
Concorde	B-24 Liberator	Nov/Dec	13p
Connaill	CV-440 (Delta)	May/Jun	19p
	CV-580 (Delta)	May/Jun	20p
	CV-990 (Japanese International Airways)	Mar/Apr	49
	CV-990 (Royal Jordanian Airlines)	Mar/Apr	49
	F106 Delta Dart	Mar/Apr	59p
	R3Y Tardweind	Nov/Dec	64a, 65p, 66p, 67p, 67a
		Sep/Oct	82p
	XP5V1 Tardweind	Nov/Dec	62p, 63p, 64p, 65p
Cooke, Richard (Author)		Sep/Oct	44-45

Cotter, Jon		Mar/Apr	38
Cotter, Jarrod (Author)		Jan/Feb	49
Cwington, Bill		Nov/Dec	29p
Creey Publishing		Sep/Oct	9
Croatian Air Force		May/Jun	11
		Jul/Aug	45p
Cruz del Sur	Argentinian Air Force Display Team	Jul/Aug	44p
CSA		Mar/Apr	24p, 81p
Curtiss	Condor (Eastern Airlines)	Jan/Feb	13p
Cyprus Airways		Mar/Apr	34p
D			
DAC Air		May/Jun	75p
Dana, Bill		Mar/Apr	77p, 70p
		Jul/Aug	6p
Dassault	Alpha Jet (Armée de l'Air Patrouille de France Display Team)	Jul/Aug	50, 45p
		Sep/Oct	10p
		Nov/Dec	80p
	Alpha Jet (Portuguese Air Force Asas de Portugal Display Team)	Jul/Aug	48p
	Mirage F.1 (Armée de l'Air)	Sep/Oct	9p
	Mirage F.1EH (Royal Moroccan Air Force)	Jul/Aug	3p
	Mydres 20	Jan/Feb	57p
	Rafale	Nov/Dec	27p
de Havilland	DH.100 Vampire F.1	Jul/Aug	62p
	DH.100 Vampire F.3	May/Jun	36p
	DH.100 Vampire FB.6 (GE DKS/ Royal Norwegian Air Force)	Jul/Aug	51p
		Nov/Dec	52p
	DH.100 Vampire F.11	Jul/Aug	60p
	DH.100 Vampire F.11 (LH OHZ/ Royal Norwegian Air Force)	Jul/Aug	51p
	DH.100 Vampire F.11 (PH ZVZ/ Rhodesian Air Force)	Jan/Feb	48p
	DH.100 Venom FB.50 (G-VENMA/WA36)	Jul/Aug	61p
	DH.106 Comet (Prototype)	Mar/Apr	77p
	DH.106 Comet 1 (Air France)	Mar/Apr	77p
	DH.106 Comet 1 (BOAC)	Mar/Apr	77p, 81a
		Nov/Dec	47p
	DH.106 Comet 2 (BOAC)	Mar/Apr	78p
		Jul/Aug	29p
	DH.106 Comet 3 (BEA)	Mar/Apr	76p
	DH.106 Comet 4 (Aerolineas Argentinas)	Mar/Apr	78p
	DH.106 Comet 4 (BEA)	Mar/Apr	78p
	DH.106 Comet 4C (Mexicana)	Mar/Apr	78p
	DH.106 Comet C.28 (Sagittarius/X6699)	Jan/Feb	101
	DH.110 Sea Vixen FRW 2 (G-VDX/PX24)	Mar/Apr	61
		Nov/Dec	28p, 29p, 52p
de Havilland Canada	DHC-3 Otter	Jul/Aug	68p
	DHC-3 Turbo Otter (Harbour Air)	May/Jun	82p
		Jul/Aug	5p, 64p, 65p, 66p, 67p, 68p, 69p, 69a
	DHC-6 Twin Otter (Bryman Airways)	Mar/Apr	50p, 51p
	DHC-6 Twin Otter (Prototype)	Jul/Aug	55p
	DHC-7 Dash 7 (Bryman Airways)	Mar/Apr	51p, 52p, 55p
	UC-6A Buffalo (US Navy)	Mar/Apr	58p
Delta		May/Jun	1p, 4p, 18p, 19p, 20p, 21p, 22p, 23p
Derby Airways		Nov/Dec	19p
DHL		Mar/Apr	3p
Diablos Rouge	Belgian Air Component Display Team	Jul/Aug	41p, 44p
		Sep/Oct	40p
Display Team Special (Feature)	Spear the Sky with Colour - From Yellowjacks to Red Arrows	Jul/Aug	36-41
Display Team Special (Feature)	Summer of '64	Jul/Aug	32-35
Dorner	Do-31	Mar/Apr	48p
Dorner	Do-X	Nov/Dec	46p
Douglas	A-4B Skyhawk (US Navy)	May/Jun	13p
	A-4C Skyhawk (Royal Australian Navy)	May/Jun	13p
	A-4E Skyhawk (US Navy)	May/Jun	16p
	A-4F Skyhawk (Blue Angels)	May/Jun	14p
	A-4F Skyhawk (US Marine Corps)	May/Jun	12p
	A-4F Skyhawk	May/Jun	14p, 16p, 17a
	A-4KU Skyhawk (Kuwait Air Force)	May/Jun	17p
	A-4M Skyhawk II (Douglas)	May/Jun	15p
	A-4M Skyhawk II (USAF)	May/Jun	17p
	B-66 Destroyer (USAF)	Sep/Oct	68p
	DC-10 (Biman Bangladesh)	Jan/Feb	9
	DC-10 (Delta)	May/Jun	22p
	DC-10 (Eastern Airlines)	Jan/Feb	12p
	DC-2 (PCA)	Nov/Dec	46p
	DC-3 (Austrian Air Charter)	Mar/Apr	49
	DC-3 (British European Airways)	Jan/Feb	64p
		Mar/Apr	57p
	DC-3 (Delta)	May/Jun	19p
	DC-3 (Derby Airways)	Nov/Dec	19p
	DC-3 (Eastern Airlines)	Jan/Feb	14p
	DC-4 (British Eagle International)	Mar/Apr	49
	DC-4 (Eastern Airlines)	Jan/Feb	14p
	DC-6 (SAS)	Jul/Aug	74p
	DC-7 (Super Snoopy)	Nov/Dec	56p
	DC-8 (Delta)	Jan/Feb	19p
	DC-8 (Eastern Airlines)	Mar/Apr	15p, 16p
	DC-8 (National Airlines)	Nov/Dec	44p
	DC-8 (SAS)	Jul/Aug	74p, 75p
	DC-8 (The Human Fly)	Nov/Dec	56p
	DC-8F (Capital Airways)	Mar/Apr	49
	DC-9 (British Midland)	Nov/Dec	21p
	DC-9 (Delta)	May/Jun	20p, 21p
	DC-9 (Eastern Airlines)	Jan/Feb	17p
	KA-3B Skywarrior (US Navy)	Jul/Aug	15p
	KC-10 Extender	Nov/Dec	40p
	TA-4E Skyhawk (US Navy)	May/Jun	15p
	TA-4J Skyhawk (US Navy)	May/Jun	14p, 15p
	TA-4SU (Singapore Air Force)	May/Jun	16p
	X401 Skyhawk	May/Jun	13p
		Jan/Feb	3p
Dow, Kate		Mar/Apr	36-41
Drags, Karl (Author)		Mar/Apr	9
Draken International		Jan/Feb	9
Dubai Airshow		Jan/Feb	9
Dunkley, Fred		Jan/Feb	25p
Dutch Hawkster Hunter Foundation		Sep/Oct	43p
E			
Eastbourne Airshow		Nov/Dec	52p
Eastern Airlines		Jan/Feb	1p, 4p, 12p, 13p, 14p, 15p, 16p, 17p

Edwards, Sir George		Sep/Oct	9
Egyptian Air Force		Mar/Apr	49
Ellis, Captain Charles 'Chuck'		Jan/Feb	53p
Elmdon / Birmingham Airport		Sep/Oct	54p, 55p
Embraer	EMB 312 Tucano (Mozambique Air Force)	Jul/Aug	11
	EMB 304 Super Tucano (Brazilian Air Force Esquadilha da Fumaca)	Jul/Aug	44
	ERJ 145 (British Midland)	Nov/Dec	23p
	ERJ 170 (British Airways)	Sep/Oct	23p
	KC 390 (Prototype)	Jul/Aug	7p
Emirates		Sep/Oct	11p
Engle, Joe		Mar/Apr	70p
English Electric	Canberra PR.3	Mar/Apr	37p
	Canberra PR.7	Mar/Apr	45p
	Canberra PR.9	Jul/Aug	70p
	Canberra PR.9(S) OMH/D/ XHL34 (Middle Sep)	Jan/Feb	82p
		Mar/Apr	1p, 36p, 37p, 38p, 39p, 40p, 41p, 41a
		Jul/Aug	8p, 61p
		Nov/Dec	10p, 52p
	Canberra TT.38 (VH S2Q/RA4F)	Jan/Feb	48p
	Lightning (production line)	Mar/Apr	64p
	Lightning F.1	May/Jun	58p, 61p, 63p
	Lightning F.1 (Firebirds)	Jul/Aug	33p, 34p
	Lightning F.1 (Tigers)	Jul/Aug	33p
	Lightning F.1A	May/Jun	58p
	Lightning F.2	Mar/Apr	13p
	Lightning F.2A	Mar/Apr	14p, 59p
	Lightning F.3	Mar/Apr	82p
		May/Jun	59p, 64p
		Jul/Aug	25p
	Lightning F.6	Mar/Apr	16p
		May/Jun	59p, 62p, 64p, 67a
	Lightning F.6 (ZU-BEW)	May/Jun	5p, 50p
	Lightning F.52	May/Jun	60p
	Lightning F.53	Sep/Oct	11p
	Lightning T.4	May/Jun	53p, 54p, 55p, 59p, 63p
	Lightning T.4 (Prototype)	May/Jun	52p, 53p, 54p
	Lightning T.5	May/Jun	52p, 56p, 57p, 59p
	Lightning T.5 (X458)	Mar/Apr	82p
		May/Jun	4p, 44p, 45p, 46p
	Lightning T.5 (ZU-BBD)	Mar/Apr	9, 82p
		May/Jun	1p, 48p, 49p, 50p, 51p
	Lightning T.54/T.55	May/Jun	60p
	PJA	Mar/Apr	82p
		May/Jun	1a, 38p, 39p, 40p, 41p, 42p, 58p, 63p
	PJB	May/Jun	40p, 53p, 58p
	Wren	Mar/Apr	82p
		May/Jun	41p
English Electric Lightning Special Issue		May/Jun	38-67
English, Malcolm (Author)		Jan/Feb	35-41
Esquadilha da Fumaca	Brazilian Air Force Display Team	Jul/Aug	44p
Estonian Air		May/Jun	5p
Ethiopian Airlines		Jan/Feb	11
		May/Jun	9
Ethiad		Jan/Feb	11
Ethiad Airways		Nov/Dec	7p
		Sep/Oct	9, 16p
Euro 2008		Sep/Oct	16p
Eurocopter	EC120 Colibri (Spanish Air Force Patrulla Aqda Display Team)	Jul/Aug	49p
	Typhoon (offered to Danish AF)	Sep/Oct	9
	Typhoon (Royal Saudi Air Force)	Nov/Dec	27p
	Typhoon (UAE deal)	Mar/Apr	9
	Typhoon FGR.2	Jul/Aug	9p, 10p
		Sep/Oct	5p, 61p, 62p, 63p
		Nov/Dec	3p, 11p
	Typhoon FGR.2 (RAF D Day Scheme)	Jul/Aug	61p
	Typhoon T.2	Sep/Oct	71p
EVA Air		Jul/Aug	8p
Ewan, Jamie (Author)		Sep/Oct	46-47
		Nov/Dec	58p
Express Air Services		Jul/Aug	27p
Extra	EA-300 (DHL)	Mar/Apr	3p
	EA-300L (Chilian Air Force Falcones)	Jul/Aug	45p
	EA-300L (Romanian Air Force Hawks of Romania Display Team)	Jul/Aug	48p
	EA-300L (Royal Jordanian Air Force Jordanian Falcons Display Team)	Jul/Aug	47p
F			
Fairchild	T-46A Eaglet	Nov/Dec	35p
Fabry	Garnet AEW.2 (XL454)	Jul/Aug	65p
	Garnet T.5 (N752TX/T752)	Jul/Aug	3p, 46p
Fannell, Capt James		May/Jun	9
Farewell (Feature)	Goodbye Timmy & Tammy	Nov/Dec	53p
Farnborough International Airshow		Jul/Aug	24p, 25p
		Sep/Oct	8p, 50p, 51p
FedEx		Sep/Oct	47p
Fiat	G.939AP (Freco Tricolor)	Jul/Aug	41p
		Jul/Aug	40p
Fiddian, Paul (author)		Jan/Feb	20-22
		Sep/Oct	32-35, 36-41
		Sep/Oct	36-43
		Nov/Dec	44-49
FIFA World Cup 1998		Sep/Oct	17p
Finair		Jan/Feb	57
Finnish Air Force		Jul/Aug	45p
Firebirds		Jul/Aug	33p, 34p
Flight Safety (Feature)	Keownorth - 25 Years On	May/Jun	28-30
Flight Testing (Feature)	Project Have Doughtnut - De Classified	Mar/Apr	72-74
fly2help Air Smiles Day		Sep/Oct	6p
Hydral		Mar/Apr	9p
Fokker	F-27 Friendship (British Midland)	Nov/Dec	22p
Folland	Gnat F.1	Jan/Feb	7i
	Gnat F.1 (G-MOVR/EZ96)	Nov/Dec	9p
	Gnat T.1 (G-MOVR/XS102/XR991)	Mar/Apr	61p
	Gnat T.1 (G-MOVR/XS102/XR992)	Jan/Feb	10i
		Mar/Apr	5a, 60p, 61p
		Jul/Aug	1p, 51p
		Sep/Oct	49p
	Gnat T.1 (G-ROR/XR538)	Jul/Aug	51p
	Gnat T.1 (G-TIMM/XP504/XS111)	Jul/Aug	1p, 51p
		Sep/Oct	49p

	Gnat T1 (Royal Air Force Red Arrows Aerobatic Team)	Jul/Aug	35p, 82p
		Jul/Aug	82p
		Sep/Oct	37p, 38p, 40p, 44p, 45p
	Gnat T1 (XN709)	Jan/Feb	65p
	Gnat T1 (XR584/X316RF)	Jul/Aug	65p
	Gnat T1 (XR586)	Jan/Feb	65p
	Gnat T1 (Yellowjacks)	Jul/Aug	5p, 56p, 36p, 37p, 38p
	Midgie (Prototype)	Jul/Aug	27p
Football Jets (special markings)		Sep/Oct	36p
Ford	Trimotor (Eastern Airlines)	Jan/Feb	13p
Foster, Peter R (Author)		Jan/Feb	44-47
Fouga	Magister (Armée de l'Air Patrouille de France Display Team)	Jul/Aug	34p, 41p
		Sep/Oct	40p
	Magister (Belgian Air Force Diables Rouges Display Team)	Jul/Aug	41p
		Sep/Oct	40p
	Magister (Belgian Air Force)	Jul/Aug	31p
Freall, Richard (Author)		Mar/Apr	66-70
		May/Jun	12-17
		Jul/Aug	12-17
		Sep/Oct	60-64, 66-71
		Nov/Dec	28-29, 36-43
Freese Tricolori	Italian Air Force Display Team	Jul/Aug	41p, 46p
		Sep/Oct	10p, 40p, 51p
From the Cockpit (Feature)	BOAC's Seven On Seven	Sep/Oct	30-35
	Gumman's Off Road Tank (OV-1 Mohawk)	Jan/Feb	58-62
	Lightning Two Seater	May/Jun	52-57
	The Enigma Jet (Flying the Messerschmitt Me 262 Replica)	Nov/Dec	12-17
	Turbo Otter	Jul/Aug	64-69
Frost, Sir David		Jul/Aug	12p
G			
Garside, David		Jul/Aug	10p
Garuda Indonesian		Jan/Feb	57
Gates	Learght (see Bombardier)	Jan/Feb	
General Dynamics	F-111	Sep/Oct	10p
Germain, Scott		Nov/Dec	16p
Germain, Scott (Author)		Nov/Dec	12-17
Gibbs, Rebecca (Author)		Mar/Apr	12-16
Gilze Rijen / RNLAF Luchtmachttdagen Airshow		Sep/Oct	48p
Gloster	E 28/39	Jul/Aug	62p, 76p, 73p, 80p, 81p, 81a
	F38-40 'Melecor'	May/Jun	36p
	Javelin FAW4	Nov/Dec	7p
	Javelin FAW8	Jul/Aug	62p
		Sep/Oct	68p
	Meteor F3	Sep/Oct	67p, 68p
	Meteor F4	Jul/Aug	62p
	Meteor F8 (Belgian Air Force)	Jul/Aug	31p
	Meteor F8 (VH-MBXV/X77-BSL/V224G7)	Jan/Feb	48p
	Meteor F8 Prime Position	Jul/Aug	82p
		Sep/Oct	12p, 13p, 14p, 15p, 15a
	Meteor L7 (G-BWMB/WA551)	Jul/Aug	25p
Gnat Display Team	Civilian Jet Display Team	Jul/Aug	51p
		Nov/Dec	5p
Goodwood Festival of Speed		Sep/Oct	48p
Gowdy, Jon		Mar/Apr	3p
Green Hawks	Thai Bureau of Rainmaking & Agricultural Aviation Display Team	Jul/Aug	50p
Griffiths, Ben (Daily Mail)		Jan/Feb	3p
Grinstead, Bob (Author)		Sep/Oct	30-35
Grob	G 102TP (Mexican Air Force)	Nov/Dec	9
Grumman	F-14 Tomcat	Nov/Dec	81p
	F9F Cougar	Sep/Oct	82p
		Nov/Dec	66p
	OV-1 Mohawk	Jan/Feb	58p, 59p, 60p, 61p, 62p
		Sep/Oct	47p
Gulf Air		May/Jun	26p
Gulfstream	G II (Rolls-Royce Ltd)	May/Jun	27p
H			
HAL	Drav (Indian Air Force Sarang Display Team)	Jul/Aug	46p
	HJF-16 Kiran II (Indian Air Force Sage Pawan Display Team)	Jul/Aug	46p
	HJF-16 Kiran II (Indian Air Force Surya Kiran Display Team)	Jul/Aug	46p
Halcones	Chilean Air Force Display Team	Jul/Aug	45p
Hales Dutton, Bruce (Author)		Jan/Feb	12-17
		Mar/Apr	50-55
		May/Jun	28-30
		Jul/Aug	18-23
		Nov/Dec	18-23, 62-67
Hall, Jerry		May/Jun	8p
Handley Page	Harrow	Sep/Oct	67p
	Herald (British Air Ferries)	Jul/Aug	71p
	Herald (British Midland)	Nov/Dec	20p
	Herald (Brynmor Airways)	Jan/Feb	82p
		Mar/Apr	1p, 51p
	Herald (Express Air Services)	May/Jun	27p
	Herald (G-APWJ repaired at Dunford)	Sep/Oct	7p
	HP115	Sep/Oct	26p
	HP42	Nov/Dec	45p
	Marathon (Dorby Airways)	Nov/Dec	19p
	Victor K.1	Sep/Oct	69p, 70p
	Victor K.2	Sep/Oct	70p
Harbour Air		May/Jun	82p
		Jul/Aug	5p, 64p, 65p, 66p, 67p, 68p, 69p, 69a
Harding, Admiral Russ		Nov/Dec	29p
Harding, Sarah		Jul/Aug	24p
Have Doughnut		Jan/Feb	8i
Hawker	Hart	Sep/Oct	67p
	Hunter F.1	Sep/Oct	79p, 80p
	Hunter F.4	Jul/Aug	27p
		Sep/Oct	80p
	Hunter F.4 (G-807B/WV256)	Nov/Dec	11p
	Hunter F.58 (G-PSSV/ Miss Demounour)	Jan/Feb	6i
		Nov/Dec	52p
	Hunter F6	Sep/Oct	80p, 81p, 81a
	Hunter F6 (Blue Diamonds)	Jul/Aug	33p
	Hunter F6A (G-KANF/XF515/N-294)	Sep/Oct	49p
	Hunter F51 (G-HUNT)	Sep/Oct	1p, 5p
	Hunter FGA.9	Sep/Oct	81p
	Hunter FR.10	Mar/Apr	34p
	PJ052	Sep/Oct	79p

	PJ067 Hunter (Prototype)	Sep/Oct	79p
	Hunter T.7	Sep/Oct	9p
	Hunter T.7 (G-BVGH/XLS72/Mdair Spr)	Nov/Dec	10p
	Hunter T.7 (G-FDOK/WV218/ Hunter Flight Academy)	Sep/Oct	49p
	Hunter T.7 (G-MMHD/XLS77/Mdair Spr)	Mar/Apr	40p
		Jul/Aug	8p
		Sep/Oct	76p
		Nov/Dec	10p
Hawker Siddley	Harrier (see BAE Systems)	May/Jun	
	HS.125 (JCB Excavators)	May/Jun	27p
	HS.125 Dominie	Nov/Dec	8p
	HS.748 (British Airways)	Sep/Oct	21p
	Kestrel FGA.1 (RAF Cosford)	Mar/Apr	7i
	Trident (British European Airways)	Nov/Dec	47p
	Trident (British Airways)	Mar/Apr	35p
		Jul/Aug	82p
		Sep/Oct	22p
	Trident (British Airways/Northeast)	Sep/Oct	20p
	Trident (Cypriot Airways)	Mar/Apr	34p
Hawkins, Kimberley (Author)		Jan/Feb	18-19
		Mar/Apr	72-74, 75
		May/Jun	72-73
		Jul/Aug	74-75
		Sep/Oct	28-29
Hawks of Romania	Romanian Air Force Display Team	Jul/Aug	48p
Heames, Sqn Ldr Chris		Mar/Apr	61p
Heathrow Noise Study		Sep/Oct	9
Heinkel	He 162	Jul/Aug	7p
		Nov/Dec	81p
	He 176	Jul/Aug	77p
	He 178	Jul/Aug	76p, 77p, 78p, 81a
	He 178B	Jul/Aug	78p
	He 280	Jul/Aug	78p
	HeS 3 engine	Jul/Aug	77p
Hellenic Air Force		Jan/Feb	46p
		Mar/Apr	8i
		Nov/Dec	25p
Heritage Aircraft Trust		Jan/Feb	3p, 7i
		Nov/Dec	9p
Historic Aircraft Association		Mar/Apr	9
		Sep/Oct	9
HondaJet	HondaJet	Sep/Oct	46p
HRH Princess Margaret		Mar/Apr	46p
Human Fly		Nov/Dec	56p
Hunter Flight Academy		Sep/Oct	49p
Hunting Percival	Jet Provost T.1 (Prototype)	Jul/Aug	27p
	Jet Provost T.3	Jul/Aug	41p
	Jet Provost T.3 (Red Pelicans)	Jul/Aug	5p, 32p, 34p, 35p
I			
Iberia Regional		May/Jun	75p
Icelandair		Sep/Oct	9p
Ilyushin	I-62 (Aeroflot)	Sep/Oct	75p
Ilyushin, Sergei		May/Jun	33
Imperial Airways		Sep/Oct	67p
Imperial Iranian Air Force		Jan/Feb	45p
		Nov/Dec	68p, 69p, 70p, 71p, 72p, 73p
Imperial War Museum Duxford		Jul/Aug	7p, 10p
		Mar/Apr	62p
		May/Jun	11p
		Sep/Oct	7p
Imperial War Museum Duxford Airshow		Jan/Feb	6i
		Jul/Aug	61p
		Nov/Dec	52p
Incoming!/Letters (Feature)		Jul/Aug	70-71
Indian Air Force		Jul/Aug	46p
Indian Airline Market		May/Jun	7p
Indian Navy		Mar/Apr	10
		Nov/Dec	8p
Indonesian Air Force		Jan/Feb	47p
		Mar/Apr	10
		Jul/Aug	46p
Interjet		Jan/Feb	6i
Iraqi Air Force		Mar/Apr	11
		Jul/Aug	10p
Iraqi Airways		Jan/Feb	52p
Irish International Airlines		Jan/Feb	57
Israel Aerobatic Team	Israeli Air Force Display Team	Jul/Aug	46p
Israeli Air Force		May/Jun	9p
		Jul/Aug	46p
Italian Air Force		Jul/Aug	46p
		Sep/Oct	49p
J			
Japan Airlines		Jan/Feb	11
Japan Transocean Air		Jul/Aug	7p
		May/Jun	11p
Japanese Air Self Defence Force		Jan/Feb	10
		Mar/Apr	58p, 59p
		Jul/Aug	46p
		Mar/Apr	10
Japanese Navy		Jul/Aug	9p
Japanese Technical Research & Development Institute	Advanced Technology Demonstration Experimental (Shimada)	Jul/Aug	9p
		Nov/Dec	7p
JCB Excavators		May/Jun	27p
Jet Art Aviation		May/Jun	68-70
		Jul/Aug	6p
		Jan/Feb	28-33
Jet Racing League		Mar/Apr	12-16
Jet Set (Feature)	Giving Something Back (Rick Peacock-Edwards)	Mar/Apr	12-16
JetBlue		Jan/Feb	6i
Johnson, Clarence 'Kelly'		Nov/Dec	37p
Jones, Julian		Nov/Dec	29p
Junkers	F13	Nov/Dec	45p
Jupiler Aerobatic Team	Indonesian Air Force Display Team	Jul/Aug	46p
K			
Kenworth		May/Jun	28p, 29p, 30p
Key Publishing	Takes over Jet's magazine	Nov/Dec	3p
KLM		Jan/Feb	57
		May/Jun	11
		Jul/Aug	8p, 58p
Knight, 'Pete'		Mar/Apr	70p
Kniweton, Patrick		Jul/Aug	10p
Korean Aircraft Industries	FA-50 (Philippine Air Force)	May/Jun	11
	KT-1B Woong Bee (Indonesian Air Force Jupiter Aerobatic Team)	Jul/Aug	46p
	T50B Golden Eagle (Republic of Korea Black Eagles Display Team)	Jul/Aug	48p

	T50Q (Iraqi Air Force)	Mar/Apr	11
Kuwait Air Force		May/Jun	6p, 17p
Kuwait Airways		Mar/Apr	9
L			
Lacy, Clay		Nov/Dec	56p
Laker Airways		Sep/Oct	37p
Lebanese International Airways		Mar/Apr	49
Leccky, Mike		Mar/Apr	39p
Libyan Presidential Flight		May/Jun	27p
Libyan Wings		Jan/Feb	11i
Lishe, Chaz		Mar/Apr	46p
Lockheed	A12	Nov/Dec	38p, 39p
	C-130 Hercules (Blue Angels)	Jul/Aug	60p
	C-130K Hercules (retires from RAF)	Jan/Feb	6i
	CL-823 SST	Sep/Oct	75a
	EC-130C 'Republic 5'	Jan/Feb	10i
	F-104A Starfighter	Mar/Apr	67p
	F-117A Nighthawk	Jan/Feb	64p
	L-100 Hercules (Delta)	May/Jun	20p
	L-1011 TriStar (All Nippon Airways)	Nov/Dec	48p
	L-1011 TriStar (British Airways)	Sep/Oct	18p, 21p
	L-1011 TriStar (Delta)	May/Jun	4p, 21p
	L-1011 TriStar (Eastern Airlines)	Jan/Feb	1p, 4p, 17p
	L-1011 TriStar (RAF)	Sep/Oct	66p
		Nov/Dec	53a
	L-1011 TriStar (RAF) Retires	May/Jun	10p
	L-1049 Constellation	Nov/Dec	47p
	L-1049 Constellation (Eastern Airlines)	Jan/Feb	14p
	L-188 Electra (Eastern Airlines)	Jan/Feb	15p
	RQ-33 (Imperial Republic of Iran Air Force)	Nov/Dec	73a
	RT-33 (Imperial Republic of Iran Air Force)	Nov/Dec	70p, 72p, 72a, 73p, 73a
	SR-71 Blackbird	Mar/Apr	63p
		Nov/Dec	1p, 5p, 36p, 37p, 39p, 40p, 41a, 42p
	SR-71 Blackbird (production line)	Nov/Dec	39p
	SR-72 'Son of Blackbird'	Jan/Feb	11
	T-33 (Imperial Republic of Iran Air Force)	Nov/Dec	1p, 5p, 68p, 69p, 70p, 71p, 72p, 73p
	T-33 Shooting Star (x-4)	Sep/Oct	47p
	U-2	May/Jun	11p
		Nov/Dec	36p
	YF-16 Fighting Falcon	Jul/Aug	14p
		Nov/Dec	7p
Lockheed Martin	C-130J Hercules (Republic of Korea Air Force)	Jul/Aug	9
	F-16 Fighting Falcon (Hellenic Air Force)	Nov/Dec	25p
	F-16 Fighting Falcon (South Korea upgrade order)	Mar/Apr	11
	F-16 VISTA Fighting Falcon (Thrust Vectoring) (NASA)	Sep/Oct	58p
	F-16A Fighting Falcon (Belgian Air Component)	Jul/Aug	30p
	F-16AM Fighting Falcon (Royal Netherlands Air Force)	Sep/Oct	48p
	F-16AM Fighting Falcon (Royal Netherlands Air Force)	Nov/Dec	7p
	F-16C Fighting Falcon (Republic of Singapore Air Force Black Knights Display Team)	Mar/Apr	8i
		Jul/Aug	48p
	F-16C Fighting Falcon (Romanian Air Force)	Jul/Aug	7p
	F-16C Fighting Falcon (Turkish Air Force)	Mar/Apr	8i
	F-16C Fighting Falcon (USAF)	Sep/Oct	58p
	F-16C Fighting Falcon (USAF Thunderbirds Display Team)	Mar/Apr	6i
		Jul/Aug	1p, 51p
		Sep/Oct	29p
	F-16D Fighting Falcon (Iraqi Air Force)	Jul/Aug	10p
	F-16D Fighting Falcon (USAF Thunderbirds Display Team)	Sep/Oct	46p
	F-22 Raptor	Nov/Dec	24p
	F-35A Lightning II Prototype	May/Jun	65p
	F-35A Lightning II (Republic of Korea AF)	May/Jun	7p
	F-35A Lightning II (Royal Australian Air Force)	Nov/Dec	10p
	F-35A Lightning II (Royal Netherlands Air Force)	Jan/Feb	11
	F-35B Lightning II	May/Jun	65p
		Jul/Aug	9p, 11
	F-35B Lightning II (RAF)	Mar/Apr	6i
		May/Jun	62p, 66p, 67p, 67a
	F-35B Lightning II (to visit the UK?)	May/Jun	8
	F-35C Lightning II	May/Jun	5p, 66p
	L-382J Super Hercules	Mar/Apr	10i
	Low Boom Flight Demonstrator	Sep/Oct	10p
	X-35	May/Jun	65p
		May/Jun	7p
Lockspeiser, David		May/Jun	53p
London City Airport		Mar/Apr	53p
London, Pete (Author)		Jan/Feb	24-26, 66-70
		Sep/Oct	12-15
LTU		Sep/Oct	16p
Lufthansa		Jan/Feb	72p
		May/Jun	76p
		Jul/Aug	54p, 59p
		Sep/Oct	11p
		Nov/Dec	49p
Lydd Airport		Sep/Oct	10p
		Nov/Dec	9
M			
Mallet, Timmy		Jul/Aug	19p
Manchester City FC		Sep/Oct	16p
Manchester United FC		Sep/Oct	17p
Manston Airport		Jan/Feb	9
Marche Verte	Royal Moroccan Air Force Display Team	Jul/Aug	47p
Marreros, Capt Adamos		Mar/Apr	33p
Martin	404 (Eastern Airlines)	Jan/Feb	14p
	WB-57F (NASA)	Sep/Oct	46p
Massesa, Dr Joe	F-101 Voodoo (USAF)	Jul/Aug	62p
McDonnell	F-115 Eagle (see Boeing)	Mar/Apr	68p
McDonnell Douglas		Sep/Oct	68p
	F-4B Phantom II (US Navy)	Mar/Apr	58p
	F-4E Phantom II (Lufthansa) (Cockpit)	Jul/Aug	6p
	F-4E Phantom II (USAF)	Jan/Feb	82p
		1p, 18p, 19p, 20p, 21p	
	F-4J Phantom II (US Navy)	Mar/Apr	58p
	F-4J Phantom II (Lufthansa) (RAF)	Nov/Dec	6p
	F-4J Phantom II (RAF)	Mar/Apr	13p, 14p, 15p, 16p

	QF-86F	Mar/Apr	58p
	RA-5C Vigilante	Mar/Apr	59p
	X-15	Mar/Apr	5p
	X-15	Mar/Apr	66p, 67p, 68p, 69p, 70p
North Korean Air Force		Nov/Dec	9
North Vietnamese Air Force		Jan/Feb	48p
Northeast Airlines/ British Airways		Sep/Oct	20p
Northrop	F-5A Freedom Fighter (Mexican AF)	Jan/Feb	41p
	F-5A Freedom Fighter (Philippine Air Force Blue Diamonds Display Team)	Jul/Aug	47p
	F-5A Freedom Fighter (Royal Norwegian AF / Tiger scheme)	Jan/Feb	39p
	F-5A Freedom Fighter (US Navy)/MIG-28	Jan/Feb	41p
	F-5A Freedom Fighter (USAF)	Jan/Feb	37p, 38p, 39p, 40p
	F-5B Freedom Fighter (USAF)	Jan/Feb	38p
	F-5E Tiger	Jan/Feb	5p
	F-5E Tiger (Swiss Air Force Patrouille Suisse Display Team)	Jan/Feb	1p
		Mar/Apr	7i
		Jul/Aug	49p
		Sep/Oct	10p
	F-5E Tiger II (Prototype)	Jan/Feb	39p
	F-5E Tiger II (Swiss Air Force)	Jan/Feb	35p
	F-5E Tiger II (US Navy Aggressor)	Jan/Feb	40p
	F-5E Tiger II (USAF Aggressor)	Jan/Feb	38p
	F-5E Tiger II (USAF)	Jan/Feb	39p, 40p
	F-5E Tiger IV (Prototype)	Jan/Feb	40p
	F-5E Tiger II (Swiss Air Force)	Jan/Feb	42p
	F-20 Tigershark	Jan/Feb	5p, 4ip
	FA-18 Hornet (see Boeing)	Jul/Aug	
	Global Hawk (USAF)	Jul/Aug	9
	N-102 Fang	Jan/Feb	36p
	N-156F (Prototype)	Jan/Feb	36p
	NF-5A Freedom Fighter (Turkish Air Force Turkish Stars Display Team)	Jul/Aug	50p
	RF-5A (Hellenic Air Force)	Jan/Feb	46p
	RF-5A (Iranian AF)	Jan/Feb	45p
	RF-5A (Royal Norwegian AF)	Jan/Feb	44p
	RF-5E (Indonesian AF)	Jan/Feb	47p
	RF-5E (Republic of China Air Force)	Jan/Feb	46p
	RF-5E (Royal Malaysian AF)	Jan/Feb	45p, 47p
	RF-5E TigerEye (Prototype) (USAF)	Jan/Feb	45p
	RF-5E TigerEye (Royal Saudi AF)	Jan/Feb	47p
	YF-17 Cobra	Jul/Aug	12p, 13p, 14p
	YF-5A (Prototype)	Jan/Feb	37p
	YF-38 Talon (Prototype)	Jan/Feb	36p
Northrop/Canadair	CF-105A (RCAF)	Jan/Feb	44p
	CF-5A Freedom Fighter (RCAF)	Jan/Feb	41p
	CF-5A (Venezuelan AF)	Jan/Feb	45p
O'Brien, Tim (Author)		Nov/Dec	53p
P			
Pacific Aerospace	CT-4E Airtrainer (Royal New Zealand Air Force Red Checkers Display Team)	Jul/Aug	47p
Pakistan International Airlines		Mar/Apr	49p
		May/Jun	33
Pakistani Air Force		Jul/Aug	47p
Panavia	Tornado (see B&E Systems)	Jan/Feb	
Patriot Jet Team	Civilian Jet Display Team	Jul/Aug	51p
Patrouille de France	Armée de l'Air Display Team	Jul/Aug	5p, 34p, 41p, 45p
		Sep/Oct	10p, 40p
		Nov/Dec	80p
Patrouille Suisse	Swiss Air Force Display Team	Jan/Feb	1p
		Mar/Apr	7i
		Jul/Aug	49p
		Sep/Oct	10p, 50p
Patrulla Aguila	Spanish Air Force Display Team	Jul/Aug	49p
Patrulla Aspa	Spanish Air Force Display Team	Jul/Aug	49p
PC-7 Team	Swiss Air Force Display Team	Jul/Aug	49p
Peacock-Edwards, Air Commodore Rick		Mar/Apr	14p, 16p
		May/Jun	52-57
Pewitt, Col J Dudley		Mar/Apr	20p
Philippine Air Force		May/Jun	11
		Jul/Aug	47p
Piaggio	P11H Hammerhead (Aerati UAV)	Jan/Feb	7i
Pilatus	PC-7 (South African Air Force Silver Falcons Display Team)	Jul/Aug	49p
	PC-7 (Swiss Air Force PC-7 Team Display Team)	Jul/Aug	49p
	PC-9 (Croatian Air Force Wings of Storm Display Team)	Jul/Aug	45p
	PC-9 (B&AF Routelites)	Jul/Aug	44p
	PC-9 (Royal Brunei Air Force Alag-Alag Formation)	Jul/Aug	44p
	PC-9 (Royal Thai Air Force Blue Phoenix Display Team)	Jul/Aug	50p
	PC-24	Sep/Oct	7p
Pioneers (Feature)	Aero's Flying Laboratory (Aero Ashton)	Jan/Feb	66-70
	Fill'er Up - A Short History of UK Air to Air Refuelling	Sep/Oct	66-71
	Fireball - Ryan's Best of Both Worlds Fighter Jetliner - Aero Canada's C-102	May/Jun	72-73
	Promote to Failure (Prone Position Meteor)	Sep/Oct	77-81
	The Flying Bedstead - Rolls-Royce Thrust Measuring Rig	Sep/Oct	12-15
	The World's First Jet? (Coanda 1910 Jet)	Sep/Oct	28-29
		Sep/Oct	52
Piper, Dave		Mar/Apr	39p
Pitcairn	Mail Wing (Eastern Airlines)	Jan/Feb	13p
Planes of Fame Airshow, Chino		Jul/Aug	60p
Polish Air Force		Jul/Aug	10p, 47p, 60p
		Sep/Oct	50p, 58p
Portuguese Air Force		Jul/Aug	48p
Pracy, Mark		Jan/Feb	31p
Pratt & Whitney	PW27XZ (ATR 72-500)	Mar/Apr	25p
Preservation (Feature)	Brumby's Buccs	May/Jun	24-25
	Lightning Flies Again!	May/Jun	48-51
	MidAir's Canberra	Mar/Apr	36-41
	Sao Vimen Returns Home	Nov/Dec	28-29
	TS Alivia (Lightning T-5 XS458)	Jan/Feb	44-46
	The Best of the Best (Jet Art Harrier & Tornado GR.1)	May/Jun	68-70
	Yellowjack's Back	Mar/Apr	60-61
Public Service Broadcasting		May/Jun	9
PZL Mielec	Lini-6 / MIG-17 Fresco	Sep/Oct	47p
	PZL-130 Orlik (Polish Air Force Team Orlik Display Team)	Jul/Aug	47p
	TS-11 Iłeka	Jan/Feb	5p
	TS-11 Iłeka (Hot Section)	Jan/Feb	28p
	TS-11 Iłeka (Pole Dancer)	Jan/Feb	28p, 30p
	TS-11 Iłeka (Polish Air Force Biało-Czerwone larky Display Team)	Jul/Aug	47p

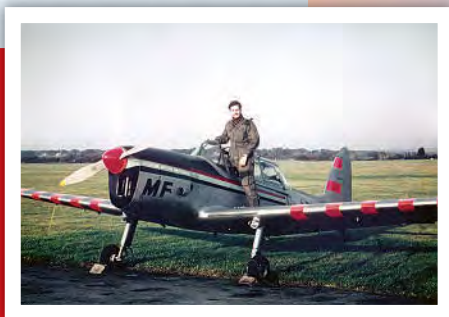
Q			
Qantas		May/Jun	27p
Qatar Airways		Jul/Aug	25p
Qingdao Airlines		Jul/Aug	11p
R			
RAF 12 Sqn	(Disbanded)	May/Jun	9
RAF 617 Sqn	(Disbanded)	May/Jun	9
RAF 617 Sqn	(Disbanded)	Mar/Apr	11
RAF Coningsby		Sep/Oct	6p
RAF Cosford Airshow		May/Jun	10p
		Jun/Aug	61p
		Nov/Dec	11p
RAF Lossiemouth		Mar/Apr	7i
RAF Museum, Cosford		May/Jun	9p
		May/Jun	36-37
RAF Museum, Hendon		Mar/Apr	8
RAF Waddington Airshow		May/Jun	9p
		Sep/Oct	49p
Record Breakers (Feature)	Antonov's Heavyweight (An-225) To Infinity & Beyond (The X-15 Story)	Jan/Feb	18-19
		Mar/Apr	66-70
Red Arrows	Royal Air Force Aerobatic Team	May/Jun	6p
		Jul/Aug	35p, 39p, 40p, 41p, 42p, 50p, 82p
		Sep/Oct	5p, 10p, 36p, 37p, 38p, 39p, 40p, 41p, 42p, 43p, 49p
		Nov/Dec	6p, 52p
Red Checkers	Royal New Zealand Air Force Display Team	Jul/Aug	47p
Red Falcons	Chinese People's Liberation Army Air Force Display Team	Jul/Aug	45p
Red Pelicans	Royal Air Force Aerobatic Team	Jul/Aug	5p, 32p, 34p, 35p, 38p
Reid & Sigrist	RS4 Bobbleleigh	Sep/Oct	12p
Reno Air Racing Association		Jan/Feb	28-33
Republic	F-84F Thunderstreak (Belgian Air Force)	Jul/Aug	31p
	RF-84 Thunderchief (Republic of China Air Force)	May/Jun	82p
	RF-84 Thunderflash (USAF)	Mar/Apr	59p
	RF-84F Thunderstreak (Belgian Air Force)	Jul/Aug	31p
	F-105 Thunderchief	May/Jun	14p
		Jan/Feb	46p
		May/Jun	82p
		Jul/Aug	50p
Republic of China (Taiwan) AF		Mar/Apr	8, 11
		May/Jun	7p
		Jul/Aug	9, 48p
		Sep/Oct	8p
Republic of Singapore Air Force		Jul/Aug	48p
		Nov/Dec	25p
Rhodesian Air Force		Jan/Feb	48p
Richards, Viv		Jul/Aug	19p
Rolls-Royce	Advance Engine Thrust Measuring Rig (Flying Bedstead) UltraFan Engine	May/Jun	11
		Sep/Oct	28p, 29p
		May/Jun	11
Romanian Air Force		Jul/Aug	7p, 48p
Rotorez de Portugal	Portuguese Air Force Display Team	Jul/Aug	48p
Routelites	Royal Australian Air Force Display Team	Jul/Aug	44p
Royal Australian Air Force		Jan/Feb	48p
		Jul/Aug	44p
		Nov/Dec	10p
Royal Australian Navy		May/Jun	16p
Royal Brunei Air Force		Jul/Aug	44p
Royal Brunei Airlines		Jul/Aug	11
Royal Canadian Air Force		Jan/Feb	41p, 44p
Royal Danish Air Force		Jul/Aug	11, 45p
Royal Danish Air Force		Sep/Oct	9
Royal International Air Tattoo		Jan/Feb	8
		Mar/Apr	7i
		Sep/Oct	49p, 50p
Royal International Air Tattoo	Award Winners 2014	Sep/Oct	8p
Royal Jordanian Air Force		Jul/Aug	47p
Royal Jordanian Airlines		Mar/Apr	49
		Nov/Dec	11p
Royal Malaysian Falcons	Royal Jordanian Air Force Display Team	Jul/Aug	47p
Royal Jordanian Air Force		Jan/Feb	45p, 47p
		Jul/Aug	47p
Royal Moroccan Air Force		Jul/Aug	3p, 47p
Royal Netherlands Air Force		Sep/Oct	48p
		Nov/Dec	7p
Royal New Zealand Air Force		Jul/Aug	47p
Royal Norwegian Air Force		Jan/Feb	39p, 44p
		Jul/Aug	51p
Royal Norwegian Air Force Historical Squadron	Civilian Jet Display Team	Jul/Aug	51p
		Nov/Dec	52p
Royal Saudi Air Force		Jan/Feb	47p
		Jul/Aug	49p
		Nov/Dec	27p
Royal Thai Air Force		Jul/Aug	50p
Rushciman, Sqn Ldr Wally		Jan/Feb	20p
Rushworth, Robert		Mar/Apr	70p
Russian Air Force		Mar/Apr	9, 11i, 14p
		Nov/Dec	9, 11p, 22p
		Sep/Oct	7p, 57p, 58p
Russian Falcons	Russian Air Force Display Team	Jul/Aug	48p
Russian Knights	Russian Air Force Display Team	Jul/Aug	48p
Russian Navy		May/Jun	17p
RwandaAir		May/Jun	6p
Ryan	Dark Shark Fireball	May/Jun	73p
		May/Jun	72p, 73p
		Jun/Aug	6p
Ryanair		Nov/Dec	9p
S			
Saab	J-29 Turbom (Swedish AF Historic Flight)	Mar/Apr	56p
	J-35 Draken (Swedish AF Historic Flight)	Sep/Oct	49p
	JAS-39 Gripen	Sep/Oct	59p
	JAS-39NG Gripen	Nov/Dec	27p
	SK60 (Swedish Air Force Team 60 Display Team)	Jul/Aug	49p
	T.17 (Royal Danish Air Force Baby Blue Display Team)	Jul/Aug	45p
Sabina		Sep/Oct	75
Sagar Pawan	Indian Air Force Display Team	Jul/Aug	46p
Sarang	Indian Air Force Display Team	Jul/Aug	46p
Saudi Hawks	Royal Saudi Air Force Display Team	Jul/Aug	49p
SaudiGulf		May/Jun	11
Sayer, Gerry		Jul/Aug	79p
SBAAC Airshow	Farnborough 1954	Jul/Aug	5p, 25p
Scaled Composites	White Knight One	Sep/Oct	7p

Scandinavian Air Services		Jul/Aug	59p, 74p, 75p
Seattle Seahawks		Mar/Apr	8i
SEPECAT	Jaguar GR.1	Sep/Oct	70p
	Jaguar GR.4	Jul/Aug	61p
Sherdils	Pakistan Air Force Display Team	Jul/Aug	47p
Shinhlawya	US 2 (Japanese Navy)	Mar/Apr	10i
Shoreham Aerogjumble		Mar/Apr	11
Short	Belfast (RAF)	May/Jun	32p
	C Class Flying Boat	Sep/Oct	67p
	C-123 Sherpa (US Army) (Retired)	Mar/Apr	7i
	PD05 (artist's impression)	May/Apr	33a
	Sea Mew	Jan/Feb	4p, 20p, 21p, 22p
		Mar/Apr	56p
	Skyvan	May/Jun	32p
	Spermin	Mar/Apr	82p
	Tucano T.1 (RAF Poppy Scheme)	Jul/Aug	61p
Showtime (Feature)	Airshow Reviews	Jul/Aug	60-61
		Nov/Dec	52
		Sep/Oct	48-51
Showtime Preview (Feature)	Farnborough International Airshow Preview	Jul/Aug	24-25
	The Art of Flight (GVA Exhibition Preview)	Jul/Aug	62
Showtime Special (Feature)	EAA Air Venture 2014	Sep/Oct	46-47
	Farnborough 1954 'Review'	Jul/Aug	26-29
	Warbirds Doncaster	Jan/Feb	48p
SIAM Marchetti	SF-260 (Belgian Air Component Duinkerke Ranges)	Jul/Aug	44p
Sikorsky	SG3N (Brinslow)	Mar/Apr	53p
Silver Falcons	South African Air Force Display Team	Jul/Aug	43p
Silver Stars	Egyptian Air Force Display Team	Jul/Aug	45p
Singapore Air Force		May/Jun	16p
Sky Wing	Chinese People's Liberation Army Air Force Display Team	Jul/Aug	45p
Skymark		Mar/Apr	9i
Sloggett, Dr Dave (Author)		Sep/Oct	24-27, 56-59
		Nov/Dec	24-27
Slovak Air Force		May/Jun	9p
		Sep/Oct	48p
Small Planet Airlines		Sep/Oct	10p
Smokey Bandits	Royal Malaysian Air Force Display Team	Jul/Aug	47p
Snowbirds	Canadian Air Force Display Team	Jul/Aug	44p
Socata	TB30 Epsilon (Armée de l'Air Carouache Dore Display Team)	Jul/Aug	46p
South African Air Force		Jul/Aug	43p
Spanish Air Force		Mar/Apr	8i
		Jul/Aug	49p
Spanish Navy		Jul/Aug	24p
		Sep/Oct	51p
SpiceJet		May/Jun	9p
Sud Aviation	Alouette III (Portuguese Air Force Rotores de Portugal Display Team)	Jul/Aug	48p
	Canavale (KLM)	Jan/Feb	57
Sukhoi	Su-22 Flitter (Polish Air Force)	Jul/Aug	60p
		Sep/Oct	50p
	Su-27 Flanker (Russian Air Force Russian Falcons Display Team)	Jul/Aug	48p
	Su-27 Flanker (Russian Air Force Russian Knights Display Team)	Jul/Aug	48p
	Su-27 Flanker (Russian Air Force)	Sep/Oct	57p, 58p
	Su-29 (Argentinian Air Force Cruz del Sur)	Jul/Aug	44p
	Su-34 fullback	Sep/Oct	7p
	Su-35 Flanker E	Nov/Dec	26p
	Su-35 Flanker E (Indonesian Air Force)	Mar/Apr	10i
	Supercrit 100 (Interjet)	Jan/Feb	6i
	Supercrit 100 (Utan-Express)	Jul/Aug	9p
	T-50/PMK-FA	Sep/Oct	9
Sun 'n Fun, Lakeland		Jul/Aug	60p
Supermarine	Scimitar	Sep/Oct	68p
	Spitfire PR.XIX (PM631)	Mar/Apr	4p, 15p
	Spitfire VIII (A78-758/VH-HET)	Jan/Feb	48p
	Spitfire XVI (TB863/VH-XVI)	Jan/Feb	48p
	Spitfire.XXX (F-22)	Sep/Oct	77p
	Swift (production line)	Sep/Oct	77p
	Swift (Prototype)	Sep/Oct	77p
	Swift F.1	Sep/Oct	78p
	Swift F.3	Jul/Aug	28p, 78p
	Swift FR.5	Sep/Oct	76p, 78p, 81a
	Type 510	Sep/Oct	77p
	Type 525	Jul/Aug	28p
		Sep/Oct	77p
	Type 541	Sep/Oct	77p
Surya Kiran	Indian Air Force Display Team	Jul/Aug	46p
Swedish Air Force		Jul/Aug	49p
		Nov/Dec	27p
Swedish Air Force Historic Flight		Sep/Oct	49p
Sweet, Gerry (Author)		Mar/Apr	22-26
Swifts	Russian Air Force Display Team	Jul/Aug	48p
Swiss		Jan/Feb	52p
Swiss Air Force		Jan/Feb	1p, 35p, 42p
		Jul/Aug	49p
		Sep/Oct	49p
Swiss International Airlines		Sep/Oct	16p
Syrian AF		Mar/Apr	8i
T			
T2 Aviation		Sep/Oct	49p
		Nov/Dec	52p
Taghvaei, Babak (Author)		Nov/Dec	68-73
Taylor, Steven (Author)		Mar/Apr	44-46
Team 60	Swedish Air Force Display Team	Jul/Aug	49p
Team Orlik	Polish Air Force Display Team	Jul/Aug	47p
Team Russ	Civilian Jet Display Team	Jul/Aug	51p
	Bombardier C-Series - Better late than never?	Jan/Feb	50-52
Technology (Feature)	The Jet - The Cmsa's Vision	Mar/Apr	28-31
Test Flying (Feature)	1,000mph in the P.1!	May/Jun	38-41
Testing Times/Reviews (Feature)		Jul/Aug	52-53
		Nov/Dec	50-51
Texton	Scorpion	Jan/Feb	11i
		Mar/Apr	10i
		Jul/Aug	9, 25p
Thai Bureau of Raimaking and Agricultural Aviation		Jul/Aug	50p
The Buccaneer Aviation Group		May/Jun	24p, 25p
The Way We Were (Feature)		Jan/Feb	56-57
		Mar/Apr	48-49
		May/Jun	32-33
		Jul/Aug	54-55
		Sep/Oct	74-75
Thompson, Milton		Mar/Apr	70p
Thompson, Warren (Author)		Mar/Apr	18-21

PATIENCE IS A VIRTUE

25
YEARS FROM
CADET TO
COMMAND

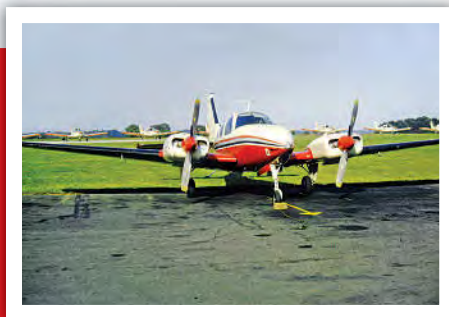




Hamble Cadet Grimstead with his favourite DHC-1 Chipmunk
all via Bob Grimstead unless stated



Our eighteen-month course at the College of Air Training, Hamble included 155 hours on Piper PA-28 Cherokee 180s



At Hamble, we students would use the Beech Baron for 70 hours of asymmetric, night and instrument flying training

Bob Grimstead reflects on a flying career that led him from BOAC's Boeing's 707-436 to British Airways' 747-400 via Boeings 720B, 737, 747-100-200, 757 and 767, and on the 25 years it took him to become a captain

A professional pilot's career is not for those of an impatient, hot-headed or impetuous disposition. Commercial aviation has always experienced huge cyclical swings in its fortunes, being even more prone than other industries to interest rate fluctuations and shifts in the public's disposable income. This makes recruitment particularly difficult, since an airline pilot is very expensive to train from start to finish. Nevertheless, once qualified, he or she should be able to anticipate a career spanning 30 years or more, but one that will inevitably suffer from this seesaw of 'boom' and 'bust'.

Forty five years ago, 24 keen new pilots joined BOAC (then Britain's national overseas airline, and joint ancestor of British Airways) towards the end of a major recruitment period. They were warned they would get less hands-on flying than their counterparts in the domestic airline, BEA, and told it would take them rather longer to become captains – perhaps even as much as ten years. In 1970, however, prospects seemed bright, with the first new Boeing 747s being delivered, and BOAC's Jumbo fleet was planned to grow to 50 by 1980, so these neophyte CPL-holders expected promotion at least before then.

I wonder how they would have reacted had they then known what the future really held.

Cadet life

The lucky young men (for in those days the corporations only employed male pilots) had just finished an eighteen-month course at the College of Air Training, Hamble. Here, high standards and hard work were

expected for six days a week, with just a fortnight of summer leave and four days off at Christmas and Easter. Life was artificially constrained, with females prohibited within its buildings and marriage forbidden.

Living on an airfield with unlimited access to perfectly maintained light aircraft should have been bliss, but was often pure hell. Most mornings bleary cadets could be seen peering through their curtains, willing the mile-distant Calshot chimney to be obscured by mist or cloud so they could escape having their confidence battered or their flying performance criticised.

These bright-eyed airline novices had completed a mere 155 hours on Cherokee 180s (with, if they were lucky, some Chipmunk time included) and 70 hours of asymmetric, night and instrument flying in the lovely Beech Baron. Half of them would go on to fly the magnificent and much-loved (if rather noisy and uneconomical) Vickers VC10. Those less fortunate were allocated to the comparatively unsophisticated Boeing 707. Though disappointed, they quickly subscribed to the tradition (at least among 707 crews) that their fleet selected the more skilled pilots because of its demanding handling, especially with one or more engines failed. (Pod-mounted engines spread out along the wing cause strong yawing and rolling forces when that power is removed).

On to airliners

It takes some courage to go straight from a Baron to a hundred-times-bigger 140-ton Boeing 707 after a mere twenty hours of preparation in a rudimentary fixed-base, no-visual simulator. I know it does, for I was



Second Officer Grimstead smiles for the official BOAC cameraman during his first week on the job



I started airline flying on the Boeing 707 with BOAC and loyally continued to pursue a career with the national airline Tom Singfield



In 1976 I was seconded to Monarch Airlines for an intensive summer of inclusive-tour charter flying. On joining, I had made 55 route landings in five years; but I returned to British Airways with nearly treble this score after a mere six months Tom Singfield

one of those 24 young men, and am not ashamed to admit that I 'bottled out' and threw away my first 707 landing, going around from the flare because I seemed quite unable to control this roaring, rolling monster as it rushed across the threshold of Prestwick's Runway 31 [see *Jets* Sept/Oct 2014 p30]. Everything happened so fast compared with the gentlemanly and forgiving Baron.

My first-ever international jet journey was actually *at the controls* of a 707 bound for Tel Aviv, Teheran, Bombay, Hong Kong, Tokyo, and that mysterious distant destination of Honolulu, about which I knew little except that it was presumably somewhere in the Pacific (Hawaii Five-O had yet to be conceived).

Youngsters learn fast, and I was soon checked out as a one-striped *Second Officer*. But, in common with many of my co-pilot contemporaries, it was well over a year before I was actually allowed to fly the aeroplane with fare-paying passengers aboard. It took us all such a long time to gain experience because many skippers seemed reluctant to let anybody else handle their demanding aeroplane. I think some of them were secretly afraid of it. Like others, I boosted my experience with a little twin Cessna air taxi work and some Auster pleasure flying.

There is no such thing as advancement by merit in the airline world, however good you are, more's the pity. Seniority (based primarily on date of joining the company) rules everything, from allocating monthly rosters and annual leave, to promotion opportunities and choice of aircraft type or base. So for several years we newcomers were on two-hour standby most of the

time, occasionally being brought up to 45-minute standby, and frankly delighted to be 'called out'. If we weren't used, we were allocated a mundane 'recency' trip every 28 days to keep our licences valid.

Two years after joining, we sat our ATPL exams (there were no frozen ATPL courses then), progressing to *Acting First Officer* status with two shiny gold rings on our sleeves.

Waiting list

In the meantime, BOAC merged with BEA. The combined airline's re-equipment plans meant the envisaged fifty-Jumbo intercontinental fleet did not materialise for many years. As scores of ex-BEA pilots

types, including some of the most modern, plying routes varying from short British domestic legs to the furthest reaches of the world, so its pilots get a broad choice of lifestyles. Seniority becomes more important the longer you stay, as does your pension's value. Perhaps most importantly, I believe BA has the highest pilotage and safety standards of any airline in the UK and most probably in the world.

Officer to gentlewoman...

Six years into my career, and by now a full *First Officer*, because of the pilot surplus I was seconded to Monarch Airlines for an intensive summer of inclusive-tour charter

"The nowadays somewhat unfashionable concept of loyalty"

transferred to long-haul, 'seniority' pushed us down the lists and our expectations were further dashed. The OPEC-induced oil shortage and progression from three-pilot Vanguards, Tridents and Tristars to two-pilot 737s, 757s and 767s brought more surpluses, continually reducing command vacancies. More than most others, British Airways' co-pilots learned the value of career patience.

Why did we not quit? Maybe because of the nowadays somewhat unfashionable concept of loyalty; the corporations had paid for much (although not all) of our training, and continued employing us through thick times and thin. Also in those times of fiscal insecurity, there were few other airline jobs around. BA also has a wide range of aircraft

flying. Their lovely girls and friendly captains were a revelation; one skipper hit me with a checklist for calling him 'Sir', a BOAC reflex that took me weeks to shed.

During that long, hot, delay-ridden summer of 1976, we seemed only to fly and to sleep, with just the briefest of time off for bad behaviour. Six of us shared a local four-room cottage, using a 'hot-bed' system, but there were few conflicts – no-one was on the ground long enough. On joining, I had made 55 route landings in five years; but I returned to British Airways with nearly treble this score after a mere six months.

Now a three-striped *Senior First Officer* on the élite long-range, fan-engined Boeing 707-336 fleet, I roved worldwide, flying

passengers or freight to and from the USA, the Caribbean, Africa, the Far East and Australia. The following year I married a Jumbo stewardess.

After twelve years and, as I believed, long overdue for a command, British Airways' 707s were scrapped at short notice and all its crews stood down as a 1981 Christmas present. Once more, there were no pilot vacancies, and this time the principles of seniority were completely ignored in favour of the cheapest solution for the airline. So a brief period of limbo preceded a voluntary personality change to 'Roberta', Zambia Airways stewardess, appropriately on April 1. My beard came off in favour of a steward's slim stripes and a 'sincere' smile and, in company with 'Geraldine' and 'Theresa' (formerly Gerry and Terry, two other stood-down co-pilots), I spent a month of twelve-hour nights as (un-trained) cabin crew, shuttling to and from Lusaka – whereby hangs an un-publishable tale or two.

Displaying talent

Next came five days of flying a SOCATA Tobago with wires protruding from the back of my head for sleep deprivation trials at Farnborough's Institute of Aviation

Medicine. After a week of practice, we were kept awake for just one night! Our flying performance was monitored the following day; there was of course some deterioration.

After much persuasion, British Airways eventually agreed to re-deploy two dozen of us as Gatwick-based BA and British Airtours stewards in the longer term, serving passengers on both scheduled and charter flights not only all around the Mediterranean but as far afield as North Africa and even to US destinations including Los Angeles. Believe me, LAX-LGW is a long night flight to cater to 194 customers crammed aboard a 707 with no in-flight entertainment!

Meanwhile, in my limited time off I started air display flying with the Tiger Club's renowned Turbulent Team in an attempt to retain my flying skills and hand-eye coordination.

Three years of (re-bearded) short-haul flying followed as co-pilot on the skittish Boeing 737, when I again virtually doubled my tally of landings from 342 to well over 600. Then, after a total of fifteen years with the company, my slowly increasing seniority at last allowed me to get my hands on the 747 I had coveted on joining. But that was such a disappointment! What had appeared to be a sleek, modern giant with big windscreens

turned out to have a cramped, antiquated, noisy flight deck with a view like looking out of a letterbox. The dislocation of a long-haul life forced me to drop the display flying in favour of writing as an aviation journalist but nevertheless, after eighteen years, my turn as captain seemed imminent.

In it for the long haul

But I was embroiled in a divorce, and did not need the extra strain of a command course, so when the opportunity eventually arose I elected to wait a further year. Big mistake! British Airways changed the working agreements of its Manchester, Birmingham and Scottish-based pilots, and so they swarmed to Heathrow like shipwrecked rats, slotting into the seniority lists above us. Bang went any command vacancies for a few more years.

For a change of scene and to boost my income, I transferred to the new ultra-long-haul Boeing 747-400 as a self-badged *Megasenior First Officer*. My planned 'couple of years' on that fleet turned into five and a half, during which I met and married Karen, the woman of my dreams, accepting the many disadvantages of long-haul flying for the chance to explore the world with her.

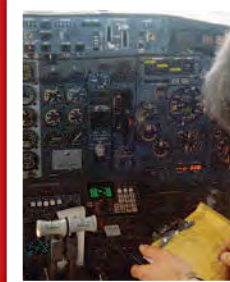
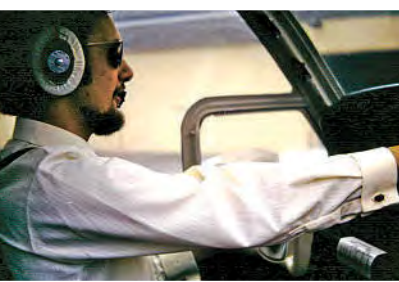


Above: A brief period of limbo preceded a voluntary personality change to 'Roberta', Zambia Airways stewardess, appropriately on April 1. My beard came off in favour of a steward's slim stripes and a 'sincere' smile. I spent a month of twelve-hour nights as (un-trained) cabin crew, shuttling to and from Lusaka – whereby hangs an un-publishable tale or two

Now a three-striped Senior First Officer on the élite long-range, fan-engined Boeing 707-336 fleet, I roved worldwide, flying passengers or freight to and from the USA, the Caribbean, Africa, the Far East and Australia *Adrian M Balch*

Three years of short-haul flying followed as co-pilot on the skittish Boeing 737, when I again virtually doubled my tally of landings from 342 to well over 600. This example, G-BGJL, subsequently burned out at Manchester and I was called out on standby an hour later to go and collect its return passengers from Corfu. Understandably they were a subdued bunch





ABOVE LEFT TO RIGHT:
Cadet Pilot Grimstead flying the Beech Baron in 1970

First Officer Grimstead flying the 707 from London to Cairo in February 1978

Senior First Officer Grimstead in the right-hand seat of a 707-336C en route to Hong Kong at Mach .80 in 1980

Senior First Officer Grimstead undertakes a training flight on the Boeing 737 in December 1982

Mega Senior First Officer Grimstead aloft in a Boeing 747-436 in 1990

New Captain Grimstead smiles from the cockpit of a Boeing 757 in early 1996

Captain Grimstead performs his last Boeing 747-436 sector to Perth, Australia in February 2000

After a total of fifteen years with the company, my slowly increasing seniority at last allowed me to get my hands on the 747 I had coveted on joining. But that was such a disappointment! What had appeared to be a sleek, modern giant with big windscreens turned out to have a cramped, antiquated, noisy flight deck with a view like looking out of a letterbox Caz Caswell



By that time our 24-man intake was widely scattered around the British Airways' fleets..Among them I was the last to get promotion, but there was at least one even more senior co-pilot who never did undertake a command course, and many of our group took over twenty years to do so. Of that original 24, by then three had left the airline to pursue other careers, several were divorced and a couple of others lost their licences for medical reasons.

Hereabouts there might have been a chance of my getting a BAC-111 command, but by now I had become selective. Sorry BA, but I didn't fancy flying short British domestic schedules on an antiquated airframe with black-and-white dials. Having waited so long, only a two-tone brown flight deck with CRT EFIS screens would suit me now.

I had thought nothing would entice me from the magnificent 747-400 and hoped to get a right-to-left seat command on type; but a flood of more senior captains from short-haul to our more lucrative long-haul fleet continually pushed back my chances.

Taking command

Eventually the lure of a fourth stripe proved stronger than fleet loyalty, so when, after just over 25 years, I was offered a command/conversion course on to the Boeing 757/767 fleet, I jumped at it. By then I had amassed nearly 15,000 hours in fourteen jet types to and from 210 international airports. But, thanks to the preponderance of long-haul flying, I still had only made 950 landings. And at 47 I was pretty ancient to undertake this transition. I well remember being told by

one of my early skippers that a command course candidate could be too old at forty – an age I had already passed without noticing some years previously.

The training was a straight conversion course, the 'command' aspects being incorporated as we went along. Two weeks of ground school took place in a *carrel* – a paper and Perspex flight deck with video screens instead of windscreens. Here we were introduced to the intricacies of a 757's electrics, hydraulics, pneumatics, instruments, and all its other systems – 54 lessons in all, with daily fixed-base simulator exercises and a single, all-encompassing final examination. The required pass mark was ninety per cent, but clearly anything less than total knowledge of one's aircraft is inadequate. I finished this phase reasonably confident, but

Eventually the lure of a fourth stripe proved stronger than fleet loyalty, so when, after just over 25 years, I was offered a command/conversion course on to the Boeing 757/767 fleet, I jumped at it. By then I had amassed nearly 15,000 hours in fourteen jet types to and from 210 international airports. But, thanks to the preponderance of long-haul flying, I still had only made 950 landings. And at 47 I was pretty ancient to undertake this transition Steve Bridgewater





slightly surprised at the 757's comparative lack of sophistication after the 747-400.

Eleven simulator details followed, including the all-important Instrument Rating and Base Check. These days everything is done on the fairly lifelike zero-flight-time simulators, so the first time you get your hands on the real aeroplane there are nearly 200 fare-paying passengers to observe your performance. Twenty route sectors are deemed sufficient preparation for the Big One, your first in-command Route Check. During this return flight the candidate gets to demonstrate the distilled essence of 25 years experience and the world's finest

standard RB 211-535C engined aircraft I had encountered throughout my training. So, as I went to plug in my headset, I could find no sign of sockets anywhere near the normal place by my left knee. *Don't panic, Grimstead, it must be here somewhere.* My search encompassed wider and wilder arcs around the cockpit before the senior training captain acting as my 'competent but not assertive' co-pilot wordlessly indicated the twin holes high above my head! Well; how should I know they were there!

I was glad to get away just three minutes late. On a straight stretch of taxiway, I relinquished control to address a better-late-

not to panic in front of 150-plus innocent witnesses and ruin their image of a captain, I scrabbled around, eventually gaining access, and slumped, drained, on to the lavatory lid. In that unorthodox location, I mentally calculated the fuel load for our return leg.

I shall not bore you with more of the petty tribulations and disasters of arguably the worst flight of my career; despite the fact that I can still remember every detail. Suffice to say that, eventually, at 21:00 on a gloomy evening in November 1995, I was pronounced 'fit for command'. I had not been so elated since my acceptance for basic training. This fulfilled my ambition from the time when, as a youngster, I had stood tiptoed on my bedroom windowsill, watching the airliners approaching Heathrow's then *Runway 28 left*. My beard was immediately shaved off (it had long since turned grey), and I now had four stripes and plenty of wrinkles as better proof of my experience.

Captain experience

Once 'on the line' I felt a bit out of my depth at first. I had become used to the gentle pleasures of operating in the Far East, Australia, South Africa and Latin America, where 'bad weather' means perhaps a few showers and the temperature plummeting to +20°C. Now I was thrust into the depths of a harsh European winter; with ice, snow, gales and freezing rain all conspiring to make us miss our ever-tighter ATC slots. But this was all good

"Seniority allowed me to get my hands on the 747"

coaching to his Flight Training Manager; who occupies the 'best seat in the house', the flight-deck jump seat.

This is a standard passenger operation ('Just treat it as a normal flight old boy, these notes are more for my benefit than yours'), but anybody who says his Command Check was routine is lying.

Doing it for real

I have never been so nervous in my life. Throughout the five-hour ordeal, my mouth was dry and my hands trembled. It was December; and I awoke from a restless night, feeling slightly light-headed and disconnected, to two inches of snow in the garden. Great! A quick skim through the bad-weather pages of the Flying and Technical Manuals seemed appropriate. That turned out to be a waste of time; Heathrow had not seen one snowflake. But our aeroplane had developed a couple of faults, including a radio altimeter problem limiting our autoland capability. This for a murky, cloudy, freezing flight to and from Zurich – in the dark.

After checking the aircraft's security, rectification work, fuel load, serviceability and the myriad other details a skipper is responsible for (even if he cannot control them), I settled into my seat. Our aircraft was a near-new, E4-powered model 757, with more thrust, more seats and different in a few minor details from the

than-never welcome to our passengers. But, in my distracted state, I forgot to re-select the audio panel. My broadcast over Heathrow's Ground Control frequency "Good evening ladies and gentlemen, this is your captain" generated much mirth from colleagues around the airport. Fortunately, I was stopped before actually saying my name!

My demeanour alternated between calm confidence and high anxiety. Later, during the cruise, I felt in need of a break from the pressures of four scrutinising eyes, so I left the flight deck for the toilet immediately behind – only to find its door opened differently from those on a standard aircraft. Trying



On a straight stretch of taxiway, I relinquished control to address a better-late-than-never welcome to our passengers. But, in my distracted state, I forgot to re-select the audio panel. My broadcast over Heathrow's Ground Control frequency "Good evening ladies and gentlemen, this is your captain" generated much mirth from colleagues around the airport Caz Caswell

Commercial Aviation

character-building stuff, and I survived without accident, incident, diversion or significant delay.

It's strange but, for 25 years, and despite holding an ATPL, as co-pilot you are just the bloke in the right seat who flies the aircraft down to limits for the captain. Then, virtually overnight, you become the maker of all decisions and fount of all knowledge, from a stewardess's weekend weather forecast, through being able to list the EU member states and knowing the capital of Macedonia, to diagnosing an odd engine or system malfunction or assessing a sick passenger's likely survival time.

The funny thing is that, although I had been around a while, I did not *feel* particularly experienced. Other than once a year in the simulator, I had never rejected a take-off from high speed, nor even had a tyre burst or a thrown tread, neither had I been struck by lightning, had a windscreen fail, experienced a low-altitude wake turbulence encounter, suffered a toilet fire nor had a passenger run amok – none of which are unheard-of occurrences. I had not even had to make a real, can't-see-a-thing, zero decision height autoland. And, while genuine engine failures were an annual event in my first decade on 707s, I never had to shut down any of the many Rolls-Royce RB 211s that had sustained my flight since then.

Twenty-five year habits can be hard to break. It took months to resist a tendency to glance over to my left when someone called out, "Captain". Being referred to as 'sir' definitely raised a grin, and for a long time I felt slightly fraudulent when saying to the passengers "This is your captain speaking" (although that phrase did guarantee my announcement would be accompanied by the recommended smiling voice). Indeed, I was so distracted by gloating over the new rank on my business cards that it took me several weeks to notice that my name had been mis-spelled!



I slowly began to appreciate that I had the best seat, on the most varied fleet in the world's finest airline, flying 65 individual aircraft of two types to 83 scheduled destinations from the USA's West Coast and Atlantic Seaboard to the Middle East and Africa, as well as ranging all over Europe

Job satisfaction

In contrast to the lofty detachment of a 747's gently inexorable departure, 757 take-offs had a much greater immediacy, with real acceleration as the runway lights flashed past our ears for the lightweight dash to Manchester, Newcastle or Paris. But I definitely did not miss the permanent curse of jetlag caused by those eight and nine hour time-changes. It was bliss to get a good night's sleep without the aid of earplugs, eyeshades and company-issued

little short of superb in their professionalism.

I slowly began to appreciate that I had the best seat, on the most varied fleet in the world's finest airline, flying 65 individual aircraft of two types to 83 scheduled destinations from the USA's West Coast and Atlantic Seaboard to the Middle East and Africa, as well as ranging all over Europe. After a few months, I was checked out on the larger but more responsive and more familiar ("It's just half a 747-400" said one

"20 route sectors are deemed sufficient preparation for the Big One"

sleeping pills. And three years on this fleet soon restored my lack of flying practice, for my former complaint of only making fifteen or so landings a year was now long gone – I had done that many in my first fortnight of training!

I could not have accomplished the task without the stalwart help and support of the 757/767 fleet's extremely professional co-pilots who, to a man and woman, made me feel slightly ashamed of my waning personal flying and operational standards towards the end of my own term as first officer. I had long believed the term 'co-pilot' should mean not 'assistant pilot', but 'joint pilot', and these young men and women were

engineer) medium/long-range Boeing 767-300ER, and qualified to fly the Atlantic on just two engines, along with three-quarters of that ocean's present-day traffic.

Although there was still for a long time a tiny, ex-BOAC bit of me that wondered if these twin-engined ETOPs operations were entirely prudent, nevertheless I resisted the urge to wear my lifejacket as I would when crossing water in a piston single. My responsibility, status and income had improved, and my job satisfaction increased beyond all imagining.

Had it been worth the 25-year wait? You bet! Every *minute* of it! ●

After three years with British Airways' 757/767 fleet I transferred back to my beloved Boeing 747-400 and its ultra-long-haul routes for my final half-decade before compulsory retirement in 2003. By then, in a 33-year career, I had amassed 21,500 flying hours operating to and from 238 jet destinations. Coincidentally, I had also flown 238 different aircraft types – but that is another story entirely! Neal Carlton



Testing Times

The team puts the latest jet-related books to the test

BOOK

Lightning 1954-2014

Ian Black
Firestreak Books
www.firestreakbooks.com
120 pages, hardback, colour
£39.99 plus p&p

Ian Black is a former RAF Fighter Pilot with a passion for photography – and this comes across in his latest self-published book. Although he began his career as a navigator in the F-4 Phantom II in RAF Germany at the height of the Cold War Ian began pilot training in 1984 and was selected to fly the English Electric Lightning in the Air Defence role. His father had been one of the RAF's first Lightning pilots and Ian was set to become the last person to graduate from the Lightning OCU.

The concept of this 'coffee table' book is very simple as it merely combines Ian's love of the Lightning with his passion for photography. No attempt has been made to cover individual aircraft histories or what lies beneath the skin as this has been covered adequately elsewhere – this is purely a photographic record of the highest quality. Each image has been chosen to capture the very essence of what it was like to operate and maintain this charismatic aircraft. The images are even unspoiled by captions – with just a brief description of each image listed on a 'contact sheet' index at the rear of the book.

No coffee table is complete without this book!



BOOK

British Aerospace Hawk: A Photographic Tribute

Michael Leek
Pen & Sword
248 pages, hardback, colour
ISBN 9781781592946
£30.00

This book highlights the BAe Hawk in RAF and Royal Navy service but also features other nation's Hawks that have visited the UK.

The book includes some dramatic low-level photographs but they seem very disjointed – for example there are a number of images of Finnish Hawk's from their 2013 visit to RAF Valley, yet they are sprinkled haphazardly throughout the book (with very similar captions) rather than grouped together in a separate chapter.

Likewise the captions are vague at times ("it is believed the 2004 Hawk display pilot was Flt Lt Jon Egging...") and the descriptions of the images rather self-indulgent ("A pleasing photo of X...").

It's a pity the detail of the captions, as well as the layout of the images, do not do justice to the subject matter – which certainly deserves a good tribute in its 40th year.

And, for the record, the 2004 display pilots were Flt Lts Jon Killerby and Dave Harvey...



BOOK

Haynes Manual – Panavia Tornado (1974 onwards – all marks & models)

Ian Black
Haynes
160 pages, hardback, colour and B&W
ISBN 9780857332479
£21.99

Since 1986 the multi-role swing-wing Panavia Tornado has been the cornerstone of the RAF's jet fighter and bomber forces. Designed to intercept Cold War Soviet bombers and drop conventional and nuclear weapons on invading Warsaw Pact forces, RAF Tornados have gone on to see action in both Gulf Wars, over Kosovo, and most recently over Afghanistan and Libya.

In this book former RAF Tornado F.3 pilot Ian Black gives an insider's insight into operating, flying and maintaining the air defence and strike versions of the swing-wing jet.

From the variable-sweep wing to the laser-guided bombs, every detail of the aeroplane and its weaponry is explored. The manual features 300 photographs of the aircraft that include detailed close-ups, plus stunning air-to-air photographs showing the aircraft doing what it does best, and giving the reader a real sense of what it's like to fly an RAF Tornado.

BOOK

Warbirds – The Aviation Art of Adam Tooby

Adam Tooby
Titan Books
190 pages, hardback, colour
ISBN 9781781168486
£29.99

Adam Tooby is a rising star in the field of aviation art, creating ground breaking photo-realistic work using state of the art computer technology. He has moved away from traditional approaches to the subject matter and 3D modelling has allowed him to produce images that are both technically accurate and visually dynamic.

As such, the pages of this book bring some of the greatest military aircraft in history to life. He has also chosen to feature some of the unsung aircraft from the last century. Of course no book like this would be complete without Spitfires or Mustangs but it is pleasing to see jet subjects such as the Gloster Javelin and Harrier appearing alongside the more often depicted subjects.

It was also pleasing to see step-by-step sections revealing the processes involved in creating these images and close-ups showing the incredible accuracy and detail of the art – down to rivets and bolts. If you are an art lover, an aviation enthusiast or love the technical element of 3D modelling you'll be blown away by this book.



BOOK

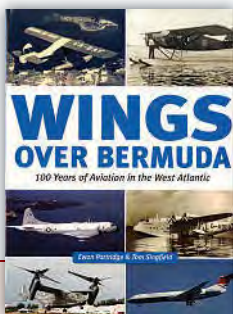
Wings over Bermuda

Ewan Partridge & Tom Singfield
The Aviation Bookshop
304 pages, hardback, B&W & colour
ISBN 9781927750322
£39.99

This new book, sub-titled *100 Years of Aviation in the West Atlantic*, is the first attempt to provide a comprehensive history of aviation in Bermuda. It does this well beginning with Walter Wellman's preparations in 1910 for an Atlantic crossing in the airship America from Atlantic City, which in the event was abandoned and never reached Bermuda. Co-authored by regular

Jets contributor Tom Singfield, this is an enjoyable book that covers all areas of Bermudan aviation up to the modern day, including fascinating accounts of the VWB-47 visits to monitor the hurricane season.

This is a splendid book, well researched, illustrated in monochrome and colour and well presented on good quality paper.



BOOK

Mikoyan-Gurevich 15 & 17 Fagot, Midget & Fresco

Gerard Paloque
Casemate
72 pages, softback, B&W & colour
ISBN 9782352503309
£17.50

This is a simple yet effective book containing potted histories of the MiG-15 and MiG-17 followed by short chapters focusing on the nations that operated this pioneering Eastern Bloc jet.

A smattering of nicely reproduced photographs are bolstered by a very impressive range of full colour side-view artwork depicting aircraft from

Afghanistan to Yemen via the likes of Congo-Brazzaville, East Germany, Guinea, Mali, Mongolia and Uganda. Short descriptions of the type's service in those countries are also included, but the well drawn artwork is worth the cover price alone.



CARTERCOPTER

Is it really possible to create a turbine-powered rotorcraft capable of 500mph at 30,000ft?

Steve Bridgewater speaks to Jay Carter about the remarkable CarterCopter programme

**THE FUTURE OF
HIGH-SPEED HELIS?**

 Carter Aviation Technologies LLC has spent more than a decade building and flying technology demonstrators for a

revolutionary hybrid aircraft, passing many very important milestones along the way.

Now the Texas-based research and development company is on the cusp of revolutionising the way we fly.

Gyro flight

The autogyro concept can be traced back almost a century to Juan de la Cierva's trials in Spain in the 1920s, but with the exception of the 1950s Fairey Rotodyne and McDonnell Douglas XV-1 progress has been protracted. The emphasis in recent years has been on improving safety rather than performance.

Both the Rotodyne and XV-1 combined

the wing of a conventional aeroplane with the rotor of an autogyro; noise from the jet engines mounted on the rotor tips would be the projects' death knell and the programmes were dropped, but development quietly continued elsewhere.

'Mu One'

Mu (the English spelling of the Greek letter μ) is commonly used in rotorcraft to represent the rotor tip advance ratio. Mu is the ratio of the forward speed of the aircraft (VA) to the rotor tip speed (Vtip) relative to the aircraft.

As the rotor rpm (and therefore the tip speed) is reduced, Mu increases and the drag on the rotor decreases dramatically. Conventional helicopters fly at a Mu of around 0.3 (meaning the rotor tip speed is

around three times greater than the forward speed of the aircraft) and increasing that ratio – and therefore the aircraft's speed – has always been difficult because during forward flight the retreating rotor blade moves in the opposite direction to the aircraft.

As you approach Mu 1, the aircraft's speed needs to equal the tip speed of the retreating blade meaning the airflow over the blade is reversed over its entire length, thus making it very unstable.

For this reason, flight at Mu-1 or higher was always thought to be impossible.

CarterCopter

Carter's design means the rotor provides the lift for VTOL and slow speed flight, allowing the wing to be sized (reduced) for high speed. This combination of a small, low drag



Access to the PAV couldn't be easier thanks to a forward tilting fuselage Jamie Ewan



Left: The original CarterCopter Technology Demonstrator aloft in the early 2000s. This was the first rotorcraft to exceed Mu-1. In its short flying career the original CarterCopter had flown 150 hours, made more than 1,000 take-offs and landings, reached 10,000ft and 150kts and become the first aircraft to achieve Mu-1 Carter Aviation

Below: The original demonstrator boasted a twin boom arrangement whereas the later PAV opted for a slim rear fuselage to accommodate the pusher propeller. The CCTD's original short Carter Prop can be seen in this image Carter Aviation



Jay Carter is a man with a mission. He has already invested a huge amount of time and money into his SR/C concept aircraft and is now looking for additional investment to help it reach maximum potential Jamie Ewan

“We plan to take the PAV up to 28,000ft as soon as possible”



wing with a slowly turning rotor is known as a Slowed Rotor Compound (SR/C) aircraft and is the premise on which Carter Aviation is now developing its future aircraft.

At low speed the vehicle flies as a gyrocopter and can pre-spin the rotor for a vertical take-off and a brief hover. Like all autogyros it can also land almost vertically but at higher speeds (above 100mph) the aircraft flies mostly using the fixed wings, with the rotor simply windmilling.

Smooth operator

On June 17, 2005 the first CarterCopter prototype was being flight tested for a US Army contract. According to Carter Aviation, “The rotor proved to be very stable as the rpm was decreased. Test pilot, Larry Neal, was decreasing rotor rpm in small increments when he neared $\mu-1$. With all systems stable, the decision was made to proceed to $\mu-1$. Data from the flight shows that the airspeed was 170mph and the rotor was slowed to 107rpm, giving a Mu value of 1.”

The first Mu-1 flight time was just 1.5 seconds before Neal reduced the throttle to slow the aircraft, but the aircraft was operated continuously above Mu-0.9 for over 20 seconds and the high Mu flight was accomplished without incident. The pilots commented that the aircraft was so smooth that there was no vibration or noise to indicate that they were in a rotary wing aircraft.

Sadly the aircraft crashed on its next flight but company founder Jay Carter was undeterred. “The Mu-1 flight was the culmination of more than 12 years of research and development and had been our goal since we first began flight-testing in 1998. To prove our technology we needed to do something that no one else had ever done. We have had several setbacks, but no one on the team ever lost faith.”

Personal Air Vehicle

At first it was thought that the CarterCopter had been completely destroyed in the accident – later traced to failing propeller bolts, which damaged cables controlling the

main rotor. However, inspection showed that it could be repaired, but Carter Aviation chose to use the opportunity to create an all-new four-seat machine dubbed the CarterCopter PAV (Personal Air Vehicle).

Although the all-composite aircraft bore a superficial resemblance to the original CarterCopter, it was larger and shed the twin boom layout in favour of a single slim fuselage. It has a 45ft-span two-bladed rotor blade and the prototype was fitted with a 350hp six-cylinder Lycoming IO-540 piston engine and the main rotor blades have 75lb weights to enhance rotational energy and to reduce flapping.

The PAV has an empty weight of 2,500lbs and can perform ‘jump’ take-offs up to a maximum of 4,000lbs. Rolling take-offs are capable at the aircraft’s gross weight of 5,000lbs.

The PAV took to the skies for the first time on January 5, 2011 – albeit using just the rotor for lift. It would be another year before the aircraft flew with its wings fitted but, according to the company, the



The McDonnell XV-1 was an experimental compound gyroplane that could reach 174kts. Like the Fairey Rotodyne, the programme was terminated due to the noise from its rotor tip-mounted jet engines NASA

aircraft reached Mu-1 for the first time on November 7, 2013. It has now achieved a speed of 177kts at 16,000ft and a Mu of 1.13. A second PAV was completed in March 2014 and was later displayed at the 2014 EAA AirVenture show at Oshkosh, where we caught up with Jay Carter:

"So far we've limited the PAV to 18,000ft," Jay told *Jets*. "We've used the same test pilot

for more than a decade and he doesn't have his instrument rating. However, we're just in the process of introducing a new [instrument rated] pilot to the programme so that we can go higher than ever. Our new pilot is also a certified gyro instructor so he can take our testing to a whole new level.

"We plan to take the aircraft up to 28,000ft as soon as possible and have fitted an oxygen system to allow this."

Jay and his team will also be continuing testing of its revolutionary Carter Prop. "This is a wide bladed, 100in diameter all-composite scimitar prop that weighs just 42lbs," explains Jay. "We've already run it above the speed of sound for more than ten minutes. With a conventional prop – such as the MT Prop currently fitted to the PAV – the blades are actually stalled when it's producing static thrust. This is the only way the blades can produce enough drag – or resistance – to avoid the engine going into over-speed.

"Of course a stalled prop' doesn't produce as much thrust, so there's lots of lost efficiency. We're not doing anything particularly aerodynamically fancy with the Carter Prop, it's just that the lightweight composites mean we can adopt a larger chord and thicker aerofoil section. This in turn allows the prop' to rotate slower – which is really important when you consider that propeller drag at 300rpm is 27 times more than at 100rpm – the key to efficiency is to slow down the propeller.

"Using our old 350hp piston engine, the Carter Prop on the original CarterCopter Technology Demonstrator (CCTD) was producing 1,850lb of thrust – that's compared to the 1,300lb/thrust that a modern aerobatic aeroplane can achieve from the same engine using a 'normal' propeller.

"Using the Carter Prop we can completely fill the wings with 140 US Gal of fuel, climb to 25,000ft then back off on the throttle to 200mph and burn just 11-12 US Gal per hour. With that performance you could fly non-stop from LA to New York City!"

Turboprop powered

Of course, as fascinating as this technology is, a modern piston-powered aircraft has little relevance to the pages of *Jets*. But this is where the next stage in Jay's plans come to the fore. "Our next development will be to develop a version of the aircraft with a 1,200shp turbine engine," he says with a wry smile. "We've already started construction and our predictions show that the aircraft will have an empty weight of 2,500lbs and will be capable of 260kts and fully vertical jump take-offs. When we fit the turbine we'll be able to take-off from downtown Dallas and fly non-stop to the Paris airshow! That's one of the things we'd like to do in order to demonstrate just how efficient it is."

Utilising turboprop power will enable Carter Aviation to increase the size, performance and potential of its concept. "This technology can easily be 'scaled' and the same systems will work in very large aircraft," explains Jay.

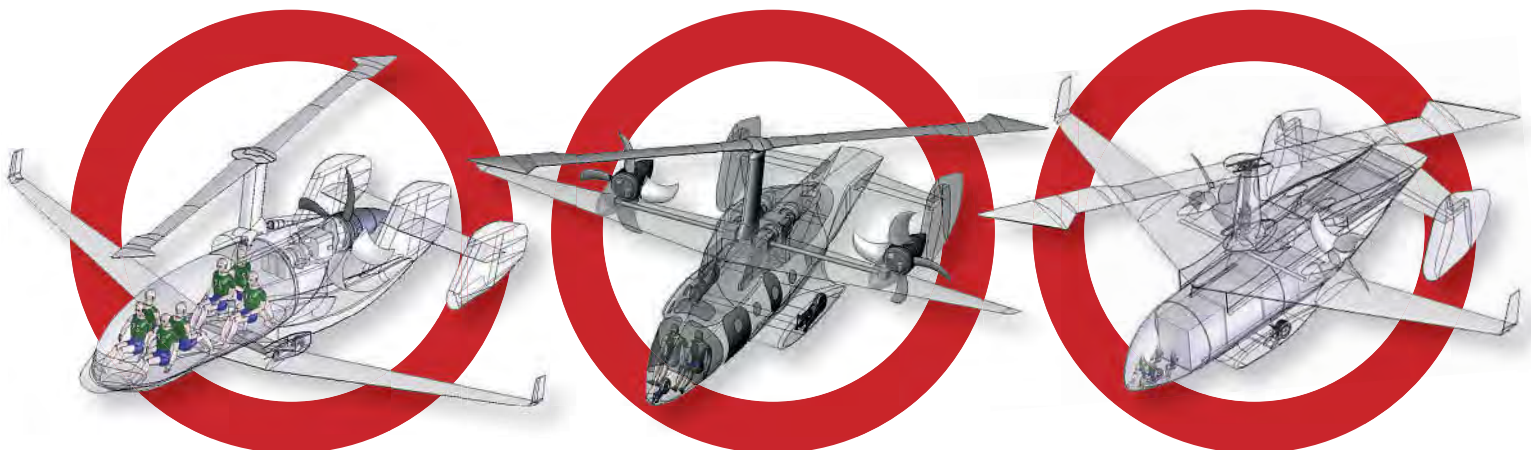
"We're already planning the six to nine-place 'Next Generation Business Air Vehicle' (BAV) for true point-to-point travel. Powered by a pair of 2,000shp turboprops it will have a top speed of up to 350kts and be able to fly 2,600 miles at 45,000ft. The entire mast will tilt, allowing for a greater Centre of Gravity range, and to keep the wings at their optimum angle of attack while the aircraft is flying at lower speeds where the rotor is providing more than its minimum lift. The 100in diameter propeller will be the same as that used on the original CCTD except it will use four blades instead of two."

BELOW LEFT TO RIGHT:

The six to nine-place 'Next Generation Business Air Vehicle' will be powered by a pair of 2,000shp turboprops and will have a top speed of up to 350kts. The entire mast will tilt, allowing for a greater Centre of Gravity range. The 100in diameter propeller will be the same as that used on the original CCTD except it will use four blades instead of two Carter Aviation

The CH-45 Heliplane project is aimed at producing a 350kts capable machine that can carry a useful load of 2,000lbs over a range of 1,150 miles. The Heliplane will have true hover capabilities as its turbine engines will be connected through drive shafts and gearboxes to the rotor and the wing mounted propellers, the latter having variable pitch propellers to provide the anti-torque needed for hovering flight Carter Aviation

The large CHT-100 and CGT-100 transports will have 100ft diameter rotors and wingspans as well as a 145,000lb gross weight. The aircraft are being developed in two formats: the CHT-100 Heliplane and the CGT-100 Gyroplane Carter Aviation





The PAV aloft on a test flight after the fitting of its 45ft span wings
Carter Aviation



The wings and main rotor blades on the Carter Aviation PAV are identical span
Carter Aviation



The main rotor blades have 75lb weights to enhance rotational energy and to reduce flapping
Steve Bridgewater



While testing continues on the Carter Prop the PAV is currently fitted with a five bladed MT prop. This was designed for a large turbine engine and originally had a 100in diameter, however the blades needed to be cropped to give sufficient ground and rotor clearance on the PAV. This means that the propeller no longer has the full 'twist' that it was designed with from root to tip
Steve Bridgewater

Potential

But the plans don't stop there and the CH-45 Heliplane project forms the basis for a 350kts machine capable of carrying 2,000lbs over a range of 1,150 miles – perhaps even as an under-slung load. The Heliplane will also have true hover capabilities thanks to a pair of turbine engines mounted in the fuselage. These will be connected through drive shafts and gearboxes to the rotor and the wing mounted propellers, the latter having variable pitch propellers to provide the anti-torque needed for hovering flight, similar to a tail rotor on a helicopter. A clutch will be used to disengage the rotor to allow it to autorotate in the high-speed cruise.

Even larger is the CHT-100 and CGT-100 transports. Boasting 100ft diameter rotors and wingspans these 145,000lb gross weight aircraft are being developed in two formats: the CHT-100 Heliplane and the CGT-100 Gyroplane.

The CGT-100 version will be capable of jump take-offs and vertical landings whilst the CHT-100 will have a full hover capability. According to the company both variants could be powered by a single P&W F-135 engine or the gyroplane version could alternatively be powered by two Rolls Royce AE 1107C powerplants.

There are even plans in place to produce 150ft span versions of the Heliplane and Gyroplane! The CGT-150 and CHT-150 are billed as capable of 435kts at 30,000ft while carrying a 140,000lb payload over 1,000 miles.

World winner?

So will we see a sky full of Carter designs in future years?

"We're only scratching the surface of the aircraft's capabilities as yet," Jay revealed. "However, the performance on the PAV is so promising that I'm confident we could take-off now with 4,500lbs of fuel and by the time we reached 43,000ft we'd still have 500lbs left! We reckon it can reach 295kts so we have a machine on our hands that could easily break the world speed record for rotorcraft, could shatter the distance record and can climb to a higher altitude than any rotorcraft has ever done before.

"Our goal is to fit the turbine engine as soon as possible, and we've already started construction of the new fuselage, but we need an injection of around \$4 million to get the airframe completed. We just need somebody to see the potential in being part of a record-breaking rotorcraft. Once you understand the potential of this thing you can't help but be excited – and there's a lot of kudos to be had!" ●

SPECIFICATION CARTERCOPTER TECHNOLOGY DEMONSTRATOR



Crew	1
Passengers	4
Length	22ft 5in (6.81m)
Height	11ft 2in (3.40m)
Wingspan	32ft 0in (9.80m)
Rotor span	43ft 6in (13.26m)
Wing area	804sq ft (74.73m ²)
Empty Weight	2,500lb (1,134kg)
Max Take-Off Weight	4,200lb (1,905kg)
Max Speed	148kts (170mph/274km/h)
Range	2,399 miles (3,860km)
Service Ceiling	10,000ft (3,000m)
Powerplant	One Nascar V-6 racing engine (350hp)
First Flight	September 24, 1998

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



The inside of the PAV is currently relatively sparse but production versions are expected to be luxuriously appointed
Jamie Ewan

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A DIFFERENT APPROACH

TEXTRON AIRLAND'S SCORPION

As combat aircraft continue to command ever higher prices, Richard Freail examines the new low-cost Scorpion and looks back at an old stablemate – the Cessna A-37 Dragonfly

Recently the British Government ordered four F-35 Lightning II aircraft; while others will undoubtedly follow, it was an event that made me smile as I remembered a perceptive cartoon which appeared in a national newspaper in the early 1970s. It depicted a review of the armed forces with a single ship, tank and aeroplane on display with the senior officer remarking to the VIP "Yes, this is it – we couldn't afford anymore."

Fast-forward 40-odd years and governments are faced with programmes costing hundreds of billions (pounds or dollars!), with new aircraft priced as much as \$150m each or more. Conceived for fighting numerically superior or similarly equipped powers such as Russia or China, fourth and fifth-generation aircraft with high operating costs have been increasingly deployed in uncontested airspace for low-intensity or

asymmetric warfare operations during the last decade or more.

At the same time, there has been an emerging alternative view that once air supremacy has been secured, many operations could then be conducted by aircraft which are cheaper to buy and operate. Allied to this is the notion that with aircraft becoming evermore complex and expensive, they are being placed beyond the needs and finances of smaller nations: a cheaper and less complex alternative is required to secure export sales and also avoid the transfer of new technologies.

Potential Solution

To challenge the status quo a prototype aircraft was secretly constructed between April 2012 and September 2013 at the Cessna facility, Wichita, Kansas: the Textron AirLand Scorpion completed its maiden flight on December 12, 2013. Designed



as an ISR/Strike (Intelligence, Surveillance and Reconnaissance) aircraft with ease of maintenance and operability, it has a unit cost of below \$20m (three to four times less than an F-16) and operating costs of \$3,000/hr (at least five times less than an F-16).

Dan Hinson, Chief Pilot at Textron and a Scorpion test pilot explains the concept behind the aircraft: "We need high end fighters to do things but they have been used in low-end missions exhausting airframes and service life. You don't need them for missions in a low-threat/no-threat environment to gather information."

For Cessna, a subsidiary of the American Textron conglomerate since 1992, the



Left: The USAF originally lost interest in the YAT-37D programme but 62-5951 was recalled from a museum and refurbished for flight testing as the YA-37A. As seen here it gained a fourth pylon under each wing USAF Museum



Main The straight high-aspect ratio wing helps boost mission endurance, provides easy handling qualities *Textron*

Below: Cessna A-37B 68-7961 of the 71st Special Operations Squadron at Grissom AFB in Indiana demonstrates the flexibility of the type's underwing pylons *USAF Museum*



concept of a cheap and easy-to-operate light-attack aircraft is not new territory.

Armed trainer

The Cessna T-37 Tweet entered service in 1957 as a trainer [See *Jets* Nov/Dec 2014] and gained a reputation for service reliability. In 1962 the USAF's Special Air Warfare Center at Elgin AFB took delivery of two T-37C aircraft (62-5951 and 62-5950) for evaluation for counter-insurgency operations (COIN). Performance in key areas was found wanting so Cessna was awarded a contract in 1963 to supply two improved aircraft, designated YAT-37D, which would have superior endurance, weapon load and survivability.

The two T-37Cs were returned to Cessna. When they emerged the wings had been strengthened with increased pylon capacity – now three per wing – and 95 US Gal wingtip fuel tanks. A General Electric 7.62mm Gatling-

type 'mini gun' had been installed in the nose on the right-hand side, together with improved avionics to assist with navigation and targeting. A strengthened undercarriage, as requested by the USAF, for rough-field operations was also installed. As the gross weight increased significantly it was realised that the two Continental J-69 engines, producing just over 1,000lbs/thrust each, would be completely unsuitable. They were replaced with the proven General Electric J-85, which produced 2,400lbs/thrust each. Despite these improvements, ease of maintenance was a continuing requirement.

The first airframe flew in October 1963 and by the following March the initial test programme at Edwards AFB was complete. Further weapon delivery trials then took place at Elgin AFB, but by the end of the year the USAF had lost interest and the aircraft were grounded with one (62-5951) finding a home at the USAF Museum at Dayton, Ohio.

Reprieve

By 1966 with the war not going well in Vietnam and mounting losses of the Douglas A-1 Skyraider close-support aircraft, used by both US and South Vietnamese forces, meant there was a growing need for a light-attack or COIN aircraft which could be made available quickly.

YAT-37D (62-5951) was recalled from the museum and refurbished for flight testing. Gaining a fourth pylon under each wing and a gross weight of 12,000lbs, with nearly 5,000lbs of that being fuel and weapons, it was redesignated as the YA-37A. The USAF reasoned that the only way to find out if it was any good was to test it in combat. To this end 39 pre-production A-37As were ordered which, in order to meet deadlines, were to be rebuilds of retired T-37s stored at Davis-Montham AFB. The resulting aircraft



The Scorpion is of modular design meaning, for example, that the wings could be swapped easily for a different design, such as swept wings *Textron*



would gain the name 'Dragonfly' but would be referred to more often as the 'Super Tweet'.

The 604th Air Commando Squadron formed at England AFB and took delivery of its new aircraft. Once training was complete, two dozen airframes were airlifted to Bien Hoa AB, South Vietnam, for trials known as 'Combat Dragon'. From August 1967 thousands of sorties, day and night, were flown with the aircraft carrying iron bombs, snake-eye bombs, cluster bomb units, unguided rockets and napalm, usually with two extra fuel tanks under each wing. The airframe was praised for its size, speed, manoeuvrability and stability, which enabled accurate weapons delivery. A high level of sorties (10,000) was flown in nine months, aided by an impressive serviceability rate of over 85%. On the downside, despite the ability to be flown 'on-station' with one engine shut down, fuel load and endurance were criticised, together with high control forces during the attack phase.

Improvements

In 1967 the USAF ordered an improved A-37B variant with a contract for 57 aircraft

quickly increasing to 127, primarily for the South Vietnamese Air Force (VNAF) where it would replace the Skyraider. The prototype was ready by September 1967 and deliveries commenced the following May. By September 1969 the order had increased to 366 aircraft.

The A-37B aircraft were all new-builds with additional structural strengthening which helped increase the aircraft limits to +6G/-2G. Other significant improvements included additional armour, seal-sealing fuel tanks, new de-icing system, cockpit and avionics upgrade, external refuelling probe and an onboard engine start system. A number of changes were also made to the controls: experience had shown that the rudder and elevator control runs – grouped together due to its trainer heritage – were particularly vulnerable to enemy fire. These were separated and the elevator runs replicated to provide some measure of redundancy. As gross weight had increased to 14,000lbs, double that of the original T-37, uprated GE J85 engines were installed with 2,850lbs/thrust each. The undercarriage was also upgraded to support the airframe.

Service

The Dragonfly served with USAF active duty, reserve and ANG squadrons. Although the type was withdrawn from many units following disengagement from the Vietnam War it still remained in service, albeit in much reduced numbers, until the early 1990s, including use in the Forward Air Control role as the OA-37B.

The Dragonfly was exported to South Korea, Thailand and Vietnam in south-east Asia and numerous countries in South America including Ecuador, Chile, Honduras and Uruguay.

During the Vietnam War the Dragonfly had the distinction of serving on both sides. Over 250 A-37Bs were supplied to the VNAF, but despite some desperate rearguard battles during the withdrawal to Saigon in 1975, many aircraft were abandoned at their bases with some being used in missions against the South. By the end of hostilities the North Vietnamese had seized 95 A-37Bs and spares. These were pressed into regular service and again saw action in the conflicts between Vietnam and Cambodia in the mid-to late 1970s.

"The world's most affordable tactical jet"



The prototype Scorpion undertakes a flight test with all six hardpoints occupied by a mix of weapons. The nose 'turret' has also been extended *Textron*



Two very different approaches to ground attack are illustrated here as a South Korean A-37 leads out a pair of Fairchild A-10A Tankbuster II jets during an exercise at Osan AB in South Korea USAF

The aircraft supplied to the Latin American nations served for many years, meeting their various needs as a platform for tackling counter-insurgency and other local conflicts. In some countries, such as Peru and Columbia, the A-37B remains operational today.

A new way

Fast-forward two decades on from the USAF's retirement of the A-37 and a group of experienced American aerospace and

carry-through strengthening and engine attachment points and ring-frames. It is of modular design meaning, for example, that the wings could be swapped easily for a different design, such as swept wings, if required.

Dan Hinson describes costs "as probably our number one driver: We've always strived to keep our target price below \$20m and our flight costs below \$3,000." To this end and to help speed the development process the Scorpion borrowed heavily from other proven products: 70% of the parts are from

"We've strived to keep our target price below \$20m and flight costs below \$3,000"

defence executives, including former Air Force Secretary Whitten Peters, formed AirLand Enterprises LLC, with a vision for producing 'the world's most affordable tactical jet'.

Any such aircraft would be designed without military backing and, wanting to eschew normal channels, in late 2011 they approached Textron – a company which, although involved in significant defence work, was not renowned for producing fixed-wing combat jets. A joint enterprise, Textron AirLand, was formed to push the proposal forward. Over the next 23 months nearly 200 engineers and staff from Textron and subsidiaries Cessna and Bell worked to produce the prototype, albeit hidden from the outside world.

Design

Initial studies looked at a dozen different designs and concepts but eventually settled on a twin-jet with a tandem seating configuration. The straight wing shield the engine intakes and a bulbous canopy affords a great view. Twin outward canted fins and a rugged and powerful undercarriage give the Scorpion a thoroughly modern look. It is powered by two Honeywell TF731 turboprops producing 4,000lbs/thrust each, although later versions could use different powerplants as Dan Hinson explains: "We've build the engine nacelles to take that size of engine and we are very happy with the Honeywell engine, but we can also fit a Pratt and Whitney 545C full FADEC engine if required and there are probably others we could utilise as well."

The Scorpion is an all-composite aircraft with metal to be found only in the horizontal leading edges, the undercarriage and associated

other Cessna aircraft, 21% are sourced from commercial suppliers and only 9% are manufactured directly for this new aircraft. For example, the Cessna Citation line of business jets was fully utilised: the wheels and brakes are from the Sovereign, the flight controls share lineage with the Citation X, the flap drives are from the XLS Plus and the power distribution system is borrowed from the CJ4.

The cockpit was designed by Cobham and allows the aircraft to be flown from either seat. With its modern all-glass interface, if used as a trainer, the manufacturer asserts it would allow an easy transition to 4/5th generation fast-jets. It has full HOTAS (Hands On Throttle And Stick) controls and provides

a range of information across its screens including primary flight data, an engine display, direct video feed from the sensors and a moving map display with integrated weather information. The displays are compatible with Night Vision Goggles (NVG) and pilots use a Helmet Mounted Cueing System (HMCS): a fully integrated head-up display is planned.

Multi-mission

The Scorpion is optimised for ISR/Strike but fully capable of undertaking a range of missions including counter-insurgency, close air support, border security and counter-narcotics, maritime security, airspace control alert, disaster response and tactical jet training. It is envisaged as being ideal for the US homeland security and permissive threat environment missions.

Helping to give the Scorpion its wide stance, the aircraft has a large internal equipment bay with some 82 cubic feet of space that holds up to 3,000lbs of surveillance and electronic warfare equipment. The aircraft is fitted with high-definition infra-red and electro-optical cameras that can beam real-time video to commanders on the ground. Two retractable turrets can be fitted: a 15in one at the front and an optional 25in turret at the rear. "The straight high-aspect ratio wing helps provide mission endurance," says Dan Hinson. "The Scorpion can dash to a situation, slow down, put out those turrets and start collecting information while remaining on station for five hours, or longer with refuelling."

The wing has six hard points for 3,000lbs of weapons which can include bombs, rockets, Hellfire missiles, heat-seeking air-to-air missiles and gun pods.

Right: The prototype Scorpion was built in utmost secrecy by Textron staff Textron



The Dragonfly served the USAF until the early 1990s, including use in the Forward Air Control role as the OA-37B. This OA-37B from the Illinois ANG was taking part in Exercise Granadero I in May 1984 when photographed USAF Museum

Home markets

Analysts believe it may be difficult, if not impossible, to sell this aircraft to the USAF. With significant defence cuts still looming and the air force heavily committed to the F-35 Lightning II strike fighter, the Boeing KC-46 tanker and its proposed Long-Range Strike Bomber (LRS-B) together with a number of UAV projects, opportunities may be few and far between. However, the Air National Guard (ANG) is embarking on a transition which will see it lose F-16s and A-10s in favour of the MQ-9 Reaper UCAV (unmanned combat air vehicle) – something that has not been greeted with acclaim as there is a natural reluctance to lose manned aircraft. However, Textron AirLand regards the Scorpion as a natural aircraft for the ANG role and will be pressing its case – in August the aircraft demonstrated its capabilities by taking part in *Exercise Vigilant Guard 2014* together with the Kansas National Guard.

A further avenue is the USAFT-X programme to find a replacement two-seat fast-jet trainer for the T-38 Talon, which has an average fleet age of around 45 years and an out-of-service date now estimated as 2023. In the pipeline since 2003, the programme has been stymied by financial constraints, but a number of companies have put forward contenders including the T-50 (Lockheed Martin/KAI), the Hawk (Northrop/BAE) and the M-346 Master (Alenia Aermacchi). The only current all-



The bulbous canopy affords a great view for the crew of two *Textron*



The Scorpion's wing has six hardpoints able to carry a total of 3,000lbs of weapons including bombs, rockets, Hellfire missiles, heat-seeking air-to-air missiles and gun pods. The engine intakes have been built to accommodate the Honeywell TF731 turbofan but can easily house the PAW 545C engine or others if required *Lukas Willcocks*

American solution for the potential 1,000 aircraft order, stretching across all air arms, is the Scorpion, which the manufacturer has indicated will be modified to fit the requirements. These may include a swept wing and, possibly, a single engine in a slimmed-down fuselage.

Exports

In any case the Scorpion will be offered for export, with the Middle East and Pacific regions expected to offer the most potential for sales. A number of countries have already expressed an interest including Bahrain, Qatar, the UAE, Saudi Arabia, Malaysia, Indonesia, Brunei and the Philippines. Textron AirLand has identified around 60 countries, with potential sales of 2,000 aircraft, where the Scorpion could find a natural fit into that country's air force. Certainly when it made its international debut in the UK in the summer of 2014 at the Royal International Air Tattoo and



Above: The Scorpion made its international debut at the 2014 Royal International Air Tattoo and Farnborough International Airshow events in the UK. Textron has identified the air forces of around 60 countries into which the Scorpion could find a natural fit *Textron*

the Farnborough International Airshow, the aircraft gained plenty of attention from military delegations.

The Future

Unkindly labelled as "the plane nobody asked for" the Scorpion undoubtedly represents a bold move for Textron AirLand. But, in a world of spiralling costs and falling defence budgets, the Scorpion will surely find a role as a low-cost, very capable, multi-mission aircraft and, in doing so, will hopefully replicate the success of its renowned predecessor, the Cessna A-37. ●

The author would like to thank Dave Sylvestre and Dan Hinson, both of Textron AirLand, and Lukas Willcocks for their assistance with this article

SPECIFICATION TEXTRON AIRLAND SCORPION



Crew	2
Length	43ft 6in (13.26m)
Height	14ft 0in (4.30m)
Wingspan	47ft 4in (14.43m)
Empty Weight	11,800lb (5,352kg)
Max Take-Off Weight	21,250lb (9,639kg)
Max Speed	450kts (518mph/833km/h)
Ferry Range	2,800 miles (4,400km)
Service Ceiling	45,000ft (14,000m)
Powerplant	Two Honeywell TFE731 turbofan (4,000lb//thrust each)

Armament Six hardpoints with a capacity of 6,200lb of armaments and an internal 3,300lb electronic warfare and surveillance equipment bay

First Flight December 12, 2013

The Scorpion arrives at RAF Fairford for the 2014 Royal International Air Tattoo, clearly demonstrating the broad fuselage which accommodates a large internal equipment bay capable of holding up to 3,000lbs of surveillance and electronic warfare equipment *PRMAVIA Collection*



Incoming! Letters to the Editor



HAVE YOUR SAY

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More on Chilean Canberras

Many thanks for printing my letter about the origins of the 'RAF spy planes in Chilean markings' story (*Jets* July/August 2014 p71).

A new book – *Exocet Falklands* by Ewen Southby-Tailyour – was published shortly after I posted my letter. This book concentrates mainly on what the SAS did – and wanted to do – to combat the Exocet missile threat. The book also includes some references to the RAF in Chile at the time.

The operating of a 51 Sqn Nimrod R.1 from San Felix would appear to be confirmed while "anecdotal evidence suggests that at least one Canberra aircraft from the RAF's 360 Sqn operated from Chile in Chilean Air Force markings alongside the host nation's ELINT-

equipped C-130s..." This is the sole reference to RAF Canberras in the book, but in the Notes at the end the author explains that: "The incorrect spelling of the Spanish word 'Aerea' on the RAF Hercules (on an unrelated mission) and the aircrew masquerading as Chileans but wearing RAF flying suits tended to give the game away."

The possibility of one or more of 360 Sqn's Canberra T.17s being sent to Chile has certainly been raised before, all of which leaves me asking whether it was T.17s "adorned in Chilean colours" and not two PR.9s that Jon Snow saw that time in Chile. Sadly the only people who could really answer the question have all signed the Official Secret's Act...

David Cole, Oakham, Rutland

Air to air refuelling – extra information

I was very interested in the articles on the Voyager and UK AAR in the September/October 2014 issue of *Jets*. However, in the interests of accuracy there are a few points in Richard Freail's article that perhaps need expanding upon.

Although flight refuelled-civil operations ceased in 1939, Flight Refuelling Ltd (FRL) continued to study civil applications for post-war operations and in 1944, the company was officially requested to prepare a report showing how the application of flight refuelling could aid post-war commercial aviation. Civil flight-refuelled operational trials were carried out by British South American Airways and BOAC during 1946-48.

Flight refuelling development for Tiger Force was cancelled in April 1945 due to the prospect of allied bases becoming available nearer Japan as American forces advanced. In addition, the Lincoln offered a greater bomb load and range (than the Lancaster) without in-flight refuelling. However, preparation for Tiger Force deployments continued up to the Japanese surrender.

Due to political and inter-service pressures, the FRL-developed looped hose system was introduced on B-29 and early B-50 bombers as it was the only proven system then available. Meanwhile Boeing was working on the flying boom system and this was first used on the KB-29P/B-50 combination.

The 'Lucky Lady' was refuelled at four locations during its global flight. Four tankers (five at Manila) were positioned at each refuelling point to provide a full fuel load

and cater for unserviceabilities.

FRL examined several fighter refuelling schemes during the winter of 1948/49 in response to USAF and Air Ministry interest. However, the first probe/drogue contact between Meteor EE397 and Lancaster tanker PB972 took place on April 24, 1949. Other dates have been mentioned in several sources but minutes of management meetings and flight reports in the Cobham Archives clearly indicate this event took

place on April 24. Fortunately, the USAF visit was delayed and the promised demonstration was given on April 27.

Brian Gardner (by e-mail)

Ed: "Sadly, the difference between writing a six-page magazine article and a specialist book on the same subject is the amount of content our contributors are able to cram in. This is why we always welcome the opportunity to run letters from readers that contain extra facts and figures."

Tanking with Hercs

On reading the article on refuelling in the RAF I was surprised to find no mention of the C-130 Hercules in the article. I must confess to a personal involvement in the Hercules tanker as I was one of the first Hercules aircraft ground engineers – technicians who travel with the aircraft to service and maintain them when away from base – to be involved with the conversion of the airframes.

I carried out training on the Hose Drum Unit (HDU) at RAF Marham before the first was fitted to an airframe and liaised with Marshalls of Cambridge who were doing the conversion, providing them with information from our HDU course on things such as fuel supply pressures, air supply pressures and temperatures, none of which they had been provided with.

The length of time the tankers were in service – considering the somewhat ad hoc conversion – was a credit to the initial work carried out by Marshalls and

the skills of those who maintained them over the years.

Nicholas Watts (by e-mail)

*Ed: "Again, with limited space available it is not possible to include all the information about every aeroplane in a short magazine article. On this occasion it was a conscious decision to not concentrate on the Hercules due to the fact that a full feature about RAF C-130s is scheduled for an upcoming issue of *Jets*. It's always nice to receive first-hand accounts from readers willing to share their experiences."*



Adrian M Balch

MEMORY LANE

Jets is all about rekindling the memories of days gone by. As part of this we're keen to hear from you and see the images filed away in your photo albums. This month Ray Deacon provides an eclectic mix of Day-glo schemes worn by Central Flying School aircraft between 1958 and 1961. They may not all be jets, but 'by heck' they're glorious!

In 1958 the Royal Air Force's Flying Training Command (FTC) instructed the Central Flying School (CFS) to devise a new livery to make its aircraft more conspicuous in all weather conditions.

Two Little Rissington-based aircraft were selected for a trial using 'Fluolac' fluorescent orange paint and by the end of 1959 the new colour, which became known as 'Day-glo', had been applied to all FTC aircraft.

When it became clear that the paint quickly faded and peeled off, CFS was again tasked with finding a solution. Seven aircraft types were selected for test designs based on strips of red 'Scotchall Fluotape' applied over a silver base. The work was carried out in Hangar 5 at Little Rissington during 1961 and variations of these schemes appeared on all FTC aircraft over the next 18 months.

Jet Provost T.3 XM478 leads a trio of Day-glo marked 'JPs' in 1960. The aircraft is painted in Fluolac fluorescent paint, but this was found to quickly fade so within the year the fleet had been fitted with red Fluolac tape. XM478 survives to this day and is now based in Italy as I-PROV



Above: Vampire T.11 XK637/VA was selected to represent the jet trainer in the Fluolac trials and is seen here at Little Rissington prior to the start of the programme in April 1958. XK637 remains extant and was on display at the Millom Museum until 2008; it is now reportedly in storage in Cheshire Central Flying School Archive via Ray Deacon

Above right: During the Scotchall Fluotape trials XK633 was selected as the prototype for the Vampire T.11 scheme. The triple-bar design on the forward fuselage was not perpetuated beyond the prototype and a revised design incorporating Scotchall strips radiating from the centre of the nose was used on subsequent aircraft. XK633 was written off on July 10, 1963 when it swung off the runway during take-off from Rufforth and the undercarriage collapsed All Ray Deacon unless stated



Right: Following a wheels-up landing at Aston Down, Hunting Percival Jet Provost T.3 XM355/RA was chosen to receive the Day-glo scheme and is seen awaiting an engine run at Little Rissington prior to post-repair flight test. Today the aircraft can be found at the Newcastle Aviation Academy where it is used for ground instructional tuition



Portraying the new Day-glo Fluolac fluorescent paint colour scheme, Piston Provost T.1 XF607/PE is seen during a test flight in April 1958. It was sold for scrap just four years later
Central Flying School Archive via Ray Deacon



One of the oldest Canberras in RAF service at the time, T.4 WD944/20 bore the new training command colours when photographed during a CFS detachment to Kemble in February 1962



Piston Provost T.1 XF900 was photographed on the flight line at Little Rissington in June 1961 and demonstrates the Scotchal Fluotape scheme worn by the basic trainer fleet. The aircraft had been reduced to spares by 1963

Below: A long term CFS resident, the final production Varsity T.1 XD366/MF carries a version of the Day-glo scheme that was not continued on the rest of the Command's Varsities. The aircraft was scrapped at Little Rissington in 1969



Interestingly, the CFS Meteors were not included in the Fluotape trial at the time but they did eventually bear the striped livery. Instead, they were painted with a deeper red version of the Fluolac design, T.7 WG962 being the example illustrated here in November 1960. On June 26, 1962 the aircraft crashed following engine failure after take-off from Little Rissington. Both crew were killed



Not surprisingly, one of the CFS Commandant's faithful 'Annies', Avro Anson C.19 VP517/MG was slipped into the schedule



The CFS Type Flight Hunter F.4s and T.7s permanently detached to Kemble were excluded from the Day-glo programme, however, T.7 XL611 did appear in this rare scheme including a generous application of Fluotape on the wings and fuselage sections. It is seen here at Little Rissington in February 1962. It later moved to A&AEE but on May 14, 1968 crashed shortly after take-off from Boscombe Down. The crew did not eject and were both killed



THE PEOPLE'S

At a time when Germany's infrastructure was collapsing, Heinkel's ability to take a drawing board design to front-line operations was remarkable. That this was the world's first single-engined jet fighter is even more astounding. Pete London investigates how the He 162 became the 'People's Fighter'

By the summer of 1944, Germany faced a grave military situation. In northern France the Allies were securing their foothold; to the east, Soviet forces had advanced into Poland. Relentless air raids on German industry, Allied air superiority and *Luftwaffe* combat losses were creating ever-greater shortages of aircraft, particularly fighters.

Germany's *Jägerstab* (Fighter Staff), since March 1944 the top-level organisation tasked with managing fighter production, was headed by Minister of Armaments Albert Speer and (until his fall from favour) *Generalfeldmarschall* Erhard Milch. But its day-to-day work was controlled by *Dipl.-Ing* Karl-Otto Saur, who'd previously streamlined several war manufacturing programmes.

Amid all the bad news, Saur's output figures exceeded targets; his influence increased

with Adolf Hitler. By contrast, the relationship between *Reichsmarschall* Herman Göring and Hitler was deteriorating, as the *Führer's* belief grew that the *Luftwaffe* fighter arm had become less resolute in combat.

A proposition

Saur saw a chance to highlight his abilities to his seniors. With Germany's advanced turbojet developments in mind, he formed the idea of a small, fast, single-engined interceptor to regain control of the air. In league with Generaloberst Alfred Keller, head of the flying training and sports organization the Nationalsozialistisches Fliegerkorps, and its *Flieger Hitler Jugend* (Flying Hitler Youth) section, it was suggested the new type could be flown by school-boy glider pilots given basic jet training and sent in shoals to defeat Allied combat veterans.

Hoping to repair his relations with Hitler, Göring clutched at the scheme. The notion circulated, although to senior *Luftwaffe* pilots including Generalleutnant Adolf Galland, any thought of putting raw lads up against a battle-hardened enemy was appalling. Yet a belief grew that the aircraft itself might have merits.

In terms of Germany's existing jets, the Messerschmitt Me 262 was well able to tackle Allied high-altitude bomber streams and their fighter protection. But there were only so many Me 262s, while jet engines were scant and each Messerschmitt needed two. At low-level, against enemy fighters and fighter-bombers arriving to strafe tactical targets, an aircraft based on Saur's idea could be invaluable.

Often the low-altitude attacks came with very little warning, from forward Allied airfields established near the German targets. Standing patrol cover was impossible; there weren't



Captured T-2-489 started life as WkNr 120 077 and flew with II./JG 1. Here, it's seen landing at California's Muroc Flight Test Base; subsequently it joined the Planes of Fame Museum at Chino

Heinkel's 162 *Spatz* FIGHTER

enough aircraft and saving fuel had become vital. A high-speed target-defence jet could solve a serious problem found with the *Luftwaffe's* piston-engined interceptors; by the time they arrived at the combat area, often the attackers had struck and left. If sufficient jets were produced, with short-field performance they could be deployed all along the front.

Expert opinion

The idea also found favour with *Oberst* Siegfried Knemayer, chief of flying development for the *Technische Luftrüstung* department (TLR: Technical Air Armaments), a pilot with a strong engineering background. For an aircraft along Soar's lines Knemayer emphasised the need for rapid mass production, and at least partially wooden airframe construction to save on essential war materials. The engine could be mounted over the wing, a layout similar to Henschel's Hs 132 design.

By July 1944 the *Reichsluftfahrtministerium* (RLM: German Air Ministry) had compiled a specification calling for a jet fighter termed the ITL-Jäger. Its project milestones were exceedingly close together: mock-up by October 1, first flight December 1, production

commencement January 1, 1945. At that time too, leading aviation concern Ernst Heinkel AG in Vienna was working on a twin-jet fighter project, P.1073, under the company's senior design engineer Dipl.-Ing Siegfried Günter.

Heinkel had a strong background in jets. Its He 280 twin had flown in March 1941, though the programme had eventually been curtailed by engine and production problems. Design and production of Soar's idea would put Heinkel back at the vanguard of jet aircraft technology. Though most versions of P.1073 employed twin jets, later options were single-engined.

In September 1944, thanks to influence in the right places, Heinkel received from the RLM advance notice of a requirement for the new jet fighter. The aircraft would be powered by one BMW 003 engine, finally emerging from its long development phase. Other competitors were Arado, Blohm und Voss, Fieseler, Focke-Wulf, Messerschmitt, Junkers and Siebel.

Selection process

Heinkel at once amended P.1073, scaling it around the BMW. The RLM called for a maximum take-off run of 500m, with top



Siegfried Günter (left) and Ernst Heinkel, architects of the Volksjäger Pete London Collection

speed of 405kts and minimum endurance of 30 minutes at sea level. Wood and steel were to be used as widely as possible in the airframe, while armour plate was to be fitted around the pilot, fuel tanks and ammunition. For vectoring to interception VHF radio was to be installed. Desired armament was two 30mm MK 108 cannon with 80-100 rounds per gun, or two 20mm MG 151/20 cannon each with 200-250 rounds. Tenders were to be lodged with the TLR by 14 September; just a few days following the specification's release.

Fieseler and Siebel weren't able to comply. Messerschmitt declined to bid, believing strongly the project would undermine resources for its Me 262 which, the company pointed out, was already a reality. The submissions' assessment was overseen for the RLM by a panel led by *Dipl.-Ing* Carl Francke, who also happened to be Heinkel Vienna's technical director.



The Arado, Focke-Wulf and Junkers proposals were declined; Heinkel's P.1073-18 was also rejected, which left the well-regarded Blohm und Voss project. But Heinkel called foul, claiming the other competitors' tenders had been evaluated against differences in specification which put the P.1073 at a disadvantage.

Eventually, after tender clarifications, meetings and heated exchanges between the competitors and assessors, despite criticism of its endurance and armament on 21 September Heinkel's submission was selected by a reviewing conference which included Karl-Otto Saur. Two days later Hitler ordered the Heinkel to proceed; the official announcement followed on September 30.

The People's Fighter

The RLM designated the new aircraft the He 162 but it was widely referred to both as the *Volksjäger* (People's Fighter), taken from the original specification, and also the Spatz (Sparrow). Later in life it also became known by its code-name Salamander.

Detailed design immediately began at Heinkel under Siegfried Günter, in a project marked by truly astonishing speed. Work on prototypes ran alongside creation of manufacturing drawings and production planning. Production would begin prior to the first flight of a prototype, a strategy of palpable risk which underlined the increasingly dire position of Germany's war. At first, target output was 1,000 aircraft per month by April 1945.

With extraordinarily deft management, as the *Volksjäger* programme progressed

worked up to 90 hours a week, eating and sleeping in their offices. Wind tunnel tests began during October; by early November detailed drawings had been completed, and component manufacture began.

Construction begins

Heinkel's manufacturing programme drew in its Rostock-Marienehe, Oranienburg and Nordhausen factories in Germany, and the Heidfeld, Mödling, Hinterbrühl, Schwechat and Vienna-Schwechat sites in Austria.

“Wood and steel were to be used as widely as possible in the airframe”

streams of inevitable amendments were cut in: engine installation, undercarriage arrangements and wing layout were all revised. Resources were augmented by staff from Heinkel's He 177 bomber programme which had been cancelled.

The company brought almost all its design personnel onto the *Volksjäger*, more than 350 people many of whom

Junkers too would produce the *Volksjäger*, utilising its Bernburg premises in Germany, while a mass of subcontractors were also involved, a complex exercise in planning and co-ordination. Across the factories forced labour was widely used, including an underground works at Nordhausen south of Hanover where conditions for the workforce were particularly atrocious.



The first prototype He 162 V1, unpainted and ready for its first flight



Early He 162 M23, W.Nr 220 006, coded VI+IP, seen at München-Riem airfield during the summer of 1945. Its engine and nosewheel have been removed Pete London Collection

HEINKEL HE 162A-2 CUTAWAY KEY

- 1 Pitot tube
- 2 Moulded plywood nose cap
- 3 Nosewheel retraction mechanism
- 4 Spring-loaded nosewheel extension assembly
- 5 Shock absorber scissor
- 6 Nosewheel
- 7 Nosewheel fork
- 8 Nosewheel leg
- 9 Nosewheel door
- 10 Gun trough
- 11 Nosewheel well
- 12 Rudder pedal

- 13 Window panel (visual nosewheel retraction check)
- 14 Wooden instrument panel
- 15 One-piece moulded windscreen
- 16 Revi 16G gunsight (interchangeable with the Revi 16B)
- 17 Jettisonable hinged clearvision canopy
- 18 Ventilation disc
- 19 Heinkel cartridge-operated ejection seat
- 20 Ejection seat handle grip
- 21 Throttle control quadrant
- 22 Retractable entry step
- 23 Gun barrel shroud in cockpit wall
- 24 Port 20mm MG
- 151 cannon

- 2S Ammunition chute
- 26 Main oxygen supply bottle (3.5 pint/2 litre capacity)
- 27 Explosive charge ejector rail
- 28 Pilot's headrest
- 29 Canopy hinge
- 30 Ammunition box behind cockpit (120 rounds per gun)
- 31 Flexible main tank (153 Imp gal/695 litre capacity)
- 32 Fuel lines
- 33 FuG 25a IFF radio compartment
- 34 Beech plywood wing skinning
- 35 Jet intake
- 36 Riedel two-stroke starter motor bullet
- 37 Oil tank
- 38 BMW 003E-1 Sturm axial flow turbojet

- 39 Auxiliary intake
- 40 Seven-stage axial compressor casing
- 41 FuG 24 R/T homing loop
- 42 Annular combustion chamber
- 43 Exhaust centre body
- 44 Exhaust outlet
- 45 Jet efflux fairing
- 46 Heat-resistant aft dorsal decking
- 47 Light metal tailplane
- 48 Starboard fin housing
- 49 Starboard rudder
- 50 Rudder tab
- 51 Elevator
- 52 Elevator tab
- 53 Tailcone (movable through +3° to -2°)
- 54 Port tailfin structure
- 55 Rudder structure
- 56 Tailplane/tailfin attachment

- 57 Port tailfin upper and lower plates (housing R/T transmitter and IFF aerals)
- 58 Tailskid
- 59 Dural fuselage skinning
- 60 Monocoque fuselage construction
- 61 Control cables
- 62 Downswept wing root fillet
- 63 Hydraulically-operated flaps
- 64 Port aileron
- 65 Detachable downswept aluminium wingtip
- 66 Wooden T-section rear spar
- 67 Wooden wing structure
- 68 Wooden T-section forward mainspar

- 69 Impregnated integral wing tank (39.6 Imp gal/180 litre capacity)
- 70 Vertical wing/fuselage attachment bolts (four stations)
- 71 Single rear horizontal engine mounting/attachment bolt
- 72 Two forward vertical engine mounting/attachment bolts
- 73 Port mainwheel well
- 74 Mainwheel hydraulic retraction jack
- 75 Mainwheel extension spring
- 76 Wooden mainwheel door
- 77 Mainwheel leg
- 78 Mainwheel tyre (660mm x 190mm)
- 79 Shock absorber scissor
- 80 Narrow-track main undercarriage assembly



He 162 fuselages under manufacture at Junkers' Tarthun plant, a feeder factory for Bernburg housed in a former salt mine near Egeln, south-west of Magdeburg Pete London Collection

During late October 1944, construction began of prototypes. Incredibly the first example, V1 WkNr 200 001, was completed at Heidfeld by December 1, only two months after official placement of the order to proceed. Taxying trials began the next day. By then various gunsights and wireesses had been evaluated while two-seat trainer versions were under consideration, one jet-powered and one in glider form of which a prototype was completed.

By that time too the He 162's wingtip design was under modification, the new arrangement fixed in a drooping attitude in an attempt to correct lateral instability found during model testing. The tips were designed by Dr Alexander Lippisch, the prominent aerodynamicist also associated with the Messerschmitt Me 163 rocket fighter. The tips were fitted to most

production He 162s, though some early examples were completed without them.

In addition, theoretical possibilities of downward-swept, swept-back and even swept-forward wings all came under Heinkel's consideration. Inclusion of an ejection seat, rocket boosters to shorten take-off runs, pulse-jets as primary power units and a butterfly tail configuration were also contemplated.

First flights

On December 6, 1944, the Heinkel He 162 V1 flew for the first time, in the hands of Heinkel's chief test pilot Flugkapitän *Dipl.-Ing* Gotthold Peter. Despite Lippisch wingtips not being fitted, the 20-minute flight revealed generally good handling and the engine performed well, though the aircraft bounced somewhat on landing; on

inspection it was found the wooden flaps had begun to part due to poor glueing.

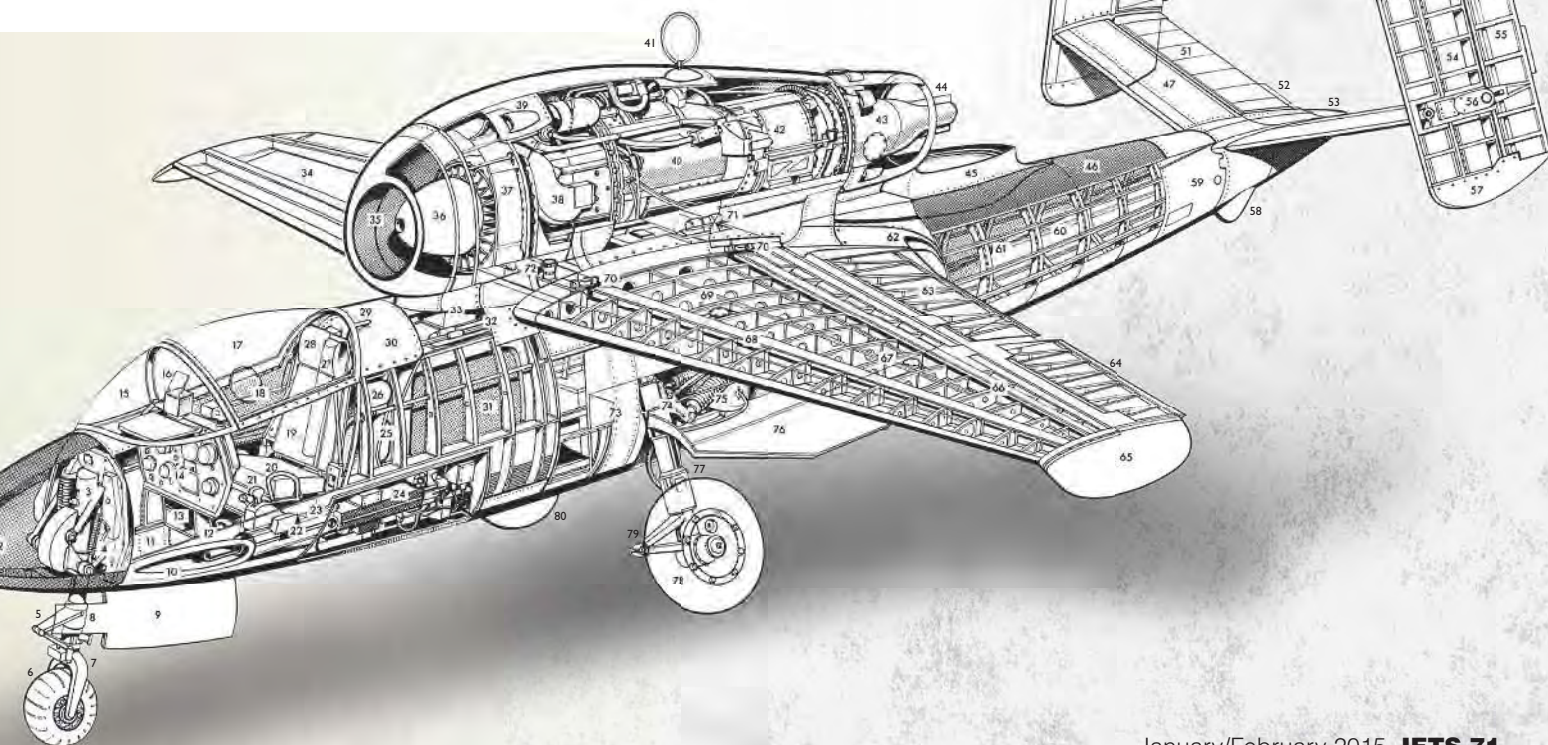
On December 10 the He 162 V1 was flown again, before high-ranking Nazi officials who'd gathered at Schwechat. Disastrously though, during a fast run across the airfield at low altitude the starboard wing leading-edge became detached. The V1 rolled, its starboard aileron and wingtip were lost and it crashed, killing Peter.

The subsequent enquiry found the crash had been caused by a combination of lateral instability and deficient glueing of the wooden wing. Strengthening was demanded; Heinkel rushed to make the necessary changes. Wing ribs, their attachment to the main spar and the wing skinning were reinforced, while the tailplane was enlarged and the centre of gravity moved by altering the fuel tankage.

Despite the accident, with Germany desperate to counter tactical air attacks (and also with the project's high political profile in mind), it was intended the He 162 production programme continue flat-out. However, forecasts of manufacturing output soon began to shrink. Continued Allied bombing; factory power failures; lack of fuel; transportation problems between supplier sites; patchy work quality; redesign stemming from the project's innovation and speed; hold-ups in reworked wing and tail manufacture and engine deliveries: all contributed to increasingly severe production delays.

Problematic prototypes

On December 22 the second He 162 prototype, He 162 V2 (or *Versuchs*: prototype – the nomenclature was later changed to





M2 Muster: model) WkNr 200 002 flew. The aircraft featured a reinforced nose and was piloted by *Dipl.-Ing* Carl Francke. Apart from his role as Heinkel Vienna's technical director, Francke was an accomplished test-pilot, while the aircraft was later used to evaluate the 30mm MK 108 cannon installation. Eight further prototypes appeared, together with a batch of 20 pre-production aircraft incorporating wing, tail and CG modifications. On January 14 Heinkel's Rostock's first production *Volksjäger*, WkNr 120 001, flew from Marienehe.

Of the prototypes, V3/M3 200 003 made its maiden flight two days later, with increased tail span and modified rudders. Despite the changes, on February 25 it crashed fatally, the suspected cause lateral instability. V4/M4 200 004 flew on the same day, fitted with new wings, Lippisch wingtips and an enlarged tail assembly, being used for stability testing.

V5/M5 200 005 was employed only for static testing while M6 200 006 first flew on

January 23 but crashed on February 4 after the plywood covering of its tail unit failed; the pilot, Oberleutnant Georg Weydemeyer, was killed. M7 200 007 conducted stability tests and evaluated a braking parachute; M8/A-1 200 008 crashed fatally on March 12. M9 200 009 and M10 200 010 were both destroyed by the Germans during April, in the face of the Allied advance.

Design details

As the specification had required, Heinkel's *Volksjäger* was small: its wingspan was a mere 23ft 7½in, length just 29ft 8in. The all-wooden shoulder-mounted wing employed a straight leading-edge, its trailing-edge swept forward, and generally embodied metal Lippisch tips. Main and secondary wooden T-section spars were employed while the skin was of ply; dihedral of three degrees was adopted (excluding the tips), and the wing bolted to the fuselage at four points.

The auxiliary spar mounted the ailerons

and landing flaps, again constructed of wood. Ailerons were controlled through push-pull rods, flaps hydraulically. Fuel tankage was partly within the wing; there were no separate tanks, the wing interior itself being used to store fuel, with a capacity of 110 gallons. The arrangement gave rise to leakage problems which further delayed the programme. The dorsal-mounted BMW 003E was attached to the wing's upper surface using three bolts; large portions of its cowlings were made easily removable for maintenance.

The streamlined fuselage was of mixed construction, its nose cone plywood-covered; the majority of the structure and the flush-riveted skinning was of duralumin, with some wooden panels. In section the fuselage was oval at the nose, flaring to a pear-shape at the centre-section with a circular aft section. The main fuel tank was situated aft of the cockpit, its maximum capacity 168 gallons. Armament consisted of either two 30mm MK 108 cannon (the He 162 A-1 version), or two 20mm MG151/20 cannon (the A-2) set low in the forward fuselage.

The *Volksjäger's* cockpit was covered by a curved windscreen and a one-piece jettisonable bubble canopy hinging aft. Within, a catapult-based ejection seat was provided, in emergency designed to fling the pilot clear of the engine and actuated by an explosive cartridge. On the cockpit's port side were engine, fuel and undercarriage controls, together with tail incidence adjustment, rudder trim and flap hand-pump. To starboard were oxygen and radio controls. The Revi gunsight was positioned just aft of the windscreen.

Within the plywood instrument panel, engine instruments consisted of fuel and oil pressure gauges, thrust indicator, oil temperature gauge, fuel contents gauge and exhaust temperature gauge. Flight instruments

WkNr 120 076, ex-III./JG 1, was captured by the British and became the Air Ministry's AM 59; it also received the serial VH532. After flight tests with RAE it was shipped to Canada



Captured WkNr 120 098 received the British identity AM 67 and serial VH153. It's seen over Farnborough on November 3, 1945





Seen here wearing the tail section of WkNr 120 222, during 1946 ex-I./JG 1 He 162 W.Nr 120 230 was taken to the United States, and later received the American code T-2-504. Built at Rostock-Marienehe it flew as White 23 with I./JG 1 until captured at Leck airfield in May 1945

were airspeed indicator; turn and bank indicator and pitot head heating indicator; together with a magnetic compass. The stubby control column was positioned aft of a prominent bulge protruding into the floor; which gave space for the nosewheel to retract.

The steel and duralumin tailplane featured a marked dihedral of 14 degrees, while the endplate fins were of wood, attached with three bolts. The starboard fin housed the R/T receiver aerial, the port fin the R/T transmitter and IFF aeriels. Main undercarriage consisted of narrow-track steel members retracting into the fuselage, with the nosewheel retracting aft; the system was hydraulically-operated, and brakes were fitted to the main members only.

Into service

The first Junkers-produced *Volksjäger*, WkNr 310 001, flew from Bernburg on February 15, 1945 in the hands of *Flugkapitän* Ing Hermann Steckhan. Despite its absence of Lippisch wingtips, all went well. As more aircraft neared completion, late in February 1945 *Luftwaffe* personnel arrived at Heidfeld to take them on charge, though further delays in final deliveries frustrated the pilots.

Meanwhile, the wild notion of using Hitler Youth pilots had faded; formation of a new unit to evaluate the aircraft was considered, but there was simply no time for any drawn-out pre-operational assessment of the *Volksjäger*. It was decided the first front-line recipients would be *Jadgeschwader* JG.1, previously equipped with the Focke-Wulf Fw 190 and one of the *Luftwaffe*'s oldest components.

Training started in February and March

1945, beginning with I./JG. 1, but at first was confined mostly to theory. Instruction was slowed down by the very limited number of *Volksjägers* available and of those, the aircraft which were serviceable. Initial flight restrictions around maximum speed (270kts) and altitude (3,000m) also hampered thorough familiarisation.

Between February and April, I./JG. 1 was stationed at Parchim airfield in the Mecklenburg area of northern Germany. Finally, He 162s began to trickle through to the front line: by mid April around 16 examples had appeared. II./JG. 1 and III./JG.

“The wild notion of using Hitler Youth pilots had faded”

I also started to receive the new mount in small numbers. By mid April too, with the war situation crumbling completely and Parchim bombed, I./JG. 1 had moved to Leck airfield, close to Germany's border with Denmark.

Initial operations

Under almost impossible circumstances, operational flying from Leck got off to a bleak start. On April 19, two *Volksjägers* from III./JG. 1 took off to intercept incoming aircraft thought to be P-47s; very shortly afterwards one He 162 lost its canopy. The pilot, *Fhj.Fw* Günther Kirchner, successfully ejected but was too low to allow his parachute to deploy and was killed. That day Hawker Tempests of No.222 (Natal) Squadron, 2nd Tactical Air Force, encountered an unrecognised enemy aircraft type and claimed it shot down, which may have been

Kirchner though this is unconfirmed.

For the rest of the month and into May, training and ferry flights (and accompanying crashes) continued at Leck, alongside ground strafing and intercepts in penny-packet numbers. The He 162 was found sometimes tricky to start up, while the handful of encounters with Allied attackers were marked not least by gunsight and cannon malfunctions. However, on 26 April *Unteroffizier* Helmut Rechenbach of II./JG. 1 may have shot down an unidentified Allied aircraft, possibly a Typhoon or a Tempest; the claim is uncorroborated.

The Leck-based *Volksjägers* continued flying as best they could until Germany surrendered. On May 4 Lt Rudolf Schmitt of I./JG. 1 encountered a Typhoon or perhaps a Tempest; he may have damaged it or (less likely) shot it down, but again the episode is unsubstantiated. The following day, the German pilots were ordered to stand down.

Post-war projects

Leck was occupied by Allied forces, its He 162s left undamaged by the Germans. Later, 24 of the 26 *Volksjägers* on the airfield were lined up and photographed. *Luftwaffe* statistics indicate that by the end of the war

around 116 He 162s had been delivered, of which the *Luftwaffe* itself had taken on charge 56 examples.

Away from the collapsing front, the technical community had been exploring potential variations to the *Volksjäger*. Among the schemes were the use of a Junkers Jumo 004 jet engine, or a BMW 003 combined with a rocket motor. Also considered was replacement of the jet with either two Argus As 014 pulse jets each of 738lb thrust (as used by the Fieseler Fi 103 (V1) flying-bomb), or the As 044 of 1,102lb thrust. A possible cheap alternative to the jet, the He 162.01-43 design featured a single As 044, and the He 162.01-44 two side-by-side As 014s. In both cases the fuselage would have been lengthened to accommodate the fuel load, and rocket assisted take-off would have been necessary.



Heinkel He 162 M6 WkNr 200006 (VI+IF) getting airborne in early 1945



He 162 built post-war by Heinkel at Rostock, under Russian control. Coded 02, it was transported to the Soviet Union for flight trials

A Mistel-type pick-a-back arrangement was also drawn up, the He 162 forming the upper component and carrying air-launched bombs, but never saw the light of day. Other new armaments considered included batteries of unguided air-to-air 50 mm R4M rockets, installed in groups of 30 beneath each wing. A further project looked at fitting the *Sondergeräte* SG 117, a weapon using seven barrels to produce a much wider and heavier cone of fire than the *Volksjäger's* usual armament, with which to attack Allied bombers during a quick pass. Fuselage- and wing-mounted units were drafted, but remained paper studies.

Allied acquisition

After the war, the He 162 was examined by various Allied nations. A total of 11 ex-JG. 1 examples were earmarked by the British together with tools and spares. Arriving in Britain by ship, beginning during the summer of 1945 they were assessed at Royal Aircraft Establishment Farnborough. Two later passed to Canada.

Among British pilots of the He 162 were Wing Commander R J 'Roly' Falk, since 1943 Farnborough's chief test pilot, and Captain Eric 'Winkle' Brown (to give him his final rank) from the Aerodynamics Flight there. Brown was impressed, although the *Volksjäger's* take-off run was longer than he'd been led to believe; he felt it was delightful to fly with good stability and control, though the rudder had to be used carefully and he criticised its paltry range.

Tragically though, on November 9, 1945 RAE pilot Flight Lieutenant R A Marks crashed in WkNr 120 072, an ex-I/JG. 1 A-2 variant with the Air Ministry identity AM 61. He'd been demonstrating the Heinkel to Army Staff College personnel at Camberley. During a slow roll the aircraft yawed violently then stalled. The pilot lost control and one fin and rudder became detached. The *Volksjäger* dived and a violent pull-out was attempted, but its tailplane then broke away and the aircraft crashed, killing the pilot and a Canadian soldier on the ground.



During the autumn of 1945 captured WkNr 120 086 / AM 62 was exhibited at Hyde Park, along with other German aircraft. By then it had possibly been fitted with a replacement nose-cone. It was later shipped to Canada

On December 10, 1944 the He 162 V1 was flown in front of high-ranking Nazi officials who'd gathered at Schwechat. Disastrously though, during a fast run across the airfield at low altitude the starboard wing leading-edge became detached. The V1 rolled, its starboard aileron and wingtip were lost and it crashed, killing Heinkel's chief test pilot Flugkapitän Dipl.-Ing Gotthold Peter

The United States received and evaluated at least three He 162s while the Soviet Union captured seven, and constructed two more from parts seized at Heinkel's Rostock factory. France too studied the *Volksjäger*, taking two A-1s and three A-2s. The latter received French identities Nos. 1, 2 and 3; first flights under their new owner, Société Nationale de Construction Aéronautique du Centre (SNCAC), took place in May 1947 from Orléans-Bricey airfield. Later flight testing was carried out by Centre d'Expériences d'Aériennes Militaires (CEAM) from Mont-de-Marsan; the aircraft wore an overall beige scheme. However, in July 1948 No. 1 crashed and the remaining examples were grounded.

In Memoriam

Between September 1944 and April 1945, an astonishingly short time, Heinkel had designed, built, flew and brought into front-line operations the world's first single-engined jet fighter. All the time Germany's infrastructure was collapsing, which makes

the achievement all the more remarkable.

Today, preserved in museums in Britain, Canada, France, Germany and the United States, *Volksjägers* commemorate Heinkel's technical accomplishment. But the He 162 was intended to preserve an evil regime, and manufactured using thousands of slave labourers; the surviving aircraft are so much more than mere aeronautical memorials. ●

SPECIFICATION HEINKEL HE 162A



Crew	1
Length	29ft 8in (9.05m)
Height	8ft 6in (2.60m)
Wingspan	23ft 7in (7.20m)
Wing area	156sq ft (11.16m ²)
Empty Weight	3,660lb (1,660kg)
Max Take-Off Weight	6,180lb (2,800kg)
Max Speed	427kts (491mph/790km/h)
Ferry Range	606 miles (975km)
Service Ceiling	39,400ft (12,000m)
Powerplant	One BMW 003E-1 axial flow turbojet (1,760lb/thrust)
Armament	Two 30mm MK 108 cannon (He 162 A-1) or two 20mm MG151/20 (He 162 A-2)
First Flight	December 6, 1944

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1097/14



Aéronavale Breguet Alizés were common visitors to the UK. Here Alizé No 40 lands at Greenham Common in July 1976 for that year's International Air Tattoo Adrian M Balch

ALIZE vs GANNET

ANTI
SUBMARINE
WARRIORS

Lessons learned while fighting U-boats during World War Two meant Anti-Submarine Warfare became a post-war priority. Sebastian Morgan compares and contrasts two approaches to the challenge



Fairey Gannet T.5 XT752 began life as the prototype T.2 (as WN365) and was later converted into the prototype Gannet T.5. It ultimately became XT752 (and G-AYPO) and in 2013 it returned to the skies in the USA as N752XT. Today it is the only airworthy Gannet although an AEW.3 is rapidly approaching completion at St Athan Steve Bridgewater

Britain's almost catastrophic experiences with German U-boats in the Atlantic during World War Two resulted in a heightened post-war awareness of the need for a dedicated Anti-Submarine Warfare (ASW) aircraft.

This was made official in 1945 with Admiralty requirement GR.17/45 for a new aircraft destined to be operated by the Fleet Air Arm (FAA) but it would be ten years before the long-awaited aeroplane finally entered service.

Rivals

Both Fairey Aviation and Blackburn Aircraft entered the competition with two similar aircraft. Blackburn's Y.A.5 was a large yet conventional single-engined monoplane with a mid-mounted, inverted-gull wing. The capacious fuselage accommodated a sizeable weapons bay while the two crew members sat high atop the fuselage. A radar scanner was carried in the rear fuselage in a retractable 'dustbin' dome and power was to come from two Napier Naiad turboprop

engines coupled to drive a contra-rotating propeller through a common gearbox.

However, the engine was cancelled before the Y.A.5 could fly and a 2,000hp Rolls Royce Griffon 56 piston engine (again driving a contra-rotating propeller) was used as a temporary replacement. This allowed the aircraft (now designated Y.A.7) to take to the skies on September 20, 1949.

The following year the Admiralty decided the new aircraft would need a radar operator so the Y.A.7 was modified into



the three-seat Y.A.8, the first of which flew on May 3, 1950. A number of aerodynamic upgrades were also included to remedy some poor aspects of the Y.A.7's handling.

The Y.A.8 would go on to form the basis of the Blackburn B-88 (Y.B.1), which gained an Armstrong Siddeley Double Mamba engine – similar in design to the original Naiad – and first flew on July 19, 1950.

Big Fairey

Meanwhile Fairey Aviation was pressing on with the design of its Type Q (later renamed the Fairey 17).

The aircraft bore a number of similarities to the Blackburn design with a large barrel-like fuselage, a mid-mounted wing, a retractable radome and an internal weapons bay capable of carrying 2,000lbs of munitions. However, whereas the Y.A.7 had a fairly conventional method of wing folding, the Fairey's wing folded in two places to form a distinctive Z-shape when viewed from the front. The aircraft was also fitted with underwing stores pylons to carry rocket projectiles or sonobuoys.

The crew of two sat atop the fuselage like the Y.A.7 but under separate canopies.

Double Mamba

Fairey originally considered the Rolls-Royce Tweed turboprop for the new aircraft but eventually selected the Armstrong Siddeley Double Mamba. This engine was basically a pair of Mamba turboprops, mounted side-by-side and driving coaxial contra-rotating propellers via a gearbox.

The combination could be run with one Mamba stopped to save fuel and extend endurance, and the engine was designed to run on kerosene, turbine fuel and even the ship's own diesel fuel, thus removing the need to carry high-octane petroleum on aircraft carriers.

The prototype (VR546) first flew on September 19, 1949 and on June 19 the following year made the first deck landing by a turboprop aircraft (aboard HMS Illustrious). The second prototype (VR577) differed from the first only in that it had radar installed in a retractable radome under the rear fuselage – it took to the skies on July 6, 1950.

It was at this point that the Admiralty changed the requirement to call for a third crew member (as well as a larger weapons bay to accommodate torpedoes). A third prototype (WE488) was therefore produced to include these changes as well as a

Above left: Blackburn Aviation's bid for the Admiralty contract began with the Griffon-powered Y.A.7 and ended up with the Double Mamba powered Y.B.1, seen here during flight testing in late 1950. The aircraft's protracted development was one reason the contract was awarded to Fairey Aviation instead

Above right: VR546, the prototype Fairey Type Q, first flew on September 19, 1949 and on June 19 the following year made the first deck landing by a turboprop aircraft

small increase in wing area. The third crew member was accommodated by adding an extra cockpit further aft, although this was subsequently found to disturb the airflow over the tailplane and small 'finlets' were later fitted.

With flight testing progressing well, the FAA opted to order the Fairey 17 in favour of the Blackburn Y.A.7/8, which was suffering from protracted development and engine woes.

Into service

Now dubbed the Fairey Gannet, the new aircraft entered production in 1953 and the programme gained Super Priority status. The first Gannet AS.1 entered service at RNAS Ford in April 1954; it was part of an initial order of 100 airframes.

Trials began with 703X Flight but without the benefit of a two-seat training version, pilots found it difficult to get to grips with the new aircraft and, more importantly, the new turboprop engines' inability to provide 'instant' power. Nonetheless, the aircraft

Right: Resembling a Venetian blind, a Gannet runs up its engine and demonstrates its characteristic wing-folding method



Gannet AS.1 WN347 is typical of an early service example of the breed. Compared to the initial prototypes, a third cockpit was fitted further aft, although this was subsequently found to disturb the airflow over the tailplane and small 'finlets' were later fitted. WN347 was delivered to the Admiralty in March 1954 but had been scrapped by the end of 1960

eventually entered operational service with 826NAS embarked on HMS Eagle late in late 1953 and Gannets were soon a common sight in the skies.

T-Bird

The need for a trainer version of the Gannet was not lost on Fairey, especially as it had plans to export the aircraft widely, and in August 1954 the first dual-controlled T.2 (modified from AS.1 WN365) flew for the first time. This differed little from the AS.1, other than removing the radome and fitting a periscope in front of the second cockpit so the instructor could see ahead! The radar was deleted, but the rear cockpit was retained for a radio operator.

Just 38 T.2s were built and in 1957 WN365 was recalled by Fairey and converted into the prototype Gannet T.5. It ultimately became XT752 (and G-AYPO) and was one of just eleven T.5s to be built.

Re-engined

The only perceived fault with the Gannet was a lack of power, especially in warmer climates and the Admiralty requested Fairey to increase the performance to allow a greater weapons load to be carried.





The need for a dual-control training Gannet to assist crew transition to the new turboprop era of aeroplanes led to Fairey developing the T.2. The prototype, WN365, is seen here preparing to take-off for an appearance at the SBAC Airshow at Farnborough



Gannet AEW.3 taxis in after an airshow at Duxford in July 1975. This aircraft was later sold to British Caledonian pilot Neil Moffatt and flown as a 'warbird' during the 1980s as G-BMYP. Today it can be found at the Yorkshire Air Museum at Elvington Caz Caswell

This was simply achieved by replacing the 2,950shp Double Mamba ASMD.1 engine with the 3,145shp ASMD.3. Redesignated the AS.4, the new aircraft was test flown in 1956 and the first of 75 new aircraft entered service later the same year. The T.2 also gained the larger engine in 1957 to become the T.5

Export success

Although designed to a British specification, the Gannet did enjoy limited export success with the Royal Australian Navy – the first overseas air arm to order the type. It received 36 Gannet AS.1 aircraft which operated from HMAS Melbourne as well as the RAN base at Nowra, New South Wales.

West Germany bought 15 Gannet AS.4s and one T.5 in 1958 and a year later Indonesia acquired a number of AS.4 and T.5s.



The Gannet was exported to the Royal Australian Navy, West German Navy and the Indonesian Navy – the latter acquiring a number of AS.4 and T.5s. One of its AS.4s is seen here at the nation's Satriamandala Museum of the Armed Forces Tom Singfield



Even though the type was replaced by helicopters in the ASW role in the 1960s, a number of Gannet AS.4s survived to fly another day. Nine were converted into the ECM.6 electronic counter measures variant – which was capable of radar jamming. Adrian M Balch



The Gannet would go on to replace the Skyraider in the Airborne Early Warning role and the aircraft gained a bulbous radome to accommodate the AN/APX-20 search radar. The tailfin area was also increased to offset the directional instability caused by the radome, the undercarriage was lengthened to ensure there was sufficient ground clearance and the rear crewman's cockpit was deleted. Here, Gannet AEW.3 XL471 prepares to launch from HMS Ark Royal in 1975 Adrian M Balch Collection

Airborne Early Warning

In 1958 the Admiralty selected the Gannet to replace the Douglas Skyraider in the Airborne Early Warning (AEW) role. This required the weapons bay to be removed to make space for a bulbous radome beneath the fuselage to accommodate the AN/APX-20 search radar (which had been cannibalised from the Skyraider fleet). The tailfin area was also increased to offset the directional instability caused by the radome, the undercarriage was lengthened to ensure there was sufficient ground clearance and the rear crewman's cockpit was deleted.

The aircraft also benefited from a more powerful 3,875shp Double Mamba ASMD.4 engine and the much modified design began test flying in August 1958. It entered service as the AEW.3 in December 1958 and 44 new-build examples would be built.

Conversions

While the AEW.3 quickly began to prove its worth, the earlier anti-submarine variants soon found themselves being replaced by the generation of helicopters that offered

both the ability to 'loiter' and could also operate from much smaller ships.

However, a number of Gannet AS.4s survived to fly another day. Nine were converted into the ECM.6 electronic counter measures variant – which was capable of radar jamming – and a further six became Carrier Onboard Delivery versions. Designated the COD.4, these were modified to act as 'relatively' high-speed resupply aircraft and aerial taxis for the 'Top Brass'.

Retirement

Eventually some 255 Gannets served the FAA and the type replaced the aging Skyraiders as well as Fairey Fireflies and Grumman Avengers. Defence cuts in the mid-1960s would mean that a Gannet replacement was cancelled and the AEW.3 and COD.4 variants would soldier on well beyond their anticipated retirement date.

Whereas the German Gannets were phased out in 1965 (to be replaced by the Breguet Atlantique) and the Australian airframes were phased out in 1967 (in favour of the Grumman S-2 Tracker) the FAA's final

AEW.3 would not retire until late 1978. The last aircraft were flown to RAF Lossiemouth where their radar (which had been recycled from the earlier Skyraiders) was scavenged once again and fitted to RAF's Shackletons.

This meant the UK was without a ship-born AEW capability for the first time since World War Two and only after the Falklands War did the Royal Navy receive radar equipped Sea King helicopters.

Survivors

Even after retirement the Gannet wasn't quite ready to fade away into history. In 1982 AEW.3 XL482 was sold to Hamilton Standard in the USA and flew propeller tests with Dowty-Rotol for a number of years. Elsewhere, AEW.3 XL502 was sold to a private owner and flown on the British airshow circuit in the mid-1980s and the prototype T.5 (XT752) was exported to the US in 1995.

XT752 (the prototype T.2 and T.5) returned to the skies again in the USA in 2013 as N752XT and XL500 is currently being coaxed back into life at St Athan, Wales as G-KAEW. The world has not seen the last of the Gannet yet...

Vultur

Meanwhile, across the English Channel, the French Breguet organisation was also working on its own carrier-based aircraft.

In 1948 work began in accordance with an Aéronavale (the naval air arm of the French Navy) requirement, initially aimed at producing a ship-born ground-attack aircraft.

Dubbed the Type 960-I Vultur, the machine was designed as a 'mixed-power' aircraft using a single 980shp Armstrong Siddeley Mamba turboprop turning a four-bladed propeller in the nose with a 4,840lb thrust Rolls-Royce Nene turbojet in the tail to provide extra power for take-off or combat manoeuvring.

Unlike the Gannet, the Vultur accommodated its crew in a side-by-side configuration beneath a framed canopy. The aircraft was designed to carry a single 1-tonne bomb as well as up to eight rockets beneath the wings. A large radar pod was carried beneath the starboard wing and a fuel tank was slung below the port wing to balance out the load. A search radar could also be carried beneath the fuselage.

The first Vultur took to the air on August 3, 1951 and a second followed it into the



Gannet T.5 XT752, now flying as N752XT, was a star attraction at the 2014 EAA AirVenture show at Oshkosh, Wisconsin. The aeroplane is now operated by Shannon Hendricks and has been restored to the colourful markings she wore as the prototype T.5 Steve Bridgewater



Six Gannets were converted into COD.4 variants to undertake Carrier Onboard Delivery duties. One was XA454, seen here landing at Yeovilton in August 1969 Adrian M Balch

skies on September 15, 1952, this time powered by a larger 1,320shp Mamba and 5,000lb thrust Nene 103 – the latter built under licence by Hispano Suiza.

'Tradewind'

Due to its complex hybrid turboprop/jet engine configuration the programme was eventually dropped but, engine aside, the Vultur had a very promising airframe. Undeterred Breguet therefore set about modifying the Vultur to fill the Aéronavale's new requirement for an anti-submarine aircraft.

One of the Vulturs was modified to act as a systems test-bed – and dubbed the Type 965 Épaulard ('Killer Whale') – and although this remained firmly on the ground it paved the way for the development of the Type 1050 Alizé ('Tradewind').

The Alizé prototype performed its maiden flight on October 5, 1956 with Yves Brunaud at the controls. Although it was evidently an ancestor of the Vultur, much had changed along the way. Gone was the Nene turbojet in the rear fuselage and the Mamba was replaced by a 1,200shp Rolls-Royce Dart 20 turboprop. The weapons bay was modified to accept torpedoes or depth charges

and a CSF radar system was fitted with a retractable radome beneath the fuselage.

The fuselage itself was enlarged to accommodate a crew of three with the pilot and radar operator sitting side-by-side in front and the sensor operator sat sideways behind them. Meanwhile, the main landing gear was fitted with dual wheels and modified to allow it to retract into nacelles in the redesigned wings.

The second prototype flew on December 22, 1956 and the last of five prototype/pre-production aircraft took to the skies on April 19, 1957.

Deck trials

The initial Dart 20 was replaced by a 1,950shp Dart 21 as development progressed and in mid-1957 one of the pre-production airframes flew to the Royal Aircraft Establishment at Bedford for simulated carrier operations. Sea trials then followed aboard HMS Eagle, indicating the aircraft could operate in anything up to a 45kt headwind and even a 15kt tailwind.



In 1948 Breguet began work on the Type 960-I Vultur to meet an Aéronavale requirement for a ship-born ground-attack aircraft. The aircraft had a heavy duty undercarriage and the ability to carry weapons beneath the fuselage



Three of the pre-production Alizés take off at the 1957 Paris Air Salon at Le Bourget

Later trials aboard the French carrier Clemenceau also revealed the aircraft could take-off without the aid of a catapult, as long as there was a 30kt headwind – even up to a maximum take-off weight of 7 tonnes.

Two pre-production aircraft performed their maiden flights on June 21, 1957 and August 1, 1958, respectively and the Aéronavale received its first aeroplane on March 20, 1959.

Deliveries

The French military had originally planned to order 100 Alizés but the contract was cut back to 75 machines in 1958 – this being split into two batches of 50 and 25. The final airframe was delivered in June 1961 with all production versions being fitted with the Thomson-CSF DRAA-2B retractable radar in place of the originally planned APS-33 unit.

As well as shore-bases, the Aéronavale Alizés were deployed aboard the aircraft carriers Arromanches, Clémenceau and Foch. The aircraft soon became popular with their crews but were found to suffer from a

high level of dependency on maintenance. A typical Alizé mission lasted four hours after which the aeroplane reputedly required 30 hours of engineering work. The aircraft were also found to be prone to corrosion if not regularly washed with fresh water, especially at sea.

Squadron service

The first unit to receive the Alizé was Flottille 6F, which received its first machines on October 6, 1959 to replace its existing fleet of Grumman TBM Avengers at Hyères. It would go on to operate 45 Alizés and would act as the training unit, providing pilots for operational units.

By January 1967 the squadron's Alizés had flown 30,000 hours and by January 1972 it had reached the 50,000 hour milestone.

Although primarily a training unit, 6F did embark on the carrier Foch in 1983 to perform reconnaissance operations over Lebanon during Operation Olifant and in 1987 it joined the carrier Clemenceau in the Persian Gulf during Operation Prométhée.

Below: The Vultur was designed as a 'mixed-power' aircraft using both a 980shp Armstrong Siddeley Mamba turboprop and a 4,840lb/thrust Rolls-Royce Nene turbojet – the latter was mounted in the tail to provide extra power for take-off or combat manoeuvring



In the late 1980s, after operations over Lebanon, the Alizé fleet was given an avionics overhaul and was also painted with a special Radar Absorbing Material (RAM) to help it avoid the latest generation of ground-to-air defences Tom Singfield Collection



Five pre-production Alizés were constructed, this is the fourth (No 04) and is seen at Rochefort in July 1972

Further service over Lebanon occurred in 1989 (Operation Caspelle) and in 1993 and 1994, 6F took part in Operation Balbuzard I & II over war-torn Yugoslavia.

The squadron embarked on the Foch one final time in 2000, returning ashore on September 15 – the day both the Foch and the Alizé fleet were retired.

Alizés also served with Flotille 4F and 9F, both units receiving their first aircraft in 1960 to replace TBM Avengers. Just like 6F, the aircraft saw action over Lebanon, the Persian Gulf and Yugoslavia whereas 4F's Alizés also saw service during the first Gulf War.

Indian order

Unlike the Gannet the Alizé didn't enjoy huge export success, although 12 new-build aircraft were sold to the Indian Navy in 1960. The first (IN201) performed its maiden flight on October 21 of that year and was soon delivered to India where it and its brethren would join the newly created 310 'White Cobras' Sqn. The remaining eleven aircraft followed within the year and were joined by two refurbished Aéronavale examples in 1968.

The Alizé was the Indian Navy's first carrier based Anti Submarine and Maritime Surveillance (ASM) aircraft and the type operated from shore bases as well as the INS Vikrant. The type was used for reconnaissance flights during India's 1961 recapture of Portuguese-occupied Goa in addition to the 1971 Indo-Pakistan War, during which one was shot down by a Pakistani F-104 Starfighter.

The type enjoyed a long service in India but by 1987 it had been relegated to shore-based patrol flights and by 1991 it had been completely replaced by anti-submarine helicopters.

Upgraded

Unlike India, the Aéronavale frequently upgraded its Alizé fleet and between 1964 and 1965, 30 airframes were overhauled and received the ability to carry the Jezebel sonobuoy system, Mk.43 torpedo and/or the AS-12 anti-shiping missile.

The aircraft soldiered on for another decade and in the mid-1970s money was found to further upgrade 28 airframes, primarily with a view to them lasting until the new out of service date of 1990. The upgraded aircraft were dubbed the Alizé Modernisé (ALM) and were fitted with Thomson-CSF DRAA-10A Iguane radar (as



Alizé No 60 was embarked on the carrier Foch when the ship visited Florida in May 1973. It neatly demonstrates the early scheme worn by the Aéronavale Alizé fleet Bill Sides via Adrian M Balch

used on the Breguet Atlantique), an Omega Equinoxe navigation system, a datalink system and an ARR-52 sonobuoy.

Stealth

In the late 1980s, after operations over Lebanon, the Alizé fleet was given an avionics overhaul and was also painted in a special Radar Absorbing Material (RAM) to help it avoid the latest generation of ground-to-air defences. By now just 27 aircraft remained in service and all received this equipment. However, by the time the type had its final major upgrade, in 1996-97, just 15 aircraft were involved in the programme. These former Alizé ALMs received a new autopilot and avionics and were redesignated as the Alizé ALH (Alizé mis à Hauteur or Upgraded Alizé).

Soldiering on

When the final Alizés were retired in September 2000, the type was replaced in Aéronavale service by the Grumman E-2C Hawkeye.

Even after almost 40 years of service, the Alizé fleet was in good condition and many aircraft reputedly still had a long fatigue life. Thalès Airborne Systems did consider buying eight machines to convert into AMASCOS (Airborne Maritime Situation Control System) standard but this project was eventually cancelled due to a lack of potential customers.

However, the world had not seen the end of the Alizé just yet and in May 2013 the Association Breguet Alizé organisation returned Alizé No 59 to the skies at Nîmes. Registered as a civilian owned 'warbird', F-AZYL now flies in memory of the 89 Alizés built between 1957 and 1962. ●

The sole export success for the Alizé was the Indian Navy. Aircraft IN209 is seen here at Sharjah in February 1967 Adrian M Balch Collection



Right: Compared to the Gannet the wing fold on the Alizé was best described as 'conventional'

Below: The last flying Alizé is No 59 which flew again in May 2013 after restoration at Nîmes by the Association Breguet Alizé organisation. It is now registered F-AZYL as a civilian 'warbird'

PRMAVIA Collection



Tom Singfield Collection



SPECIFICATION FAIREY GANNET AS.1



Crew	3
Length	43ft 0in (13.11m)
Height	13ft 9in (4.19m)
Wingspan	54ft 4in (16.56m)
Wing Area	483.0sq ft (44.87m ²)
Empty Weight	15,069lb (6,835kg)
Max Take-Off Weight	19,600lb (8,890kg)
Max Speed	269kts (310mph/498km/h)
Ceiling	25,000ft (7,600m)
Ferry Range	690 miles (1,110km)
Powerplant	One Armstrong Siddeley Double Mamba ASMD.1 turboprop (2,950shp)
Armament	Up to 2,000lb of bombs, torpedoes or depth charges plus eight hardpoints for rockets
First Flight	September 19, 1949 (Fairey Q) June 1953 (AS.1)

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

SPECIFICATION BREGUET ALIZÉ



Crew	3
Length	45ft 6in (13.86m)
Height	16ft 5in (5.00m)
Wingspan	51ft 2in (15.60m)
Wing Area	387.5sq ft (36.00m ²)
Empty Weight	12,566lb (5,700kg)
Max Take-Off Weight	280kts (322mph/518km/h)
Max Speed	542kts (624mph/1,004km/h)
Service Ceiling	26,250ft (8,000m)
Ferry Range	1,553 miles (2,500km)
Powerplant	One Rolls-Royce Dart RDa.7 Mk 21 turboprop (2,100shp)
Armament	Torpedoes or depth charges carried in internal bay plus bombs, depth charges, rockets, or missiles carried on hardpoints
First Flight	August 3, 1951 (Vultur) October 6, 1956 (Alizé)

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



NEXT ISSUE

COMING UP IN THE MARCH/APRIL 2015 ISSUE OF *JETS*



BOAC

On May 2, 1952 one of Britain's two nationalised airlines became the world's first jet airline. Bruce Hales-Dutton looks back at the history of the British Overseas Airways Corporation

Gormless Ace

In the 1940s jet engines were a rare commodity and Gloster's E.1/44 was created as a single-engined alternative to its twin-jet Meteor. Although officially known as the 'Ace' the aircraft was dubbed the 'Gormless' by Gloster's Chief Test Pilot Bill Waterton. Pete London investigates why



Last of the Gunfighters

The Vought F-8 Crusader was the last American fighter to use guns as its primary weapon. On the occasion of its 60th anniversary Richard Freail looks back at the career of the fighter dubbed "Vought's Last Chance"



First Generation Jet Trainers

In the first of a five-part series Dr Dave Sloggett compares the first generation jet trainers that entered service in the 1950s. Featured types include the Lockheed T-33, Hunting Jet Provost, Fouga Magister, Hispano HA-200 and Aero L-29

Mid-Size Market

With the recent rollout of the Mitsubishi Regional Jet (MRJ) Kimberley Hawkins looks at the burgeoning market for the next generation of mid-sized airliners. The 'big two' manufacturers are rapidly developing the Airbus A320neo and Boeing 737 MAX, whereas other flyers already include the Sukhoi Superjet, Embraer E-Jet and Bombardier C Series. Meanwhile, waiting in the wings are China's Comac C919, Russia's Irkut MS-21 and Japan's Kawasaki YPX and MRJ



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