



AIR

INTERNATIONAL

INSIDE THE SKUNK WORKS

Engineers share the secret of X-59's shape

THE X-59 FILES

- Why it has no windscreen
- How junkyard jets helped build the 'Frankenplane'
- The robots aiding construction

SUPERSONIC COMEBACK

NASA & Lockheed Martin's quest to stifle the sonic boom

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Welcome

ello and welcome to a landmark edition of *AIR International*. Every now and again in this industry, a seemingly normal working day can be transformed into an exceptional one. In this case, the *AIR International* team was granted unprecedented access to an incredible ongoing story.

Thanks to a Lockheed Martin Skunk Works and NASA collaboration with *AIR International*, we are proud to devote 12 pages of exclusive interviews and previously unseen images of the **X-59 Quiet SuperSonic Technology (QueSST)** demonstrator.

Assistant editor Khalem Chapman writes: "This unique aircraft will be NASA's first manned supersonic X-plane in decades, but the administration has been keen to get back into the game. The X-59's conception is extraordinary. Every aspect of this jet has been specifically designed and scrutinised for its sole mission: to bid farewell to the thunderous sonic boom and hello to a quieter sonic thump.

"The X-59 has so many distinctive features: a long, slender, lightweight body, a T-shaped tail, unique wings and engine position – all optimised for quieter supersonic operations. One seemingly unnerving fact is that the cockpit has no forward window! So how did Lockheed get around the issue of having no front windscreen? NASA's innovative eXternal Vision System (XVS) provided the solution.

"The Low-Boom Flight Demonstration (Lbfd) mission could hugely influence the future of commercial air travel by halving journey times around the globe. Stifling the supersonic boom would enable regulators to change the rule book and allow flights overland at supersonic speed,

something Concorde could never do. It's an extremely exciting project."

Don't forget you can see more exclusive footage and interviews on our website, **key.aero**, from August 27. Watch test pilot Dan Canin discuss flying the X-59 for the first time and see Lockheed Martin and NASA consider the challenges of designing a groundbreaking X-plane in lockdown.

Switching from supersonic fixed-wing aircraft to blades of assorted numbers and types, you'll find this edition is also rich in rotary content. In addition to our regular UAV Focus section, there is the latest on helicopter crimebusters in Argentina and sci-fi-style gyrocopters in Africa, China and the Middle East. We trust this will whet your appetite for the EUROPEAN ROTORS VTOL Show and Safety Conference to be staged in Koelnmesse, Cologne from November 10-12. *AIR International* is delighted to be a media partner for the event and will be previewing the industry showcase next month.

Whether your choice of future steed is supersonic or a touch slower, the *AIR International* team will keep you informed of the latest developments.

We hope you enjoy reading this very special edition.

Carol Randall
Associate Editor, Commercial Aviation

A Brazilian Navy Sikorsky S-70B Seahawk, local designation SH-16, from the 1st Anti-Submarine Helicopter Squadron (HS-1) at São Pedro de Aldeia Naval Air Base. See Blue Amazon Warriors on pages 70-75.
João Paulo Moralez and Santiago Rivas



COVER PHOTO: Concept artwork of the X-59 Quiet SuperSonic Technology (QueSST) demonstrator. Lockheed Martin/Key Publishing



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VIRGIN GALACTIC has unveiled images of a striking delta-wing supersonic commercial aircraft intended to operate at Mach 3 carrying nine to 19 passengers at an altitude around 60,000ft.

The company said: "The design philosophy of the aircraft is geared around making high-speed travel

practical, sustainable, safe, and reliable. Virgin Galactic is designing the aircraft for a range of operational scenarios, including service for passengers on long-distance commercial aviation routes."

A collaboration with Rolls-Royce involves the development of what

Virgin Galactic chief space officer, George Whitesides, called "sustainable, cutting-edge propulsion systems".

Rolls-Royce North America chairman and CEO Tom Bell noted the engine company's "technical capabilities to develop and field the advanced propulsion systems needed to power



High-Mach

Returning the MAX to service

IN AUGUST, the Federal Aviation Administration (FAA) opened a 45-day comment period on four updates to the Boeing 737 MAX design that it has proposed for an Airworthiness Directive (AD) to return the aircraft to service.

A key change is introducing new control laws to the MAX's flight control software to prevent erroneous activation of the jet's Manoeuvring Characteristics Augmentation System (MCAS), cited as a primary cause of the October 2018 Lion Air and March 2019 Ethiopian Airlines disasters that killed 346 people and led to the type's grounding.

Another proposal is an alert to pilots that

the MAX's two angle of attack (AOA) sensors are disagreeing, indicating a potential AOA failure. The FAA also wants updated procedures "to ensure that the flight crew has the means to recognise and respond to erroneous stabiliser movement and the effects of a potential AOA sensor failure".

Further changes concern adjusting trim wire routing installations in the horizontal stabiliser and requiring operators to test AOA sensors and undertake an operational readiness flight prior to returning each MAX to service.

The FAA said it "has preliminarily determined that Boeing's proposed changes to the 737 MAX design, flight crew procedures and maintenance procedures effectively mitigate the airplane-related safety issues" in the accidents.

Three days of recertification flight tests on a manufacturer MAX were completed by the FAA on July 1. Proposed changes to pilot training requirements for the MAX will be published separately by the Joint Operations Evaluation Board and the FAA's Flight Standardization Board.

An Airworthiness Directive on the Boeing 737 MAX calls for several design changes to the aircraft.
Image Boeing



Checking In

Share your views with us

Welcome to the *AIR International* spot where you can be part of the magazine's evolving conversations. We focus on military, commercial, business, systems and technology issues crammed with data and detail. Our editorial team of subject specialists digs behind today's headlines while keeping their sights set on the future of aviation. This month's X-59 QuesST exclusive feature is a typical example. But do you want to see the return of supersonic air travel, or are you happy with today's journey times? Does the idea of London to New York in under three hours appeal, or should we be focusing our technological efforts elsewhere? And what truly positive action can be taken towards greener air travel of the future. *Checking In* appears regularly in the magazine so get in touch here or via our Key.Aero portal.

Email your views to us at: airinternational@keypublishing.com under the subject heading *Checking In*.

THE IMPACT of COVID-19 on aircraft purchasing was shown again recently when Airbus announced its first commercial aircraft orders since April 2020: two A320neos (an undisclosed operator) and a pair of A321LRs (Lufthansa Technik, for the German Air Force). The company's orders for the year totalled 369 as of August 2020. Boeing's latest figures show only 26 orders (nine 767s, 17 787s).

A JOINT team from Airbus' commercial, defence and helicopters divisions has created a solution to quickly convert passenger airliner interiors with a medical evacuation configuration. The company said its engineers developed the product, based on the A330/A340 platform, in only six weeks and now offers it "to any customers wishing to perform medevac operations".

commercially available high-Mach travel" and its previous history producing Concorde's Olympus engines.

Few other specific details were released, nor was any information on development timescales forthcoming, but Virgin Galactic stated that the jet "would take off and land like any other passenger aircraft and be expected to integrate into existing airport infrastructure and international

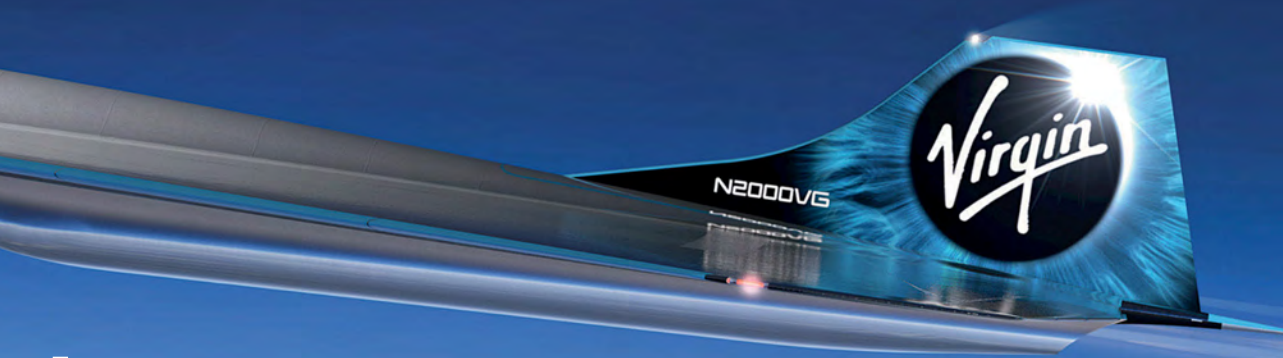
airspace around the world".

Virgin Galactic has an agreement with the Federal Aviation Administration Center for Emerging Concepts and Innovation office to work on a "certification framework" for the aircraft, and a mission concept review involving NASA representatives has been completed.

Specific "system architectures and configurations and determining which

materials to use in the design and manufacturing" is now under way, the company said, adding: "The team will also work to address key challenges in thermal management, maintenance, noise, emissions and economics that routine high-speed commercial flights would entail."

Virgin Galactic's concept supersonic airliner.
Virgin Galactic



hopes

Little and large axed by BA

BRITISH AIRWAYS (BA) has withdrawn the Boeing 747-400 and Airbus A318 as it grapples with the downturn caused by the impact of COVID-19.

BA said: "The airline's remaining fleet of 31 747-400 aircraft will be retired with immediate effect as a result of the devastating impact the COVID-19 pandemic has had on the airline and the aviation sector, which is not predicted to recover to last year's levels until 2023/24."

The 747-400 was in its twilight years with BA anyway, with the fleet steadily decreasing in number as the carrier received more efficient A350s and 787s ahead of the jumbo's original 2024 retirement date. Regardless, the type's sooner-than-planned demise will be felt keenly by staff, passengers and enthusiasts alike as it is synonymous with

BA. The airline's predecessor BOAC was one of the earliest 747 operators in 1971 and during the 1990s and 2000s no other carrier had as many -400 variants in its fleet.

Including the examples operated by its forerunner, BA operated 101 Jumbos over the years (19 -100s, 25 -200s, 57 -400s).

Less emotion surrounds the A318's withdrawal, but its exit is significant in its own way. The smallest type in BA's mainline fleet operated a unique 32-seat all-business class service between London/City and New York/JFK with the prestigious BA001/002 flight numbers used by Aerospatiale-BAC Concorde.

Outbound flights stopped at Shannon, with passengers completing US immigration checks there to speed their arrival into New York. A BA spokesperson



said the service ended because the airline had to adapt to lower demand due to COVID-19, but the route had been a single-aircraft operation since 2016. The aircraft, G-EUNA (c/n 4007), is currently in storage in Madrid.

A familiar sight consigned to history: BA Boeing 747s lined up at London/Heathrow.
British Airways

PREMIUM AEROTECH in Augsburg, Germany is producing the initial Rear Centre Tank (RCT) for the first Airbus A321XLR. Unique to the 4,700nm-range (8,704km) variant, the RCT is a permanently installed high-capacity tank making maximum volumetric use of the aircraft's lower fuselage. Located behind the main landing gear bay it holds up to 12,900 litres (2,837 imp gal).

REGIONAL CARRIER Blue Islands unveiled a new identity ahead of restarting flights to Jersey with an expanded schedule. Blue Islands has taken over the Jersey to Bristol and Southampton and Exeter and Southampton to Manchester services formerly operated by now-defunct carrier, Flybe. It will also introduce new routes from Jersey to Birmingham and Exeter.



777X delivery date slips

The third flight-test Boeing 777-9, in the company's 'light' test livery, departs Everett in August 2020.
Boeing/Jim Anderson

SERVICE ENTRY of the Boeing 777X has been pushed back to 2022, the manufacturer said in its second-quarter earnings results. Previously the company targeted a 2021 start for deliveries of the next generation 'Triple Seven'.

Just a few days after the announcement, the third flight-test 777-9, N779XY (c/n 65799), also known as WH003, undertook its maiden flight from Everett. This jet is testing flight loads, engine performance, avionics and the auxiliary power unit.

The initial flight test airframe, N779XW (c/n 64240), WH001, flew on January 25, of this year, with the second, N779XX (c/n 64241), WH002, following on April 30, 2020.

WH001 is evaluating flutter, stability and control, low-speed aerodynamics, ice shapes, avionics and brakes, while WH002 is testing stability and control, ground effects, and autoland systems.

A fourth jet, N779XZ (c/n 65800), WH004, due to fly by the end of 2020, will test extended-range twin-engine

operations performance (ETOPS), noise, the environmental control system, and functionality and reliability.

Currently, the aircraft is scheduled to become the maiden 777X to join the programme's launch customer.

A Boeing statement to *AIR International* said: "We continue to execute our robust test programme for the 777-9. We remain pleased with the progress we are making and with the aircraft, which will deliver the efficiency and passenger experience our customers expect."

It's a Beluga bonanza for Spain



Airbus has expanded its BelugaXL operations.
Image Airbus

AIRBUS HAS added its Getafe, Spain factory to the route network of its BelugaXL airlifter. The first in-service example of the new jet, F-GXLH (c/n 1824), is now transporting components manufactured at the plant – horizontal

tailplanes for all Airbus commercial jets and the A350's rear fuselage section. The Illescas complex also produces A350 wing lower covers which are shipped to Airbus sites in Toulouse, Hamburg, and Broughton (UK) for assembly.

Usage of the XL at Getafe is another sign of the new jet's gradual integration into the pan-European network building Airbus jets. The aircraft entered service in January transporting wing sections from Broughton to Toulouse.

The initial BelugaXL to fly, in July 2018, was F-GXLG (c/n 1824). While this airframe is tasked with ongoing flight tests and evaluations, the second example, F-GXLH, is in service. Aircraft three, F-GXLI (c/n 1930, flew in July this year and is due to enter service in Q4 2020.

By 2023 four BelugaXLs – including F-GXLG, which will be modified to standard configuration after completing its testing role – will be delivered to Airbus Transport International, which operates the Belugas.

This quartet, to be joined by a further pair by the mid-2020s, will supersede the five current BelugaST jets in service, bringing a 30% capacity increase for Airbus production.

AIRCRAFT FINANCE Germany has signed an agreement with Boeing for two 737-800 Boeing Converted Freighters (BCF). The -800BCF can carry up to 23,900kg (52,800lbs) loads of express cargo on domestic or short-haul routes. First delivered in 2018, it is now operated by ten customers. It has 132 orders, of which 34 have been handed over.

RUNWAYSENSE IS a new system from NAVBLUE for Airbus aircraft that uses the onboard Braking Action Computation Function software to improve the quality of runway condition reports. Data generated by the system can be used by airports to improve runway clearing activities and undertake targeted application of de-icing chemicals, while airlines can better monitor operations.

An airliner of the future?

BRISTOL-BASED ENGINEERING and development firm, Electric Aviation Group (EAG) says it can bring its Hybrid Electric Regional Aircraft (HERA) to market in 2028.

Designed to carry 70+ seats, the HERA will be a low-noise short take-off and landing (STOL) aircraft. A proprietary system called Gear Assisted Take-off Roll, an electric motor in the landing gear, provides power for the initial take-off run. The type will also use a Potential Energy Recovery System, described as "innovative airborne battery regeneration", to minimise turnaround time and eliminate the need to charge batteries after landing.

Efficient battery integration and thermal management of motors and power electronics combined with the STOL configuration, will open new routes for passengers and opportunities for cargo operators, the developer says.

Basic configuration details about the HERA list 800-1,200nm at 275kts cruise speed. A flexible interior design will mean the airliner can carry passengers during the day and cargo at night.

EAG added: "To achieve airframe longevity, our aircraft has been futureproofed should an alternative energy source become available before 2030. The airframe could be turned

into all-electric or carbon-neutral as the battery energy density improves or alternative fuels [hydrogen, biofuels, synthetic aviation fuels] and associated powertrain technologies mature and become affordable."

The developer claimed successful

integration of its proprietary technologies into a 70-seater can potentially increase operating profit per aircraft by 50% from existing regional examples. It also cites substantial emissions savings (90% lower nitrous oxide and 75% in CO₂ per passenger kilometre) and 65% less noise.

Electric Aviation Group's ambitious concept for a 70-seat UK-built turboprop.
Electric Aviation Group

BELOW: Lufthansa has deferred deliveries and grounded more aircraft, including 11 A320s.
Image Lufthansa



Embraer commercial aircraft now have new cargo options.
Image Embraer

Conversions for E-Jets

EMBRAER IS offering quick-change conversions to enable operators to repurpose aircraft as freighters and provide increased air cargo capacity.

The Brazilian manufacturer has published Technical Dispositions for its ERJ145 and E-Jet families, including the new E-Jet E2 models, permitting the carriage of more cargo from the standard amount housed underfloor.

In addition to placing small packages in overhead bins and stowage compartments, freight can be placed on each seat, subject to certain restrictions. A fully loaded 96-seat

E190 can now carry 3,000kg (6,720lb) of cabin freight and a 118-seat E195 3,750kg (8,260lb).

Customers can also opt to have cargo accommodated in a floor-mounted freight configuration if goods cannot fit on passenger seats. Freight is contained in approved netting attached to inboard and outboard seat tracks. A first generation E195 operated by Azul Cargo in Brazil already has this configuration.

Embraer added it "may offer a Service Bulletin for full cargo configurations" for customers requiring even more capacity, as it has already done for the EMB-120.

Lufthansa cutbacks

LUFTHANSA GROUP'S restructuring to cope with the air travel downturn due to COVID-19 means fewer new aircraft deliveries than planned and dozens of grounded jets.

A second-quarter financial results presentation by CEO Carsten Spohr showed the German company will receive 23 new airframes this year (nine were handed over in the last six months). Only 12 jets will be received next year and will not include the new Boeing 777-9 as originally planned, as that aircraft's introduction has been delayed until 2022.

Lufthansa Group added: "The financial planning up to 2023 provides for the acceptance of

a maximum of 80 new aircraft into the Lufthansa Group carriers' fleets. This will reduce the investment volume for new aircraft by half."

Sixty-five airliners will be grounded, including 11 Airbus A320s, six A380s and five 747s in Lufthansa's mainline operation and two Lufthansa Cargo McDonnell Douglas MD-11Fs

Three Austrian Airlines 767s and 13 De Havilland Canada Dash 8-400s, two Brussels Airlines Airbus A330s and eight A319s, and 15 Eurowings Dash 8-400s will be axed. Separately, 17 A340-600s will not return to regular schedules for 12-18 months.



A NEW Canadian regional operator has been established by the Nolinor Group. OWG (Off We Go) was due to launch on August 31, equipped with three Boeing 737-400s operating flights from northern Canada to "tropical destinations". Under a partnership with travel operator Hola Sun Holidays its initial routes from November 1, 2020 will be to Cuba in the Caribbean.

TIGERAIR AUSTRALIA is to close as part of parent company Virgin Australia's restructure although its Air Operator Certificate will be retained to support future development when/if demand returns. Virgin Australia itself will consolidate on the Boeing 737 and remove its regional, charter and widebody aircraft (ATRs, Airbus A320/A330s, and 777s), and cease long-haul flying.



RAF's upgraded Rivet Joint aircraft operational again

The upgraded RAF RC-135W Rivet Joint ZZ664 at its RAF Waddington base, where 51 Squadron crews are getting to know its new glass cockpit and systems as it prepares to re-enter operational service.

UK MOD Crown Copyright/
RAF Waddington

THE ROYAL Air Force announced on July 14 that the first of its three RC-135W Rivet Joint electronic surveillance aircraft to undergo a major upgrade is preparing to resume operations after completing a test and certification programme.

The enhancements to the aircraft, ZZ664 (designated RJ18, the 18th Rivet Joint conversion in the US/UK programme), include a new state-of-the-art 'glass' flight deck, providing a significant improvement in the aircraft's capability for UK forces and its allies.

The Ministry of Defence procurement

arm, Defence Equipment and Support (DE&S), managed the programme of modifications and secured UK certification of the new flight deck.

Rivet Joint ZZ664, complete with its newly acquired world-leading technologies, has undertaken the first of a series of aircrew flight deck training sorties from its base at RAF Waddington, Lincolnshire, where it is operated by 51 Squadron. This will lead to the aircraft shortly resuming exercises and operations covering a wide range of areas of interest for the UK.

The aircraft had departed for the US from Waddington on December 18, 2017, headed for Greenville, Texas, where the upgrade was carried out by L3 Technologies. Following completion of 18-months of work, it reflew at Greenville on May 10, 2019. Six months of flight testing of the new equipment in the US then followed before it was re-delivered back to Waddington on November 19 last year.

The modernised flight deck makes flying operations easier and safer for pilots. It has improved situational awareness, enabling crews to concentrate more on their mission. The new glass cockpit features digital flight instrument displays and large LCD screens, rather than the previous traditional dials and gauges.

The Rivet Joint global fleet includes 20 aircraft, three of which belong to the RAF, while the USA operates the remainder. ZZ664 is the first aircraft from the combined UK/US fleet to undergo these major enhancements. The other two RAF River Joints, ZZ6655 and ZZ666, will also go through the same upgrade in due course, as will the USAF fleet.

UK Rivet Joint crews were the first to receive a bespoke training package, including a new state-of-the-art simulator, which is already in place at RAF Waddington. This is currently the only Rivet Joint simulator modified to incorporate the new glass cockpit.

RIGHT: The first of five Rafales to be delivered to India departs from Bordeaux-Merignac, France, on July 27. The aircraft landed at Air Force Station Ambala two days later to join 17 'Golden Arrows' Squadron.

Image Dassault

BELOW: New Tupolev Tu-214PU airborne command post RA-64532 in the Spectr-Avia paint shop at Ulyanovsk, on July 8, after its Russian Air Force Special Flight Detachment colours had been applied. The Kazan-built aircraft had made its first flight on June 19 and is the second of three on order, the first having been delivered last year.

Image Spectr-Avia



Luftwaffe to acquire two Airbus A321NXs

GERMANY' BUNDESWEHR has revealed that two A321-200NX (A321neo) aircraft are being acquired for the Luftwaffe to complement the existing BMVg transport fleet. A contract was finalised between the German BAAINBw and Lufthansa Technik on July 8 for delivery of the two new aircraft. The choice of the A321 will make it more compatible with the existing BMVg Airbus fleet.

The two additional A321s will be modified to Luftwaffe requirements at Lufthansa Technik's Hamburg facility, including interior cabin outfitting, medevac equipment and various military elements. Delivery of both aircraft is scheduled for the first quarter of 2022.





Boeing wins F-15EX contract worth \$22.89bn

A MAJOR development and production contract for the F-15EX has been awarded to Boeing by the US Air Force Life Cycle Management Centre (AFLCMC) at Wright-Patterson AFB, Ohio. The indefinite contract, awarded on July 13, is worth up to an eventual maximum value of \$22.89bn and could involve purchases of up to 200 aircraft over a 10-year ordering period and 15-year period of performance.

The initial \$1.192bn delivery order is for two F-15EX prototypes, plus options on a further six aircraft, and provides for design, development, integration, manufacturing, test, verification, certification, delivery, sustainment and modification of the aircraft, as well as spares, support equipment, training materials, technical data and technical support.

In anticipation of the order, Boeing has started manufacture of the first two aircraft on its production line in St Louis, Missouri, where they are already structurally complete. Work is expected to be finalised on December 31, 2023. AFLCMC has also awarded General Electric an \$101.3m

contract for F-15EX Lot One engine production. The deal, agreed on June 30, provides for the purchase and delivery of 19 F110-GE-129 engines, comprising 16 for the first eight aircraft, plus three spares.

It is planned to replace the oldest F-15C/Ds in the USAF inventory with the F-15EX. Funding for the first eight was approved in the fiscal year (FY) 2020 budget, on the proviso that only two are purchased initially, while release of full funding for the remaining six will be subject to submission of a report on the F-15EX to the House and Senate defence committees for approval.

A further 12 have been requested in the FY2021 budget and the USAF plans to purchase a total of 76 over the five-year Future Years Defence Programme. Previously, the USAF had stated that it envisages acquiring up to 144 of the type, but the new contract has upped this figure to provide funding for a possible maximum of 200, although final numbers are yet to be determined.

The first eight aircraft will be based at Eglin Air Force Base, in Florida, to support the flight test programme. The first two are

due for delivery in the second quarter of FY2021, with the remaining six following in FY2023. The Strategic Basing Process will be used to determine the fielding locations for subsequent aircraft lots. Transition from current F-15 models to the F-15EX will require minimal transitional training and little to no infrastructure changes.

General Mike Holmes, commander of Air Combat Command, said: "The F-15EX is ready to fight as soon as it comes off the line. When delivered, we expect bases currently operating the F-15 to transition to the new EX platform in a matter of months versus years."

The F-15EX's Open Mission Systems (OMS) architecture is the most significant difference between it and legacy F-15s and will enable the rapid insertion of the latest aircraft technologies. Other features of the F-15EX are fly-by-wire flight controls, a new electronic warfare system, advanced cockpit systems, two additional wing hardpoints and the latest mission systems and software capabilities. The F-15EX is based on the F-15QA variant currently being built for the Qatar Emiri Air Force.

The first F-15EX, serial number 20-0001, on the production line in St Louis, Missouri, is already structurally complete, even though the contract has only just been awarded. Manufacture of the second aircraft is also similarly well advanced.

Image USAF

Germany approves four ISR-configured Global 6000s

GERMANY'S BUNDESTAG (federal parliament) gave approval on July 2 for the purchase of three commercial Bombardier Global 6000 business jets for conversion into signals intelligence (SIGINT) aircraft. The Bundestag's Budget Committee cleared the €750m acquisition for the Bundeswehr.

The type was selected as the preferred option to meet the requirement because

the Luftwaffe already operates three Global 6000s in the VIP role, thus giving savings on maintenance, aircrew training, spares, and support costs for the new aircraft.

Previously, the intention was to purchase four unmanned Northrop Grumman MQ-4C Tritons for the SIGINT role under the Persistent German Airborne Surveillance System

(PEGASUS) programme, but the US Navy offer for these expired in December 2019. On January 28, 2020, the German government said it was abandoning the acquisition and would instead buy three Global 6000s for the role.

As Bombardier is winding down Global 6000 production in favour of newer models, an initial 10% of the approved budget for the PEGASUS

programme was released on July 8 to enable a deposit to be placed with the Canadian manufacturer, ensuring that it will not miss out on the three aircraft required.

German company Hensoldt Sensor Solution will install its Integrated Signal Intelligence System-ZB (ISIS-ZB) SIGINT system into the aircraft, which are expected to enter service from 2025.

USAF to buy Turkey's F-35A fighters - official

A CONTRACT awarded to Lockheed Martin on July 20 and valued at \$861.7m has confirmed the handing over of eight F-35A Lightning IIs intended for the Turkish Air Force to the USAF. The contract announcement said the eight Lot

14 aircraft had now been "repositioned" as a result of Turkey's removal from the F-35 Joint Strike Partner programme.

The contract also included procurement of a further six Lot 14 F-35As for the USAF. Additionally, it provides funds for

modification of the eight repositioned aircraft to USAF configuration. Work is expected to be completed by May 2026. Six earlier Turkish F-35As already built and flown are also planned for transfer to the USAF.

Iraqi Air Force C-130J Hercules YI-305 was an unusual visitor to Budapest Airport, Hungary, on July 11. It was operating a Covid-19-related cargo flight, taking out a Mercedes-Benz ambulance and various medical supplies to Baghdad.

Tamás Martényi

Iraqi C-130J visits Budapest



The third French Air Force Airbus A330 Phénix Multi-Role Tanker Transport, serial number 043 (c/n 1916, ex EC-330, MRTT043), which was delivered four months ahead of schedule. It was accepted by the DGA, the French Defence Procurement Agency, at Base Aérienne 125 Istres on July 10, having been delivered to there from Getafe, Spain, two days earlier.

Image DGA

Early delivery for third French A330 Phénix

PLANS FOR a possible Foreign Military Sale to Lithuania of six UH-60M Black Hawks, valued at approximately \$380m, have been approved by the US State Department, the Defense Security Cooperation Agency (DSCA) announced on July 6. US Congress was notified of the proposed deal on the same day.

THE FIRST of an initial two light surveillance and reconnaissance King Air 350ERs ordered for the French Air Force under the ALSR programme was delivered on August 6 to Airborne Electronic Squadron 1/54 'Dunkirk' at Base Aérienne 105 Evreux. It had been handed over to France's defence procurement agency, the DGA, on July 31.



First RAAF F-35A for 75 Squadron

Royal Australian Air Force (RAAF) F-35A Lightning II A35-029 landing at Fort Worth, Texas, following its maiden flight on July 30. The aircraft is the first to wear the markings of 75 Squadron, which will be the second operational RAAF F-35A unit.

Sebastian Does

UK signs £65m deal for three Protector RG1s

UK DEFENCE Secretary Ben Wallace announced at the virtual 2020 Air and Space Power Conference on July 15 that the Ministry of Defence has signed a £65m contract with General Atomics Aeronautical Systems Inc (GA-ASI) to build the UK's first three Protector RG1 Remotely Piloted Air Systems (RPAS).

It will be the first UK-operated system capable of strike missions anywhere in the world. In addition to the three aircraft, the contract includes options for an additional 13. Also included in the deal are a firm order for three ground control stations (GCS), together with associated ground support equipment, plus options on a further four GCS.

The first system will be delivered in 2021, though it will remain in the US to be utilised in the test and evaluation programme. Once this is completed, Protector is scheduled to enter RAF service by mid-2024.

The aircraft, which will replace the current Reaper RPAS force, will be deployed from its base at RAF Waddington, Lincolnshire. The RAF's No 31 Squadron will re-form at Waddington in 2024 to operate the type. This historic unit, originally formed on October 11, 1915, had latterly flown the Tornado GR4 from RAF Marham, Norfolk,

but was disbanded on March 14, 2019, with the phase-out of the Tornado.

Original plans had been for the acquisition of 26 aircraft, comprising an initial firm order for 16, with options

on the remaining 10. As the contract announcement only refers to "current planned fleet of 16" this would suggest that plans to acquire a further 10 seem likely to have been shelved.

Ground testing of the MQ-9B's structural soundness while carrying Brimstone and Paveway IV as part of the development work for the UK's Protector RG1, the first three of which are now on firm order.

Image GA-ASI



LOCKHEED MARTIN was awarded a \$15bn contract on July 17 for Foreign Military Sales C-130J development, integration, retrofit and production activities for all C-130J variants. The award provides flexibility to accommodate the broad enterprise of activities associated with the C-130J programme. Work is due for completion on July 16, 2030.

THE US Defence Security Cooperation Agency (DSCA) announced on July 6 that US State Department approval has been granted for a planned \$2b Foreign Military Sale to France of three Northrop Grumman E-2D Advanced Hawkeye aircraft and related equipment. US Congress was notified of the proposed deal on the same day.

The second prototype FLYOX in Spain in July this year.
Roberto Yáñez



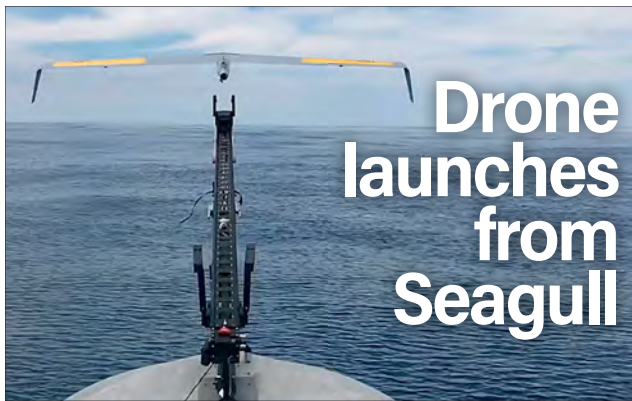
FLYOX the amphibious UAV

BARCELONA-BASED SINGULAR Aircraft has produced a second prototype of its FLYOX I unmanned airframe. A maiden example, XUR.40-01, flew in 2015, but with the emergence of a second, XUR.40-02,

the developer hopes Spain's civil aviation regulator INTA will certify the aircraft to undertake test flights in its home country.

According to Singular Aircraft, the FLYOX has four principal roles: firefighting, goods

transportation, surveillance and agricultural work. The Unidad Militar de Emergencias (Military Emergencies Unit), a branch of the Spanish armed forces responsible for providing disaster relief, is interested in the project.



Drone launches from Seagull

A mini drone launches from the Seagull USV.
Elbit Systems

LAUNCHING AN unmanned drone from an autonomous ship sounds futuristic, but Elbit Systems recently flew a mini unmanned air vehicle from its Seagull unmanned surface vessel (USV).

The visual feed from a camera on the aircraft was transmitted to the land-based unit controlling the Seagull, an autonomous multirole vessel carrying electronic warfare and electro-optical/infrared payloads to provide situational awareness and enable intelligence gathering. The Seagull has been tested in several NATO exercises, including mine countermeasures with the Royal Navy's (RN) HMS Ocean and anti-submarine warfare with the Spanish Navy's Victoria and RN's HMS Duncan frigates.



Aerial Robotics' GT20 Gyrotrak.
Aerial Robotics

A HAMBURG-BASED developer has introduced a concept it claims "redefines the possibilities of commercial drone applications".

AIRIAL ROBOTICS' GT20 Gyrotrak "differs markedly from the traditional multi-copter and VTOL fixed-wing solutions", according to the company.

Described as "somewhere between helicopter and autogyro", the aircraft uses the autorotation principle from autogyros to ensure little energy is used in forward flight while still providing stability and safety if the motor fails.

The firm's co-founder and CEO Jörg Schamuhn said the Gyrotrak gives "the ability to at least double flight time, range and payload, when compared with traditional multi-copter systems".

He added: "Long hovering flights and multiple take-offs and landings are not a problem, which isn't the case or possible with a lot of VTOL fixed-wing solutions".

Aerial Robotics reports the various civil applications for unmanned systems to emerge in recent years, from agriculture and cargo delivery to inspection and security missions, "require effective new solutions tailored precisely to their specific needs".

The fully-electric GT20 has a modular structure to make it adaptable for take-off weights up to 300kg [661lb]. Schamuhn said: "... fitted with a professional camera weighing about 500g [1.1lb], it can stay in the air for about 2.5 hours and cover up to 150km [81nm] at cruise speeds of 90km/h [48kts]."

BELL IS seeking to expand beyond visual line of sight (BVLOS) testing with its Autonomous Pod Transport (APT) to include medical supply drops, basic supply chain operations and even kiosk deliveries. The APT recently carried a 60lb (27kg) payload on its first BVLOS sortie at a test site in southeastern Oklahoma.

A UK developer, UAVTEK, has delivered the first examples of its tiny Bug Nano drone to the UK Ministry of Defence. In tests the 191g (0.41lb) UAV proved it could provide full motion 1080px video from 2km (1nm) away, withstand 40kt (74km/h) wind gusts and provide 40 minutes' endurance. No details have been provided on the number of systems acquired.

THE UK'S Maritime and Coastguard Agency (MCA) is trialling the Camcopter S-100 in support of search and rescue (SAR) missions in North Wales.

Operated by Bristow Group, two S-100s are flying from Caernarfon Airport responding to emergency situations on the coast from Conwy Bay to Llandudno and in the mountains of Snowdonia National Park.

Working alongside the Sikorsky S-92 Bristow operates from Caernarfon for the HM Coastguard Search and Rescue Helicopter Service, the UAVs are operating for the coastguard at weekends, with Bristow conducting routine testing on them during the week.

Russ Torbet, director UK Search and Rescue, Bristow Helicopters, said: "UAV technology has advanced to the stage where its deployment significantly enhances the capability of air search and rescue operations, improving the reach of the service and reducing risk for the public and our crews."

He added: "These systems provide us with an option to keep our Sikorsky S-92 helicopter crew at Caernarfon on standby for lifesaving events, while the unmanned aircraft are tasked with providing safety overwatch and monitoring which those manned



aircraft would otherwise have been sent to carry out."

The Caernarfon trial is part of the MCA's studies supporting the procurement of the Second Generation Search and Rescue (UKSAR2G) service, due to be introduced in 2024.

The agency is assessing new and innovative methods of SAR delivery including fixed-wing and unmanned technologies. This work also involves a trial of the larger Hermes 900 medium altitude long endurance UAV from West Wales Airport (Aberporth).

Bristow Group is trialling the Camcopter S-100, pictured flying with a Sikorsky S-92 in North Wales. Maritime and Coastguard Agency

Free flight for Airbus VSR700

AIRBUS HELICOPTERS' VSR700 performed its first untethered test flight in late July at a drone test centre near Aix-en-Provence in southern France.

The system completed an initial test in November 2019, but Airbus had to introduce geofencing (a virtual perimeter) technology to enable the free flight. Further testing will now progressively open the aircraft's flight envelope.

Airbus Helicopters CEO Bruno Even said the flight "is a major step leading up to the sea trials that will be performed at the end of 2021 as part of the de-risking studies for the French Navy's future drone".

Two unmanned demonstrators and an optionally piloted vehicle will develop and mature the technical and operational aspects for successful UAS operations in a naval environment, Airbus said.

Derived from Hélicoptères Guimbal's Cabri G2, the VSR700 is in the 500-1,000kg (1,102-2,204lb) maximum take-off weight category of unmanned aircraft. It is designed to carry multiple



full-size naval sensors for extended periods and for operations from existing ships alongside traditional helicopters.

Since its maiden sortie last year the prototype has evolved, with the

installations of the geofencing function, a Flight Termination System enabling the mission to be ended if necessary, autopilot software updates, and structural modifications and reinforcements.

Airbus' VSR700 on its initial autonomous flight. Airbus

THE ECA Group has selected the UMS Skeldar V-200 to form part of the naval mine countermeasures capability it will provide to the Belgian and Royal Netherlands navies. ECA and partner Naval Group will supply various unmanned systems, including surface and underwater drones for autonomous mine clearance missions. Deliveries are expected to start in 2023.

SUNGLIDER IS the new name for the high-flying telecommunications platform under development by HAPSMobile, the company majority-owned by SoftBank Corp. The solar-powered aircraft, designed to beam connectivity from high altitude, was formerly known as the HAWK30. It recently flew from Spaceport America in New Mexico as the developer builds up to an initial test in the stratosphere.



Airbus' H160 certification

Newly certified: the H160.
Image Airbus

THE AIRBUS H160 twin-engine helicopter has received European Aviation Safety Agency type certification, with Federal Aviation Administration approval set to follow ahead of the first customer delivery.

Certification and initial deliveries were initially expected in 2018, but the schedule slipped. Airbus Helicopters used three flight-test prototypes to develop and certify the H160, comprising two test

examples and the first serial aircraft, as well as two static specimens for dynamic loads and systems. More than 1,500 flying hours were involved in testing.

Powered by two Turbomeca Arrano turboshaft engines, the H160 is designed for various commercial applications including offshore transportation, emergency medical services, private and business aviation and parapublic roles.

A military version, the H160M, will replace several types in France's three armed services: Armée de l'Air Eurocopter AS555 Fennecs and SA330 Pumas, Aéronavale SA365 Dauphins and AS565 Panther, and Armée de Terre (army) Pumas, Fennecs and SA341/342 Gazelles.

Notable innovations include a new version of Airbus' Helionix avionics system with more automation and improved flight envelope protection, and Blue Edge rotor blades for quieter operations.



A Life Link III AW119Kx.
Image Leonardo

Cleared for poor weather

LEONARDO'S AW119KX has become the first single-engine civil helicopter in decades to be fully certified for low visibility and challenging weather conditions. The instrument flight rules (IFR) approval enables pilots to operate the aircraft safely in low visibility and challenging weather conditions, thanks to Genesys Aerosystems avionics and redundant flight systems.

Leonardo says the capability provides an "IFR entry point for commercial and

public service operators who seek for the highest level of safety and performance in demanding conditions while keeping single engine economics."

Life Link III, based in Minnesota and Wisconsin in the US, has placed an order for one IFR-certified AW119KX with an option on a second aircraft. The aircraft will be added to an existing fleet of ten examples. Delivery from the Philadelphia final assembly line is expected in Q3 2021.



Team Nightjar pitches H145M

Team Nightjar is offering the Airbus H145M.
Airbus Helicopters

AUSTRALIA'S EFFORT to find a new rotary-wing fleet for its special forces has attracted a bid led by Airbus Helicopters. Team Nightjar is offering the multirole H145M for the Commonwealth of Australia's Project

Land 2097 Phase 4 requirement for a rapidly deployable, four-tonne multirole helicopter.

Airbus Australia Pacific MD Andrew Mathewson believes the H145M to be "a solid match" for the requirements.

A statement listed reliability, extensive global support, maturity and "excellent price-performance ratio and the short delivery time" as key benefits.

Noting the H145M's military use in Germany, Hungary, Luxembourg, Serbia and Thailand, Airbus cited a mission readiness rate of more than 99% for H145Ms used for special operations by the Bundeswehr (German Armed Forces).

Mathewson also emphasised "a strong focus on Australian industrial support and innovation" in Team Nightjar's bid. More than 20 members spanning Australian industry, international names such as Kratos, QinetiQ and Safran, and the country's universities are involved.

Separate Land 2097 Phase 4 bidders are a Babcock-Bell team offering the Bell 429, Boeing with the AH-6i, Leonardo's AW109 Trekker and Northstar Aviation with the 407 Multirole Helicopter. An Australian Department of Defence selection is expected in 2021.

OFFSHORE SPECIALIST NHV Group's Airbus H175 helicopters recently passed 40,000 operating hours. The company was the type's launch operator in 2014; its 13 helicopters operate in the North Sea and West Africa. Separately, NHV recently announced its Leonardo AW139s will be flying from Norwich in Norfolk and the Dutch port of Den Helder to Shell platforms in the southern North Sea.

ITALIAN ARMY aviation has received its initial Leonardo UH-169B at the 2nd Army Aviation Regiment at Lamezia Terme. The type will replace Agusta A109 and Agusta-Bell AB205/6/212/412s in Italian Army service under the Light Utility Helicopter programme. Leonardo said the UH-169B represents "a new era in terms of capabilities, technical support, mission flexibility and interoperability".



Rolls-Royce powers V-280 Valor

BELL HELICOPTER has selected Rolls-Royce to provide an engine for the refined design of the V-280 Valor tiltrotor, its response to the US Army Future Long-Range Assault Aircraft (FLRAA) programme.

No details were provided about the specific powerplant or delivery date, but the announcement followed an agreement in March of last year for Rolls-Royce to develop an engine option for the V-280 concept demonstrator (N280BH, c/n 60105).

As well as the powerplant,

Rolls-Royce will supply what it calls “an advanced infrared suppressor system to deliver greater range and enhanced survivability” to provide a “low-risk and reliable integrated propulsion solution”.

Bell manages the V-280 programme and works with 12 other companies in Team Valor. It says it is working to enable rapid production and systems integration and “validate the V-280’s flight capabilities and operational relevance”.

The V-280 concept demonstrator first flew in December 2017 and is powered by GE Aviation T64-GE-419 engines.

It has achieved more than 170 flying hours, flown at 300kts (555km/h), demonstrated low speed manoeuvrability and undertaken initial autonomous flight.

It is expected that the FLRAA, an effort to field a new assault helicopter and replace the UH-60 Black Hawk as part of the US Army Future Vertical Lift project, will be launched in 2022. Other contenders are the Sikorsky SB-1 Defiant and AVX-L3 Technologies’ compound co-axial design (a detailed feature appeared in the April edition of *AIR International*).

General Electric engines power the Bell V-280 demonstrator but Rolls-Royce is now a supplier on the programme.
Bell Helicopter

BELOW: A US Air Force 160th Special Operations Aviation Regiment (Airborne) MH-47G photographed in 2016.
US Army/Staff Sgt Reed Knutson

Boeing puts special ops on cloud nine

BOEING HAS signed a \$265 million contract to supply nine more MH-47G Block II Chinook helicopters to the US Army Special Operations Aviation Command (USASOAC).

Twenty-four such helicopters, which feature what the manufacturer calls “an improved structure and weight reduction initiatives” to enhance performance, will be delivered to the army.

Conducting overt and covert infiltration, exfiltration, air assault, resupply and sling-load operations, the MH-47 is operated by the USASOAC 160th Special Operations Aviation Regiment (Airborne) at Fort Campbell, Kentucky.

Two variants are used: the MH-47E heavy assault helicopter (based on the CH-47D airframe) specifically designed and built for special operations missions

with an integrated avionics subsystem, and the improved MH-47G.

Although the ‘G’ has the same basic fuselage, fuel system, power train, engines and performance as the ‘E’ model, it has further structural modifications including a new cockpit with an extended nose and enhancements for special operations.

Equipment includes the US Army special operations aviation specific Common Avionics Architecture System, a digital avionics package with upgraded software and hardware, including active matrix liquid crystal displays and data processing and control display units.

The model also has multi-mode radar, a fast rope system for insertions and extractions, a defensive armament system with two M-134 and one M-60D machine guns, and an external rescue hoist.



A QINETIQ Airbus H125 from the Empire Test Pilots School at Boscombe Down, Wiltshire, recently undertook the initial UK demonstration of ‘manned-unmanned’ teaming with a semi-autonomous drone on Salisbury Plain. An operator aboard the helicopter switched between monitoring images sent from the drone’s cameras, allowing it to operate independently, search for and identify potential targets.

LEONARDO IS to introduce Honeywell Primus Epic Phase 8 integrated avionics to its AW139. This latest software release introduces advanced synthetic vision with surrounding terrain and obstacles presented in 3-D on the primary flight display. Other features include improved 2-D maps showing the helicopter’s position and flight plan on the multi-function display.



G700 expands envelope

Several milestones have been passed in the flight test programme for the Gulfstream G700.

The fleet of three G700 development aircraft (including the prototype, N700GA c/n 87001, seen here) have completed more than 100 test sorties and the flight envelope has been expanded to include a maximum speed of Mach 0.99 and altitude of 54,000ft, beyond the advertised maximum cruising criteria of Mach 0.925 and 51,000ft. The G700 is the largest member of the Gulfstream family, with a five-zone living area in the cabin and the longest range, able to fly 7,500nm while cruising at Mach 0.85.

Image Gulfstream

Embraer rationalises business jet line



Artist's impression of the interior of the Phenom 300MED, announced in early August.

Image Embraer

IN EARLY August Embraer Executive Jets announced it would no longer offer four of its business aircraft models. While the Legacy 450 and 500 have been replaced by the Praetor 500 and

600 on the assembly lines – they are the latest production standards of the same airframes – the decision to end promotion of the Legacy 650 and Lineage 1000 removes Embraer from the heavily contested large airframe segment of the market.

The Legacy 650 is a refined version of the earlier 600 model introduced in 2001 as the first Embraer business jet, itself derived from the ERJ135 small airliner, a variant of the wider ERJ145 family. Sales have been low in recent years and removing the aircraft from the product line will enable Embraer to close the ERJ145 assembly line.

The Lineage 1000 family, based on the first generation (E1) Embraer 190, has sold in small numbers, accounting for approximately 30 airframes from the airliner's production line. Although

the company indicated that it would develop a new variant of its largest business aircraft based on the E190-E2 in late 2015. No further details of the 'Lineage 1000-E2' were subsequently released at the time of going to press.

After the changes are implemented Embraer will continue to offer the Phenom 100 and 300, as well as the Praetor 500 and 600. Details of the latest variant of the Phenom 300, the 300MED, were announced by the company on August 4. The Phenom 300MED is a medical-evacuation modification offered as a retrofit in partnership with Aerolite of Switzerland (responsible for the mission equipment) and the consultancy and engineering firm umlaut (working with the manufacturer on the supplemental type certificate).

Stratos 716X enters flight test programme



The prototype Stratos 716X making its maiden flight on July 2.

Stratos Aircraft

FLIGHT TESTING of the Stratos 716X very light jet has begun at Roberts Field Airport in Redmond, Oregon. The all-carbon Stratos 716 airframe is a development

of the earlier 714, designed for personal, business and air taxi use.

Test pilot Sean VanHatten made a successful 22-minute initial flight in the prototype, N716X (c/n S716X-101), on July 2, climbing to 13,500ft using the full power of the single 3,000lb st Pratt & Whitney JT15D-2 turbofan from Stratos Aircraft's facility at Redmond.

The Stratos 714 was announced in July 2008 and a proof-of-concept prototype flew on November 21, 2016, at which point the company lacked the finance to complete type certification for the aircraft.

By mid-2018 Stratos decided to increase the size of the 714, which was optimised for four, so that it could accommodate up

to six as standard as the 716. The fuselage was stretched by 79cm (31in) and widened by 5cm (2in). The Stratos 716 is designed to fly at 400kts with a maximum range of 1,500nm (2,778km). The prototype is equipped with dual Garmin G3X screens, a GTN750 multifunction display and an integrated autopilot.

Stratos plans to initially offer the aircraft as a kit (known as the 716X) with a comprehensive build assist programme, which is estimated to take 2,500 hours to complete. The company aims to produce three such kits annually early in the production programme, before creating and offering a fully certified version of the aircraft (the 716).

In the Spirit of growth

DURING JULY Aerion Supersonic continued to announce further additions to its network of suppliers for its AS2 supersonic business jet programme.

Spirit AeroSystems of Wichita, Kansas, signed a memorandum of understanding (MOU) to design and produce the forward fuselage of the AS2.

The company previously undertook preliminary design work on the supersonic aircraft.

Work is due to start in 2023 and at full-rate production Spirit will build 36 forward fuselage assemblies.

In addition to Spirit, Aerion recently announced that the flight control actuation system for the aircraft will be developed by Collins Aerospace at its facilities in Wolverhampton in the West Midlands, UK, and Vernon, France.

Aerion expects to produce 300 AS2s at its final assembly facility in Melbourne, Florida in a decade from the mid-2020s.

The first flight of an AS2 is expected in 2025 and the trijet will enter service two years later.



First KSA PC-24 flying

Pilatus PC-24, HB-VVB (c/n 186), the first of six for Kommunalförbundet Svenskt Ambulansflyg (KSA) 'Swedish municipal ambulance flight', made its maiden sortie on July 22 at its manufacturer's Stans airfield. After initial flight tests by Pilatus, the aircraft was due to be transferred to the Swiss engineering and completions company, Aerolite, to install its aeromedical interior. KSA ordered the jet in 2019 and will become the third operator of aeromedically configured PC-24s when the first is delivered to the Swedish firm early next year. The jet is to be registered SE-RVA once delivered.

Pilatus Aircraft

COVID impact detailed

FIGURES RELEASED by business jet manufacturers for the second quarter of 2020 highlight the impact of COVID-19 on the industry since the end of March. Central to Textron Aviation's report, released in late July, was a US\$66m loss and 50% drop in Citation aircraft released. The company handed over 23 Citations in the second quarter, half the numbers in the same period last year. (The trend was also reflected by its turboprops, falling from 34 in those three months last year to 15 in 2020.) Revenue of US\$1.62bn for the first six months was announced, compared with US\$2.26bn 12 months earlier. Textron has resumed production of its business jet range after shutting its factories for several months and reports strong interest in the lighter end of its Citation family (specifically the M2) from private businesses and wealthy individuals.

Gulfstream handed over 32 aircraft (comprising six G280s and 26 large cabin jets) in the second quarter, one more than in the same period in 2019, although the total in the first six months of this year was ten fewer at 55. The decline was caused by international customer difficulties in trying to accept new aircraft during the pandemic, according to the company. It still expects to release between 125 and 130 jets this year as announced at the

end of the first quarter, down from original prediction of 150. Sales of new Gulfstreams also fell during the second quarter, primarily because the prevailing conditions made it hard to meet potential customers during the period.

Dassault dispatched 16 Falcon business jets in the first half of this year, one less than last year and on July 23 announced plans to send 30 airframes to customers by the end of the year, ten fewer than originally forecast. The manufacturer has also delayed releasing details of its 'next Falcon', the NX, which was planned this year. While no orders were cancelled in the first half of 2020, several customers have delayed receiving their examples, the company stated.

The corresponding figures for the Brazilian manufacturer Embraer were 13 business aircraft in the quarter, compared with 25 a year earlier, for a total of 22 (down from 36) in the first six months of 2020.

Overall flight activity within the business aviation sector has returned to around 75% of last year's figures in North America and Europe, having built steadily since its April nadir. Recovery in the United States has been driven primarily by increased levels of leisure travel, as a safer alternative to larger commercial carriers, with most of the flights between domestic (rather than international)

locations. Flights in support of business operations account for the greatest percentage of the decrease, as the financial impact of the COVID-19 crisis continues to reduce global economic activity.

Utilisation rates of business aviation within Europe vary greatly among different nations. Given that most rotations within Europe are also domestic, it is unsurprising that the majority of active fleets are those of Germany and France, the largest and most populous countries on the continent. Implementing a 14-day quarantine for passengers arriving in the UK contributed to the total number of business aviation flights in the country remaining below 50% of last year's levels.

Although this number is expected to continue to increase slowly in the coming months, regional coronavirus outbreaks of the virus across both North America and Europe and the downturn in the world economy make all but generalised predictions of the sector's near-term trends unreliable.

In late July LABACE 2020 (Latin American Business Aviation Conference and Exhibition) became the latest industrial fair to be cancelled because of the pandemic. Organised by the Brazilian Association of General Aviation, LABACE 2020 was due to be held in São Paulo in mid-August.



Icarus Aerospace develops new tactical aircraft

An impression of the proposed Icarus Aerospace Tactical Air Vehicle. Icarus Aerospace

CANADIAN COMPANY Icarus Aerospace announced on August 10 that it is developing a 'clean slate' design Tactical Air Vehicle (TAV) which it describes as a mission-specialised, swing-role aerial platform utilising advanced aerospace design and manufacturing technologies. Images released by the Montreal, Quebec-based company show the design to be reminiscent of the Rockwell OV-10 Bronco configuration, with a tandem two-seat cockpit, twin-engine, twin-boom, high wing layout.

It will feature in-flight refuelling and

automated aerial refuelling capability, state-of-the-art avionics including a Leonardo Osprey 360° AESA radar, with integrated mission and weapon systems.

A fully-militarised version of the TAV, dubbed the Wasp, is being developed for a wide range of roles, including close air support, counter-insurgency, forward air control, armed aerial scout, special operations coverage, combat SAR, homeland defence and border patrol. Other suggested missions are armed coastal and maritime patrol, anti-submarine warfare, anti-piracy, intelligence, surveillance and

reconnaissance, electronic warfare, signals intelligence, COM/INTEL relay, battlefield management, military MEDEVAC, re-arm and re-supply and even as a refuelling tanker.

An optionally piloted, remotely piloted, or fully autonomous version is also planned. In addition, a high-altitude variant, the Branta, with a long-span wing, which could also be manned or unmanned, is being proposed with a 30+ hour unrefuelled endurance that could be extended by in-flight refuelling. This would also have various armament options.



USAF asks Hermeus to develop hypersonic jet

LEFT: An impression of a possible Mach 5 commercial aircraft being developed by Hermeus Corporation that could be used by the US Presidential and Executive Airlift fleet. The company based in Atlanta, Georgia, was awarded a contract on August 6 by the USAF and Presidential and Executive airlift Directorate to examine options for hypersonic travel for the US Department of Defence. Hermeus Corporation

Rolls-Royce and Boom collaborate on Overture



An impression of the Boom Overture supersonic passenger aircraft. Boom Supersonic

ROLLS-ROYCE AND US aerospace company Boom Supersonic announced an agreement on July 30 to jointly explore a Rolls-Royce propulsion system suitable for Boom's planned flagship supersonic

passenger aircraft, Overture. It will involve teams from both companies collaborating in engine-airframe matching activities for Boom's Overture. The teams will also examine certain key aspects of the

propulsion system, including whether an existing engine architecture can be adapted for supersonic flight, while Boom's internal team continues to develop the airframe configuration.

Blake Scholl, Boom founder and CEO, said: "We've had a series of valuable collaborations and co-locations with Rolls-Royce over the past years to lay the groundwork for this next phase of development."

"We look forward to building on the progress and rapport...to refine Overture's design and bring sustainable supersonic transport to passenger travel."

The Overture certification programme will involve five flight test aircraft with expected rollout in 2025 and completion of type certification in 2029.

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The organisation is best known for aircraft from the Flanker family and the new generation Su-57 Felon. The now synonymous Su-27 has been around for almost 40 years, but the family now includes the Su-30, Su-33, the fighter-bomber Su-34 and the top of the range Su-35.

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Two aviation writers who share a rich seam of industry and enthusiast knowledge will be compiling the GA Review section, which *AIR International* introduces here. Our assistant editor **Martin Needham** is a former aviation events organiser and is well acquainted with the UK GA scene. Digital reporter **Thomas Haynes** logged his first hour in a light aircraft at the age of 14, before going on to be selected for the RAF Air Cadet Pilot Scheme, where he soloed and subsequently obtained his private pilot's licence. In the years since, he's flown various types and now primarily pilots a Pipistrel Alpha.

The Pipistrel Velis Electro became the world's first type-certified electric aircraft in June. NEBOair's maiden example is due to arrive in October.
Image Pipistrel



NEBOair Plans Electric GA Boost

UK START-UP NEBOair is getting ready to launch the world's first zero emission micro air service using a pair of electric aircraft. The company plans to operate a connection between London and the East Midlands via its home base in East Anglia.

NEBOair intends to use the Pipistrel Velis Electro, the world's first type-certified electric aircraft, which was only approved by the European Union Aviation Safety Agency (EASA) on June 10.

A passenger's journey will begin at Damyns Hall Aerodrome in East London and, after a 45-minute flight, they will arrive at Shipmeadow Airfield in Suffolk. Following a change of aeroplanes, the final leg of the northbound trip is a 55-minute flight to Wickenby Airfield in Lincolnshire. The return itinerary is expected to be the reverse of the outbound operation.

NEBOair CEO Sergey Grachev said he hopes the firm's use of electric aircraft will act as a catalyst for change within the general aviation industry:

"It will be a call to others to join in, because the restriction for the electric powerplant is the charging network. It's a project of two layers: the first is establishing the air service and the second is the [infrastructure]."

Describing it as "a movement" on their website, NEBOair plans to create a network of electric aircraft charging facilities throughout the UK and beyond. The company has so far received more than ten letters of intent from airfields around the country expressing interest in becoming a charging station. "The response has been amazing," Grachev said. "I was quite surprised because, for me, the British general aviation community is very conservative, especially when it comes to something as disruptive as this."

The micro air service and charging network form part of a feasibility study into the electrification of general aviation in the UK. The firm plans to share its findings with regulators and other industry stakeholders.

ATP Affirms 100 Aircraft Order

AMERICA'S LARGEST flying training company, ATP Flight School, has received six new Piper Archer TXs and has signed a purchase agreement for an additional 100 examples with the Vero Beach, Florida-based manufacturer.

Originally placed at the 2018 Sun 'n' Fun Fly-In at Lakeland Linder Airport, Florida, it's the second order to have been firmed up by ATP, following an April 2013 commitment for 15 Archer TXs and 85 options.

While the aviation industry has been hit hard by the COVID-19 pandemic, ATP Flight School expects continued growth as more than 80,000 US airline pilots will be retiring at age 65 over the next 20 years, in addition to those taking early retirement - a number that has increased since the coronavirus outbreak began.

The company has opened six locations in 2020 and plans to add five more before the end of the year. It fields a fleet of more than 400 aircraft, including 150 Archer TXs - based on the PA-28 Cherokee - and 92 twin-engined PA-44 Seminole.



ATP Flight School operates more than 240 Piper-built aircraft.
Flickr Commons/Andrew E Cohen

Legend Unveils Mother of All Cubs



The American Legend MOAC is based on the Piper PA-18 Super Cub, an aircraft which can trace its lineage back to the Taylor J-2 Cub, first produced in 1938.
Martin Needham

AMERICAN LEGEND Aircraft Company has launched the latest variant of its famous Piper PA-18 Super Cub, the backcountry-flying-optimised Mother of All Cubs (MOAC).

Although based on the 1949-built Super Cub - more than 15,000 of which were built - the MOAC is an all-new aircraft offering three seats instead of the original two and powered by a Titan Continental O-370 producing 208shp. The uprated engine, coupled with full-span flaps with up to 40° of movement, leading edge slats and square wingtips provides excellent landing and take-off performance - the Sulphur Springs,

Texas-based company claims the MOAC can take off in its own length.

Darin Hart, president of American Legend, said: "After years of lessons learned, including an 80-year Piper history, we build our Cubs to alleviate potential problems. This includes fit-and-finish, engine performance and control systems. Doors and trim fit to perfection and we often use common PMA-standard (parts manufacturer approval) components for easy serviceability. Positioning of physical controls is optimised to ensure freedom of motion from stop to stop without the annoying interference issues so often present in other designs."

Small Fly!

Members of the All-Party Parliamentary Group on General Aviation (APPG-GA) have written to Oliver Dowden, Secretary of State for Digital, Culture, Media and Sport, calling for a dedicated organisation to assist the owners of historically significant aircraft to ensure their protection. The appeal follows a report by experts which sit on the APPG-GA's Heritage Working Group. The panel concluded that not enough is being done to secure the future of culturally important airframes and advised that both flying and non-airworthy aircraft can be uniquely vulnerable due to their fragile construction and being subjected to a wide range of stewardship.

Slovakian aircraft manufacturer Pipistrel has joined forces with Green Motion, a Swiss pioneer in electric vehicle charging, to establish a network of recharging stations for electric aircraft and drones. The two firms are to develop a universal standard for aircraft charging that will be easy to install and can be combined with photovoltaic systems and energy storage infrastructure. Green Motion has already fitted two of its Flight XT charging points at airfields in Switzerland.

Toulouse/Francazal-based start-up Aura Aero has flown its Integral R two-seat aerobatic aircraft, F-WJMK (c/n 001), for the first time. A maiden flight was conducted by test pilots Eric Delesalle, who also flies Novespace's Zero-G Airbus A310, and Hervé Poulin on June 22. A nosewheel-equipped variant of the Lycoming AEIO-390-powered aircraft, known as the Integral S, will also be offered. The type's side-by-side seating arrangement suggests the company has its sights on the upset recovery training market, with such instruction now mandatory for professional pilots.

ZeroAvia of Cranfield in Bedfordshire has successfully completed the UK's first commercial-scale electric flight using a modified six-seat Piper PA-46 Malibu Mirage. The company, which also has a base in Hollister, California, is focused on developing a hydrogen fuel cell powertrain. It believes hydrogen-electric offers the same zero-emission potential of battery-electric, but has a much more promising energy-to-weight ratio, making it viable for larger commercial operations. The June 23 test has been described by the firm as "a significant milestone" for the country's net zero and green aviation ambitions.

Skyborne Buys Bye



Bye Aerospace has secured more than 300 deposits for its eFlyer 2 and eFlyer 4 models.
Bye Aerospace

GLOUCESTERSHIRE-BASED SKYBORNE Airline Academy has become the first UK pilot training school to place an order for Bye Aerospace's all-electric aircraft. The order comprises six eFlyer 2 and four eFlyer 4 examples. The manufacturer estimates the type will eliminate the five million metric tons of CO₂ generated every year during airline pilot training worldwide.

Skyborne's chief executive Lee Woodward said: "We are radically redefining every aspect of airline pilot training and that includes incorporating all-electric aircraft into our fleet as we invest in the latest technology for our trainees and staff."

George Bye, founder and chief executive officer at Bye Aerospace, added: "Skyborne is a pioneer of electric aviation in the UK and has been particularly resilient in its approach to flight training during the pandemic. Its ability to recognise and prepare for the benefits of electric aviation, while adjusting to the challenges presented by coronavirus, has been impressive."

Bye Aerospace's eFlyer 2 aims to be the first all-electric aircraft to achieve Federal Aviation Administration (FAA) Part 23 airworthiness certification. The Critical Design Review for the type was achieved last month, with the next phase of the flight test programme currently underway.

The first two-seater eFlyers are expected to join the Skyborne fleet in the autumn of 2022, with the four-seat variant entering service the following year. The Staverton-based company currently fields three Diamond DA42 Twin Stars alongside sole examples of the DA40 Diamond Star and Slingsby T-67M Firefly.



Almost 40 years in the making, **Piotr Butowski** discovers whether Russia's Mi-38 mega-heli was worth waiting for.

Reading the above, you will be surprised to learn that design of this helicopter began almost 40 years ago. On July 30, 1981, a resolution from the USSR government ordered the Mil design bureau to create the Mi-8M medium-sized helicopter successor to the Mi-8/Mi-17. In 1983, the design evolved into the Mi-38 with new-generation VK-3500 (TVa-3000) engines, an elastomeric rotor head, composite rotor blades, an X-type tail rotor, retractable landing gear (later abandoned) and modern avionics. A full-size mock-up of the Mi-38 was shown to the public at Mosaeroshow 1992 in Zhukovsky, and the maiden flight was announced for 1995. However, the Russian economy entered a deep crisis and the Mi-38 programme stalled.

Failed internationalisation

The political changes in Russia in the late 1980s and early 1990s opened the gates for international co-operation. In October 1994, the MVZ Mil

design bureau and the Kazan Helicopters production plant concluded an agreement with the Franco-German Eurocopter (Airbus Helicopters, today) to establish the Euromil company, in which each partner had a third share, and the purpose of which was to implement the Mi-38 programme.

Still, not much happened with the helicopter itself – the main obstacle being the lack of a sufficiently powerful, modern engine in Russia. After a few years of dormancy, the Euromil partners decided to accelerate the programme and on August 18, 1999, they signed a contract to complete the construction of the first flying prototype.

On the same day, they concluded an agreement with Pratt & Whitney Canada (P&WC), under which P&WC agreed to adapt its PW127H aircraft engine to the needs of the Mi-38 and provide engines. These were designated PW127/5 after the modification, and were provided free of charge for the helicopter trials. In return, the company was promised a contract for serial production PW127ST engines for at least 50 helicopters in the future.

However, in December 1997, a new law was adopted in Russia which dictated that a foreign shareholder in a Russian defence industry enterprise may not own more than a 25% share. Also, foreigners were banned from sitting on the governing bodies of such a company. Euromil applied for an exemption, but nothing came of it. So, Eurocopter did not receive its share of the intellectual property rights in the Mi-38, and finally, after years of negotiation, it left the Euromil consortium in December 2003. Ironically, its departure coincided with the Mi-38's first flight!

On December 22, 2003, the prototype Mi-38, OP-1 (opytnyi, test; registration RA-38011) with PW127/5 engines lifted off for the first time, and for six minutes it hovered at a height of several metres. The helicopter was

Russia's mega



Mi-38-1 prototype OP-2, 38012, during a test flight in 2013. This was the second development airframe and first flew on October 30, 2010. It was retired in 2016 and placed in storage.

Piotr Butowski

First prototype Mi-38 38011/OP-1 in 2014 after upgrade to Mi-38-2 with Klimov TV7-117V engines. Approaching behind is an Mi-28N.
Piotr Butowski



Mi-38

flown by Vladimir Kutanin and Alexander Klimov. The first full profile flight was made many months later, on August 25, 2004. Further tests were also not very intense and up to 2010, OP-1 made only 84 flights, in other words, it flew about once a month.

On May 15, 2008, the Russian Helicopters Corporation and Pratt & Whitney Canada signed a memorandum on the serial production of the PW127ST engine for Mi-38. However, the memorandum did not turn into a contract. In 2010, the Russian United Engine Corporation (UEC) announced that "due to the existence of the TV7-117V engine in the UEC production plans and the activation of work on this engine, the locating of the PW127 production in Russia is no longer considered".

The reasons for this move have never been publicly explained. The Russians claim that P&WC's withdrawal from the Mi-38 project is the result of pressure from the US, which, after Russia's war with Georgia in August 2008, prevented the supply of engines for a helicopter with military potential. It can also be assumed that P&WC assessed the possible demand for the Mi-38 as rather low, and concluded that there was no chance of the promised order of 50 helicopters with Canadian engines, so there was no



Mi-38T 38015 (c/n 26001) undergoing final completion. This was the first production transport version for the Russian Ministry of Defence and first flew on November 3, 2018. Piotr Butowski

This full-scale mock-up of the Mi-38 was on display at the Mosaeroshow at Zhukovskiy in 1992. Piotr Butowski



point in investing further in the programme. The second prototype Mi-38, OP-2, flew for the first time on October 30, 2010, and made its first full-circle flight on November 22. The helicopter was powered by the same two Canadian PW127/5 engines that had been removed from OP-1 and reused after being renovated. The OP-2 prototype was used primarily to test the new IBKO-38 integrated avionics suite made by the Transas company of St Petersburg (OP-1 only had a temporary set of clock-type instruments in the cockpit). The flight control system was also improved.

After the PW127/5 engines were moved to the second, OP-2, prototype, the first, OP-1, was used for testing new Russian TV7-117V engines developed by Klimov of St Petersburg. Testing was supposed to begin in 2011, but shortly beforehand, the modified VR-382 main gearbox disintegrated



Mi-38-2 38014/OP-4, the fourth and last prototype, first flew on October 16, 2014.
Piotr Butowski

during test-bed trials. This delayed the start of the helicopter trials by more than two years. In the meantime, the Kazan plant had completed the third, OP-3, which overtook the re-engined OP-1 and, on November 13, 2013, became the first Mi-38 to fly with Russian engines.

A year later, another prototype (and what was to be the last), OP-4, joined the flight testing schedule complete with TV7-117V engines.

Since 2013, Russia's helicopter trials have accelerated significantly.

From 2013 to 2017, the Mi-38 prototypes performed a total of 824 test flights.

With this new helicopter version, new designations appeared. The original helicopter with its Canadian engines is now called Mi-38-1, and the version with Russian engines – Mi-38-2, or *izdeliye*, item, 2602. The Mi-38 programme has an internal designation 'izdeliye 260' in the design bureau.

The typical transport role of the Mi-38 is to carry a load weighing 5,000kg (11,023lb) over a distance of 227 nautical miles (420km).

Its ferry range, with an additional fuel tank inside the hold, is 702nm (1,300km). The military version can accommodate up to 40 troops; the passenger version carries 30 seated passengers, while the super-comfy, luxurious VIP version transports seat up to eight people. For the first time in a Russian helicopter, the cabin is air-conditioned.

In heavy-lifting work, the helicopter can lug 5,000kg (11,023lb) on its external hitch. In 2012, prototype OP-2 with PW127/5 engines broke five world records in the FAI E-1h category, including, on August 26, 2012, reaching an altitude of 28,281ft.

According to the TsAGI institute: "The Mi-38 has the best aerodynamics of any Russian helicopter."

Instead of the traditional layout with front engines, its engines are placed behind the main transmission, which significantly reduces noise and vibration in the cabin. It also increases passenger safety in the event of an emergency landing. Furthermore, moving the engines backwards changed

the helicopter's balance and allowed the equipment blocks to be moved forward (in the Mi-8 they are in the rear part of the hold), thus significantly reducing the length and weight of the wiring.

Shrinking forecasts

Years ago, the Mi-38 was intended as a direct successor to the mass-produced Mi-8/Mi-17 family. It was estimated that, although the helicopter itself would be more expensive than the Mi-8, its operation would be much cheaper. The service life of the basic components will also be four to six times longer than that in the Mi-8. Thanks to modern helicopter avionics, only one pilot is required (the second is only for passenger transportation); and, unlike the Mi-8, there will also be no need for a technician on board. The extensive range of control equipment will reduce the time and cost of servicing the helicopter. In addition, the Mi-38 was supposed to be faster and fly further, while carrying a greater load.

This is all true when you compare the Mi-38 with the original Mi-8 that existed 30 years earlier. However, the modernisation potential of the Mi-8 was underestimated. Up-rated engines and construction improvements allowed an increase in the Mi-8's lifting capacity from 3 to 4 tons. The same Transas avionics



ABOVE: The VIP cabin of Mi-38 14341 (c/n 26005), which was delivered to Gazprombank Leasing in February 2020.
Russian Helicopters

OPPOSITE LOWER RIGHT: The modern glass cockpit layout of a series production Mi-38.
Piotr Butowski

OPPOSITE BOTTOM LEFT: The third prototype, Mi-38-2 38013/OP-3, under construction at the Kazan Helicopter Plant in Kazan.
Piotr Butowski

Second prototype Mi-38-1 38012/OP-2 during trials at the Mil Moscow Helicopter Plant in Tomilino during May 2011.
Piotr Butowski





The second of two Russian Air Force Mi-38Ts, '72 Red'/RF-45029, in a digital two-tone green camouflage scheme.
Piotr Butowski

as found on the Mi-38 are also installed on the latest Mi-8s. The Mi-171A2 helicopter, the latest production version of the Mi-8 family, also features composite blades and the X-type tail rotor. Moreover, the proposed next-generation Mi-171A3 version will have fuel tanks built into the floor like the Mi-38. This will reduce aerodynamic drag and increase the speed and range of the helicopter. Up to now, all Mi-8s have carried fuel in cylinders on the fuselage sides.

Thus, the Mi-38's biggest competitor was found in its own camp. The main advantage of the Mi-38, compared with the latest Mi-8, is its cargo hold, which is 1.6m (5ft 3in) longer (width and height differ very slightly), plus an additional ton of lifting capacity. Furthermore, it flies 27kts (50km/h) faster and has approximately 25% greater range. However, these advantages may not be enough when it costs roughly twice as much as the Mi-8.

The manufacturer is working on the future development of the Mi-38, including increasing its take-off weight to 16,200kg (35,715lb) and boosting its lifting capacity to 6 tons inside the hold or 7 tons on external suspension.

In 2004, I was in Kazan viewing the first Mi-38, when the manufacturer announced a plan to sell 300 helicopters by 2020 on the civilian market. Military customers would supplement this. Later, in December 2012, the government programme 'Development of the Aviation Industry for 2013-2025', stated that 175 helicopters would be built by 2025. Then, more recently, in February 2020, Andrei Boginsky, director general of Russian Helicopters, assessed that "the need of potential customers is for more than 100 Mi-38 helicopters by 2030".

Start of serial production

The first customer to buy the Mi-38 was the Russian Ministry of Defence, which in July 2017 placed an order for two Mi-38T transport helicopters.

The first Mi-38T '38015' (the fifth Mi-38 overall), took off for the first time on November 3, 2018, and both helicopters to be ordered were handed over to the military in 2019. The first civilian customer was Gazprombank Leasing, which received its VIP version in February this year and handed it over to the Russian Helicopter Systems company. The helicopter is intended to



meet the needs of the Ministry of Industry and Trade of Russia.

The plan for this year is to deliver two examples to the Special Air Group Rossiya, serving the state's highest authorities. This was announced at the end of 2019 by Andrei Boginsky. The Kazan Helicopters plant says it has more than 15 firm orders for the Mi-38 from Russian state structures, as well as around 70 letters of intent, including some for export.

Koptilshchik and other military versions

For routine transport tasks, the current Mi-8MTV-5 and Mi-8AMTSh helicopters, supplemented by a small number of super-heavy Mi-26s, are sufficient for Russian military aviation needs.

The intermediate Mi-38 platform can also be used for special purposes. In 2008, under the code name Koptilshchik (stoker), studies on the PSTDV (Future Medium Transport and Assault Helicopter) began.

Two variants of the Koptilshchik are being considered. One is a slightly adapted Mi-38 – this is today's Mi-38T. The other is an Mi-383 with the same powerplant, gearboxes and rotors, but with an entirely new airframe incorporating stealth technology. It also has retractable landing gear, a rear loading ramp and an extensive avionics suite, including an electro-optical surveillance turret. A new L370V38S Vitebsk self-defence system, featuring ultraviolet warning sensors and a directional infrared countermeasures (DIRCM) system, is being developed for the military specification Mi-38s. The Mi-383 helicopter will primarily serve the special forces.

In May 2019, during a visit to NPP Polyot in Nizhny Novgorod, a communication systems company, the deputy minister of defence responsible for acquisitions, Alexei Krivoruchko, revealed the possibility of using the Mi-38 as an airborne command post. The Russian Ministry of Defence has ordered three such Mi-38 helicopters, designated Mi-38-7 (izdeliye 2607), which are to be made in 2021. **AI**



A Schlieren image depicting how the shockwaves will build up on the X-59 when it is travelling at supersonic speeds. This method of photography was invented to study supersonic motion by German physicist August Toepler in 1864. NASA scientists use Schlieren images to see the pressure waves generated by an aircraft pushing air molecules out of the way when travelling faster than sound.

Lockheed Martin/Key Publishing

RIGHT INSET: Peter Coen, mission manager of the Low-Boom Flight Demonstration (LBFD) at NASA's Aeronautics Research Mission Directorate.

LM Skunk Works

The X Factor

NASA and Lockheed Martin Skunk Works have teamed up to develop the X-59 QueSST – an X-plane that will employ low-boom technology, designed to replace the famous sonic boom with a quiet thump. **Khalem Chapman** explores the mission to date, with exclusive words and images.

Picture this. The year is 2040 and the commercial aerospace industry has once again embraced supersonic air travel, reviving the capabilities that were lost following the retirement of Concorde in 2003.

But this time it's different, because these supersonic flights can speed over land. The thunderous boom traditionally associated with breaking the sound barrier is a thing of the past, thanks to the introduction of low-boom technology and the quieter, almost unnoticeable, sonic thump it produces.

It is a sound that will make civil supersonic air travel more acceptable

to both regulators and residents on the ground. This supersonic future could become a reality if NASA's Low-Boom Flight Demonstration (LBFD) is successful, and the commercial sector is certainly keen to revive this lost capability (*see panel on page 33*).


This mission will be flown by the X-59 Quiet SuperSonic Technology (QueSST) – a specifically designed, one-off demonstrator currently being manufactured

by Lockheed Martin Skunk Works. It will be NASA's first manned supersonic X-plane in decades, reminiscent of the famed Bell X-1

exploits, but with a very different objective.

Peter Coen, the

mission manager of the LBFD at NASA's Aeronautics Research Mission Directorate, outlined the ambitious undertaking to *AIR International*: "We're trying to use [the X-59] to prove that the sounds from supersonic flight can be made quiet enough for overland supersonic flight, to make them acceptable to the public and the international regulatory community."

To prove its low-boom theory, NASA will fly the X-plane over several US cities from late 2023. "The X-59 will be used in a series of community overflight tests, where for a month or so, we'll fly it over people and generate different levels of sound. We'll be surveying groups of people to try and [gauge] their response," Coen added. 



Peter Coen



CLOCKWISE FROM ABOVE: The X-59's final assembly area at Lockheed Martin Skunk Works' facility in Palmdale, California. The empennage and nose are also currently in production and will be delivered here to be fitted.

All images on this page LM Skunk Works

David Richardson, pictured, was appointed programme director early this year. He is responsible for ensuring X-59 production remains on schedule and within budget.

Michael Buonanno, pictured, is the lead engineer on the X-59 programme at Lockheed Martin Skunk Works, heading up the team that has designed, is producing and will eventually deliver the QueSST to NASA.

Throughout the build process, Skunk Works has leveraged a Combined Operation: Bolting and Robotic AutoDrill (COBRA) system. The application drills, countersinks and inspects holes, increasing accuracy and overall manufacturing speed. COBRA's involvement in the X-59's production marks the first time the system has been employed by the company.

Shock and awe

At present, national and international regulators – such as the Federal Aviation Administration (FAA) and the International Civil Aviation Organization (ICAO) – have set 'speed limits' for overland commercial air travel, because passing the sound barrier generates a loud sonic boom, which exceeds acceptable noise limits and disrupts populated areas.

A conventional sonic boom (or N-wave) is a shockwave that is generated when the speed of an object passing through the Earth's atmosphere becomes greater than the local velocity of sound.

As an aircraft moves through the air, it creates pressure waves in front and behind it, which travel at the speed of sound. The velocity of these waves varies depending

on altitude and temperature. For example, at sea level and 20°C (68°F), these waves travel at roughly 761mph (1,225km/h). At 30,000ft (9,144m), with temperatures ranging between -40°C (-40°F) and -57°C (-70°F), they travel at around 678mph (1,091km/h). Sound travels slower at altitude as the air is thinner and cooler.

If an aircraft is cruising at the speed of sound, it's travelling at Mach 1. A platform going at twice the speed of sound would be flying at Mach 2, and so on. At speeds of Mach 5 and above, the airplane would be travelling at hypersonic speeds. When an aircraft exceeds Mach 1, it can no longer push a pressure wave out in front of it, or, as Coen described it: "A sonic boom can be said to happen, because the air doesn't know the airplane is coming."



See... **KEY.AERO** ... for an interview with director David Richardson



As an object travels faster towards the speed of sound, the waves can't get out of the way of each other, so they build up and coalesce into a single shockwave. This causes a sonic boom when it exceeds Mach 1.

There are typically two distinct sounds, the first is caused by the change in air pressure as the aircraft's nose passes the sound barrier, and the second when the tail passes this limit and the air returns to normal.



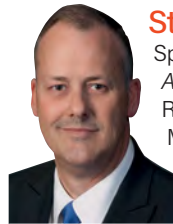
Michael Buonanno

Michael Buonanno, the lead engineer for the X-59 at Lockheed Martin Skunk Works, referred to some of the science involved: "[If] you design a supersonic airplane for performance, like an F-22, or a Concorde for

that matter, those shockwaves that come from the individual features will inevitably coalesce – they'll join together into one very large shockwave, which results in a very loud bang. We've carefully designed [the QueSST] to keep those shockwaves separate, so that they don't come together. The result is a soft thump."

The X-59's design seeks to navigate its way around the creation of the sonic boom. Buonanno continued: "[All planes] flying supersonically will generate shockwaves, that's unavoidable. But what we do on [the] X-59, and what anyone else would do on a low-boom airplane, is carefully design the shape so that those individual shockwaves are well ordered, they're separated by an adequate distance and they're of an appropriate magnitude, so that they don't coalesce.

"They stay distinct and, as they propagate through the atmosphere, small effects of viscosity and turbulence end up smoothing out those individual shockwaves and result in a 'shaped boom', which is dramatically quieter than the N-wave that's always been produced by other supersonic airplanes, where they don't pay attention to this phenomenon."



David Richardson

Stifling the boom

Speaking exclusively to *AIR International*, David Richardson, Lockheed Martin's X-59 programme director, explained how bringing back commercialised faster-than-sound air

travel has long been in the corporation's interest: "It was in the late-1990s, early-2000s that we started looking at quiet supersonic business jets. We've invested a lot of money in it [and] we see it as an opportunity for future businesses." That interest, research and investment led the company to be awarded a US\$247.5m contract by NASA in 2018 to design, develop, build, test and deliver the X-59.

Richardson added that Lockheed's involvement in the NASA programme began roughly five years ago, when the company entered the competition to develop an X-plane to demonstrate low-boom technologies and key design

capabilities: "Lockheed won that [competition] in February 2016. That programme got the aircraft to a preliminary design level. At that point, the programme was recomputed for the acquisition plan for NASA. Lockheed won the second phase, which we're currently in."

Lockheed Martin Skunk Works and NASA are attempting to silence the boom by employing several innovative design features on the X-59 to produce the quieter thump in an aircraft that is easy to handle.

The QueSST's impressive length is one of its key features. "The airplane is nearly a hundred feet long from the tip of the nose to the [tail]," said lead engineer Buonanno. Combined with its slender shape – or outer mould line – the aircraft has been optimised to spread out the shockwaves generated when approaching

Mach 1 speeds. This prevents them from

coalescing as quickly as they would on a traditional supersonic aircraft, resulting in a low-boom capability. "It's a very elegant and simple design... the nose of the airplane is hollow. It's 35 feet long and it's full of air. It's very light [and only weighs] 300lbs," added Richardson.

The aircraft is split into three subsections: the tail empennage; the main-wing body and the forebody fuselage. Its principle structure is made from aluminium, but high-temperature areas of its rear end are built from titanium. It also employs composite control surfaces and wing skins.

Buonanno noted other key features of the X-59's shape and their importance on maintaining its low-boom capabilities: "It's all about the details of how we arrange the individual, fairly small, features on the airplane to keep those shocks separated. One example is the air data probes that we have in front of the canards on the forebody. We have three of those and we had to go through some design studies to carefully position them and shape the

"The airplane is nearly a hundred feet long. Combined with its slender shape it has been optimised to spread out shockwaves"

Michael Buonanno, lead engineer, Lockheed Martin Skunk Works

fuselage around their location to create a bit of an inverse effect to cancel out their impact on [the] sonic boom.

"We have the canards that are really important to meet the overall trim of the airplane. It's important that the airplane [is] balanced in steady flight and, for low boom, we have to carry lift on the back end of the airplane. So, the tail – we call it the 'stabilator' – is lifting at cruise conditions, which would tend to make the airplane pitch down. The purpose of the canard is to provide pitch up movement to counterbalance those lifting stabilisers.

"You can see some other pretty distinctive features, like the vortex generators that are immediately behind the repurposed T-38 canopy. Those are added to help improve the quality of the airflow to the engine inlet, which is located further aft... We've got that highly swept delta



wing [and] we've used a lot of advanced manufacturing techniques on that to both reduce the amount of money that we have to spend on fabricating it, but also [to] improve quality and make it lighter weight," he explained.

The X-59 will be powered by a single, modified GE Aviation F414-GE-100 afterburning turbofan engine, which will provide 22,000lbf (98kN) of thrust. The powerplant – which is also employed by the F/A-18E/F Super Hornet – is located on top of the rear section of the aircraft's fuselage to meet its low-boom goals. This is another distinctive feature, as traditional platforms typically employ engines under the wing or on the sides of the fuselage.

"There was some uncertainty in terms of how the shock system would set up around both the inlet system and the nozzle system. So, we explored the feasibility of putting the engine on top of the airplane and did aerodynamic analysis using CFD [(computational fluid dynamics)] and then validated that analysis in the wind tunnel. [We] found that we could get very good performance from that inlet [location]," Buonanno recalled.

The QueSST will employ all-moving horizontal stabilisers, similar to those used by F-15 and F-16 fighter aircraft. It features a T-shaped tail, which Buonanno said was unusual "in that it's not used for flight controls, but we use it to tailor the shock –

the pressure signature behind the airplane – so that we can slightly modulate the values that will be measured in flight."

Wind-tunnel testing and advances in CFD tools have enabled researchers and designers to put low-boom supersonic theories, which originated as early as the late-1960s, into physical practice.

This is one of the reasons why the X-59 is being built now rather than 20/30 years ago, as Buonanno explained: "We've used wind-tunnel testing to validate our tools for

aerodynamic performance and the stability and control characteristics, but have not yet tested its low-boom characteristics in a wind tunnel. We're relying on those validated tools and the earlier testing that was done."

Skunk Works and NASA Aeronautics have constantly evolved the X-59's design with every aspect being carefully scrutinised and optimised to make sure it has a low-boom capability. "That is by far the most important requirement for this airplane," said

"Some of the next big milestones are finishing the wings, centre section and empennage... then integrating a lot of subsystems"

Peter Coen, NASA's flight demonstration mission manager

a long time on this programme... Almost a decade ago, we worked with NASA on a contract called N+2 supersonic validations, where we designed a [concept] for a large supersonic transport. It was kind of something that might go into service in the future. We built a wind tunnel model of that under contract with NASA and tested it in one of their facilities. "We got very good experimental data from that test, [which] validated our tools... That was a key point in the programme because then we had hard data that showed that our design techniques worked, and we then applied those exact same tools to the design of [the] X-59.

"We have done other wind-tunnel testing to validate

Buonanno. "If we build an airplane that flies beautifully, has great performance and looks great, but it can't meet the sonic boom requirements, then we failed at our mission."

A key change in design of the aircraft was its original V-shaped tail. "[These tail] designs were actually very favourable from a sonic boom perspective," Buonanno continued. "Early on, they were selected because of that, but they had other problems associated with them from a control-law and handling-qualities perspective that were causing us problems." After a detailed analysis, the team opted for the T-shaped tail, which was still able to meet NASA's 75 PLdB (perceived level of noise) requirement. In comparison, Concorde's sonic boom was 105 PLdB.

See... **KEY.AERO** ... for more from pilot Dan 'Dog' Canin

The X-59 is a 'Frankenplane' – to curb costs, the Skunk Works has reused parts from military aircraft stored at the famous Boneyard at Davis-Monthan Air Force Base (AFB) in Tucson, Arizona. The aircraft's landing gear comes from an F-16 Fighting Falcon and its control stick originated in an F-117A Nighthawk. The heat exchanger used in its environmental control system was sourced from a Korea Aerospace Industries T-50 Golden Eagle jet trainer. Its canopy and Martin-Baker Mk.16 ejection seat hails from a former NASA-operated Northrop T-38 Talon that had been used for astronaut transportation and training during the Space Shuttle programme.

Programme director Richardson observed: "It looks like the landing gear is way in the back of the airplane because the [centre of gravity] is actually back towards where the engine is." An F-16 undercarriage was suitable for the X-59, as the X-plane falls into that weight class.

However, due to its huge length in comparison with the multi-role fighter, the ground clearance for the QueSST is constrained. He continued: "One of things on this airplane that's unique is as we come in, we just need to be careful that we don't scrape the tail. In our flight simulations, nobody's done that, so far."

Producing the QueSST

This one-off demonstrator is currently being manufactured at Lockheed Martin facilities across the US. The empennage of the aircraft was designed in Marietta, Georgia, and most of the structures and dynamics, flight controls and vehicle management systems are being produced in Fort Worth, Texas. Most of the final assembly will be in Palmdale, California. The X-59 is due to be rolled out and initially ground tested by the firm in late 2021, before handover to NASA in 2022.

A lost capability

The commercial sector has been keen to revive supersonic air travel capabilities that were lost following Concorde's retirement in 2003. The rules that limited Concorde's high-speed capabilities were arguably one of the biggest factors in its downfall. The Anglo-French-designed aircraft has so far been the most successful supersonic airliner to enter operations, despite similar efforts from Russia and the US.

Even with its success, three main factors led to its demise: poor fuel efficiency, high operational costs and the restrictions surrounding its faster-than-sound capability. It was banned from flying supersonic overland, which led to it being used predominately on ocean-crossing routes.

Since Concorde, commercial air travel has been provided by slower, subsonic airliners. Over the last two decades, these platforms have become quicker, quieter and more efficient, to meet environmental standards.

During this time, the appetite for supersonics remained strong, but was stymied by regulations and the lack of viable technology. However, Concorde's limitations served to highlight the need for future supersonic commercial aircraft to be cheaper, more efficient and quieter – the last of which is where the Low-Boom Flight Demonstration (Lbfd) and the X-59 come in. This thump, which NASA seeks to create, could be the key to sparking that revival, making civil faster-than-sound flight more acceptable.

A number of start-up companies, including US-based Aerion and Boom Supersonic, are already leading a charge to return this long-lost capability to the civil sector by the mid-2030s. NASA's Lbfd will take place outside this bubble, but its results could directly inform future supersonic operations and aircraft design.

The race is definitely on to break the sound barrier...quietly.


Mission manager Peter Coen said four NASA aeronautical research centres are involved with the project: NASA Langley in Hampton, Virginia, is managing the Low-Boom Flight Demonstration (Lbfd) campaign; NASA Glenn in Cleveland, Ohio, deals with the propulsion work; NASA Ames in Silicon Valley, California, oversees engineering and logistical support; and NASA Armstrong at Edwards AFB, California, for initial flight testing.

According to programme director David Richardson, there are roughly 750-800 people working together to produce the X-59 – including personnel from Skunk Works, NASA and the 60 to 70 companies involved with the supply chain.

"We've in general worked very diligently at creating a good atmosphere for collaboration between NASA and the Lockheed team," said Coen. "We have NASA people on-site in Palmdale for technical and quality roles. We're working together quite well."

Coen revealed that production of the wing, centre section and empennage are progressing well: "Some of the next big milestones are finishing those components and then mating them, putting the pieces together and then integrating a lot of the subsystems. We purchased two engines from GE. Those are done [and] they're sitting in engine containers up in Lynn, Massachusetts."

Skunk Works has applied new build techniques, such as utilising an automated fibre placement (AFP) machine to manufacture large wing skins; model-based instructions (MBI) to drive mechanic effectiveness; and alignment of engineering design through the build process. It also combines operations, for example by using a mobile bolting and robotic autodrill (COBRA) to match and drill precision holes through the vehicle skin and underlining structure for later fastener installation.

Amber Ousnamer, the X-59's production operations lead at Skunk Works, 

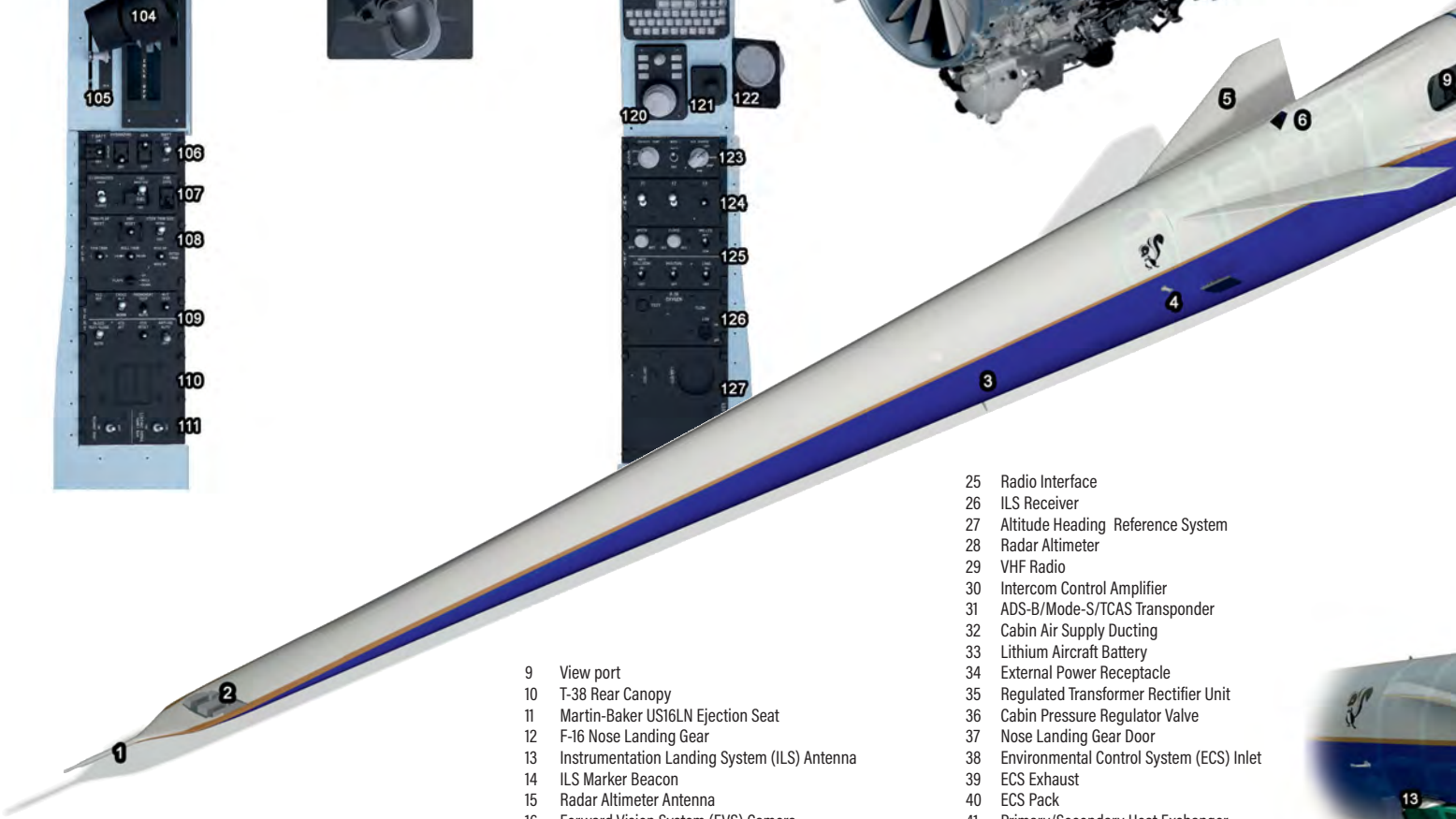


LEFT: In June 2020, engineers and technicians at Skunk Work attached the QueSST's wing and cockpit sections together.

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OPPOSITE: A concept shot of the X-59. Lockheed Martin test pilot, Dan 'Dog' Canin, will be at the controls during its early days of flight testing.

The inside story



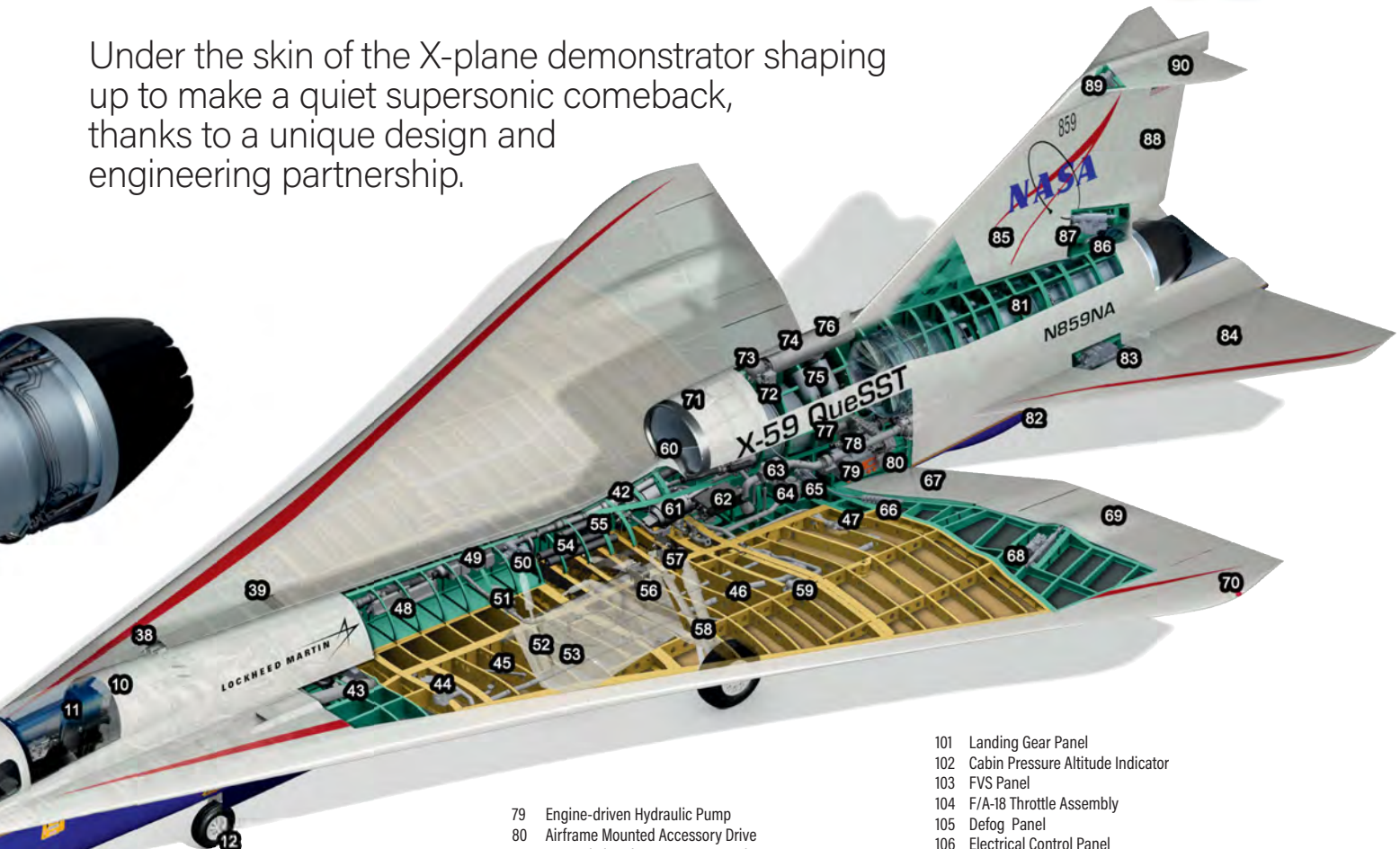
- 1 Nose Multifunction Probe
- 2 Air Data Module
- 3 Conical Multifunction Probe
- 4 Total Temperature Probe
- 5 Canard
- 6 External Vision System (XVS) Camera
- 7 GPS Antenna
- 8 XM Weather Receiver

- 9 View port
- 10 T-38 Rear Canopy
- 11 Martin-Baker US16LN Ejection Seat
- 12 F-16 Nose Landing Gear
- 13 Instrumentation Landing System (ILS) Antenna
- 14 ILS Marker Beacon
- 15 Radar Altimeter Antenna
- 16 Forward Vision System (FVS) Camera
- 17 F-16 Rudder Pedal Assembly
- 18 NASA Payload Pallet
- 19 Vortex Generators
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- 31 ADS-B/Mode-S/TCAS Transponder
- 32 Cabin Air Supply Ducting
- 33 Lithium Aircraft Battery
- 34 External Power Receptacle
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- 36 Cabin Pressure Regulator Valve
- 37 Nose Landing Gear Door
- 38 Environmental Control System (ECS) Inlet
- 39 ECS Exhaust
- 40 ECS Pack
- 41 Primary/Secondary Heat Exchanger
- 42 Bleed Air Ducting
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- 44 Fuel Tank Vent Valve
- 45 Fuel Quantity Probe
- 46 Fuel Plumbing
- 47 Ejector Pump
- 48 Flight Test Instrumentation Encoder
- 49 Fuel Quantity Signal Conditioning Unit
- 50 Inertial Measurement Unit
- 51 Transfer Pump
- 52 Main Landing Gear Door Actuator
- 53 Main Landing Gear Door

See... **KEY.AERO** ... for more from mission manager Peter Coen

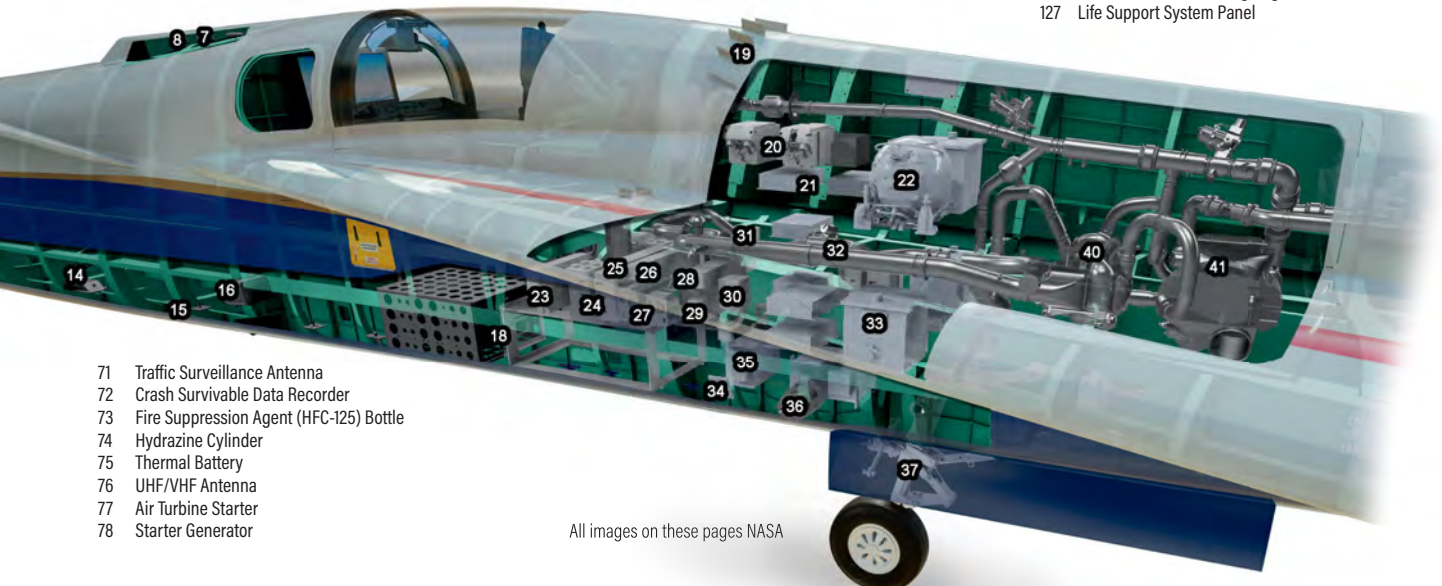
Under the skin of the X-plane demonstrator shaping up to make a quiet supersonic comeback, thanks to a unique design and engineering partnership.



- 54 Brake Accumulator
- 55 Reservoir Accumulator
- 56 Pressure/Filter Manifold
- 57 Return/Filter Manifold
- 58 F-16 Main Landing Gear
- 59 Refuel/De-fuel Receptacle
- 60 Supersonic Diverterless Inlet
- 61 Hydraulic Reservoir
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- 63 Fuel/Oil Heat Exchanger
- 64 Boost Pump
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- 66 Rotary Gear Assembly
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- 79 Engine-driven Hydraulic Pump
- 80 Airframe Mounted Accessory Drive
- 81 General Electric F414-GE-100 Engine
- 82 Boom Bump
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- 89 T-tail Actuator
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- 91 XVS Monitor
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- 95 Master Caution Light
- 96 XVS Control Panel
- 97 Multifunction Display
- 98 Audio Panel
- 99 Avionics
- 100 Canopy Jettison Handle

- 101 Landing Gear Panel
- 102 Cabin Pressure Altitude Indicator
- 103 FVS Panel
- 104 F/A-18 Throttle Assembly
- 105 Defog Panel
- 106 Electrical Control Panel
- 107 Fuel System Panel
- 108 Flight Control Panel
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- 124 Miscellaneous Vehicle Management System Panel
- 125 Lighting Panel
- 126 Panel Mounted Breathing Regulator Panel
- 127 Life Support System Panel



- 71 Traffic Surveillance Antenna
- 72 Crash Survivable Data Recorder
- 73 Fire Suppression Agent (HFC-125) Bottle
- 74 Hydrazine Cylinder
- 75 Thermal Battery
- 76 UHF/VHF Antenna
- 77 Air Turbine Starter
- 78 Starter Generator

All images on these pages NASA

explained that production is monitored every day and is “constantly changing.” She said: “Here at Skunk Works, we work really hard to ensure that we are not reinventing the wheel. We’ve looked to Kelly Johnson’s ‘14 rules’ [the management style of Lockheed’s famed aircraft designer] and applied those methodologies to every platform that we do, particularly [the] X-59.

“We want to ensure that we’re leveraging all of our past experiences and knowledge and applying that to this platform. That includes incorporating anything off our production lines, such as F-35 or C-130, that we can cut and paste onto our platform for our use, so that we can ensure we have the highest quality and the most efficient vehicle,” she concluded.

Flying ‘Thumper’

There’s a lot more to the X-59 than just low-boom design. Among its leading unique features is the forward cockpit window for the pilot... or rather, the lack of one.

Including a forward windscreen would have made achieving the desired sonic

thump problematic, as it would create strong shockwaves. The QueSST’s length and slender design could not accommodate one *and* maintain its low-boom capabilities, though it still has side windows.

To enable the pilot to see in front, the aircraft will employ NASA’s eXternal Vision System (XVS). This innovative suite uses a combination of sensors, computers, high-definition cameras and displays to ensure safe navigation. It will also provide visual aids during approach, take-off and landing, along with informing the pilot of other aircraft in the X-59’s vicinity.

Two camera systems are included in the suite – NASA’s XVS and the Forward Vision System (FVS). The former is a full-colour, ultra-high-definition 4K resolution camera that displays its view on a 24in multifunction display in the cockpit. It is located atop the aircraft’s nose and is used only when the aircraft is in flight.

The FVS is what the X-59 team calls the commercially-sourced Collins Aerospace EVS-3600 multispectral imaging

system – a tri-band, three-colour suite, which combines the signals from visible, long-wave and short-wave infrared cameras into a monochromatic image that can be used in both day and night settings. It is retractable, located underneath the aircraft and will be primarily used during taxiing, take-off, approach and landing.

According to Randy Bailey, NASA’s resident XVS expert, the biggest challenges in developing the system for the X-59 have been gaining environmental qualification: “The equipment that we choose has to be high-performance, but not only that, it has to be high-performance and meet the environmental requirements. It has to be able to survive the vibration, the temperature, the altitude and so that’s really the hardest part,” he said. So far, both cameras have been qualified and the team is in the final stages of authorising the computer systems.

For safety reasons, the XVS has built-in redundancies in case of system failures. “It is not a single string system,” said Bailey. “[The] XVS has multiple failure modes that have to happen before we lose that display. In the unlikely event that we do lose XVS, there are head-down displays with camera views on those as well, that the pilots can use for a view forward of the airplane. Even in the event that those two systems fail, there are the side windows, there’s guidance information on the head-down displays that the pilots can use. We have done simulations of what happens if that were to occur.”

In mid-2019, NASA tested its XVS on a Beechcraft UC-12B Huron, installing the same hardware and software on it that will be used aboard the X-59. Bailey recalled: “We actually had two pilots in the [Huron], one looking out the window, one looking at the XVS system. We could fly various manoeuvres and we could quantify when the pilot looking out the window saw other traffic. Similarly, we could do the same with the XVS pilot and then we could do a direct comparison between the two, and that would prove or disprove whether [the] XVS was equivalent to a forward-facing window or not. We flew



ABOVE: The X-59’s cockpit section is a unique feature of the aircraft. Shown here during production, space has been made for its side windows but not a forward cockpit window – because there isn’t one. Instead, the platform will employ NASA’s innovative XVS suite.

Images on these pages LM Skunk Works unless stated differently

RIGHT: Production of the X-59 continued despite the outbreak and global spread of COVID-19 and the company really adapted to the added challenge that the pandemic presented to remain on schedule. Note that the engineer here is wearing personal protective equipment (PPE) while working on the QueSST’s fuselage.



See... **KEY.AERO** ... for more from pilot Dan ‘Dog’ Canin

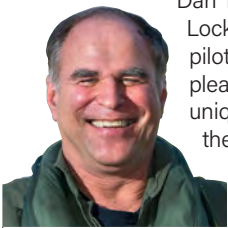


THIS IMAGE: Elegant and simple in design the X-Plane sports a hollow nose that is 35ft long. Filled with air, it weighs just 300lbs.

BELOW INSET: The programme patch worn by those working on the X-59 mission. Image NASA

BELOW: Lockheed Martin test pilot, Dan 'Dog' Canin, is responsible for flying the aircraft, expanding its flight envelope and proving that the QueSST's unique design actually generates a thump instead of a sonic boom.

that for approximately a month... and that gave us the proof that it was meeting performance goals," he concluded.



Dan 'Dog' Canin

Dan 'Dog' Canin is the Lockheed Martin test pilot who will have the pleasure of flying this unique aircraft during the initial flight-test phase of the Low-Boom Flight Demonstration (Lbfd mission).

His job will be to perform the initial flights and then, along with two additional NASA test pilots, open up the X-59's flight envelope. He has a rich background of testing many aircraft, including the F-16 and F-35, and the experiences of the QueSST's flight test team have directly informed the design of its cockpit.

He told *AIR International*: "I think flying the airplane should be very easy and it should be no different than flying a normal airplane... we're designing a lot of the displays. The head-up display, which is an overlay on top of the XVS, is taken right from fighters. We've taken a lot of the symbology, the layout and the philosophy behind those."

Referring to the XVS, he added: "It's going to be beautiful! I fully expect that after a short while flying this airplane, we're going to forget that it's not a window. This is actually the perfect platform for us to get introduced to this environment because, unlike a fighter, the dynamics are relatively low. It's limited to two-and-a-half Gs and relatively low high-roll rates. It's going to be interesting. It's a fighter cockpit, but kind of a business jet flight envelope."

The X-59's airframe will be limited to 400kts (460mph or 741km/h) at lower altitudes due to its dynamic pressure limit – limitations on

its flight envelope. "At high altitude, where the air is thinner, that same dynamic pressure gives us a much higher speed,"

Canin said that take-off speeds will be between 170-175kts – close to 200mph (322km/h) – and approach speeds will be slightly less, at between 155-160kts, which is roughly 180mph (296km/h). "This airplane is going to accelerate very fast, because it's designed to go to [Mach] 1.5 and 60,000ft. It's got tremendous excess power and it's a very lightweight airplane. We could take off [using the] afterburner, [but] we'll probably just take off in military power – that is 100% dry power!"

The slim margins in the X-59's combined ground clearance and long length, prevent it achieving large pitch attitudes when taking off and landing, without scraping the tail. The QueSST will approach the runway with a 6° angle of attack (AoA), which is routine for fighter aircraft. This is in place to achieve the desired approach speeds required for landing the X-plane but also prevents the tail from hitting the ground.

The challenge with the X-59's geometry is that if the pilot over-rotates on landing, he could hit the tail. To mitigate this risk, the aircraft will be flown onto the runway at approach speed, as opposed to doing what most airplanes do, which is flare and then hold the airplane off the runway until it slows down before landing.

The Skunk Works reported: "The upshot of 'flying the airplane onto the runway' is that we touch down at a relatively high speed

compared to, say, a similar-weight F-16 (whose brakes we're using). That presents a challenge from both a landing distance and brake energy standpoint. Also, whereas the F-16 can dissipate a lot of this energy by aerobraking (holding the nose in a 15° attitude to decelerate after touchdown), the geometry of the X-59 does not allow that, so we have to coast for a while before we get slow enough to apply the brakes."

The X-59's pilot life support system (LSS) is also a distinctive feature. It provides the pilot with an oxygen breathing supply during missions and is designed to ensure their safety, protecting

against any physiological effects that may occur due to exposure to potentially hazardous conditions during flight, such as hypoxia and decompression sickness.

Brian Griffin, NASA's X-59 LSS expert, discussed how it works:

"It really does build on proven applications, but it also contains some unique features, and really the integration

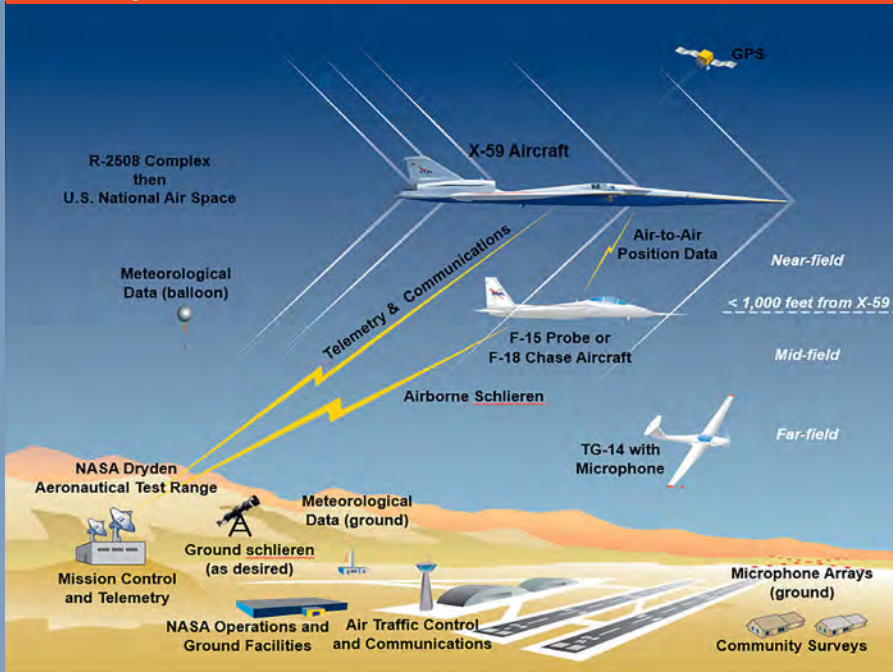
approach that we've used is where the differences arise, especially with regards to the emergency oxygen system, which is installed on the pilot's ejection seat."

The QueSST employs a liquid oxygen converter in the pilot's primary breathing supply. "It supplies 100% oxygen at all times [and] it applies the use of positive pressure breathing when the situation warrants. Those are some of the things that collectively make this system unique for us," he added.

Griffin elaborated on how the LSS was extensively tested by KBRwyle at Brooks



Low-Boom Flight Demonstration Data



City-Base (formerly Brooks AFB) in San Antonio, Texas, over a few months: "Those tasks were performed using altitude chambers that are available at those facilities. [They] are capable of producing the environments that the system and the pilot would be exposed to during the flight. Thus far, those tests have all proven successful and [they] have really contributed significantly towards proving the airworthiness and system compatibility on the X-59," he concluded.

Test pilot Canin said the LSS is: "Very familiar to us. It's taken right out of fighters. It's what we're used to. The one element that we don't always fly with is a thing called an upper pressure garment, which in this case is taken right from an F-22. The main difference between this airplane and most of the fighters we fly is most of these fighters are limited to 50,000ft, whereas we're going to be able to go to 60,000ft.

"I think at one point they looked into a

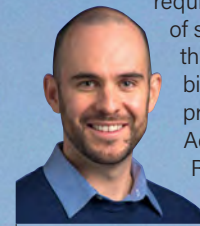
full-pressure suit and thankfully they couldn't fit it in the cockpit, because that would not be a pleasant thing to have to fly with. The combination of a lower garment – the G-suit – to squeeze our legs and an upper pressure garment to squeeze the chest will keep us safe at 60,000ft."

The demonstration

While creating the X-59 is a significant technological feat in itself, this airplane is merely the vessel that will provide the data needed by regulators to change the current rules surrounding overland commercial supersonic air travel. This mission builds on previous research flights that NASA has conducted in recent years (see *The Galveston Trials panel tbc*).

Programme director David Richardson elaborated: "The deliverable here is not the X-plane itself. It's actually the data that will be collected during phase three

of the programme. [That data] will be presented to the FAA [and] to ICAO to do the evaluation on going forward [with] regulation reform, as well as the requirements for any sort of supersonic aircraft in the future. It's really the big-picture purpose of the programme."



Jonathan Rathsam

According to Jonathan Rathsam, an acoustics validation expert at NASA, the Low-Boom Flight Demonstration

(LBD) is split into three phases: "The first phase includes verifying the performance and the safety of the aircraft. The second phase will be verifying the quiet supersonic technology, making sure it's quiet like it's designed to be. The third will include the community tests. After that, NASA will turn this data over to regulators," he said. The project is currently in its first phase, with the third targeted for late 2023.

Following its roll-out, ground trials and initial flight tests, the X-59 will be scrutinised by NASA to see if its innovative low-boom design meets the capability requirements and actually works. These trials will occur over the desert in the vicinity of Edwards AFB, California.

If successful, the QueSST will progress to phase three – the community overflight tests, with NASA gathering sound-level data from the public about the quieter 'thump.'

Mission manager Peter Coen detailed how the X-59 will physically produce the data: "For a month or so, we'll fly [the X-59] over people and generate different levels of sound. We expect to fly multiple times per day and generate anywhere from two to six sounds over the community..."

"That's kind of representative of what a typical community might hear when supersonic operations become more commonplace. Each day will be a different sound level. So, we fly the airplane at slightly different speeds, slightly different

See... **KEY.AERO** ... to hear XVS expert Randy Bailey

The Galveston trials



A NASA-operated F/A-18 Hornet test aircraft, serial number 161355, conducted a series of research flights near Galveston, Texas. These tests informed how data would be collected when the X-59 performs similar overflights.

Images NASA

In November 2018, NASA conducted a series of research flights using an F/A-18 Hornet test aircraft off the coast near Galveston, Texas. Dubbed Quiet Supersonic Flights 2018 (QSF18), the operation was a precursor to the Lbfd, informing how data would be collected during the community testing phase.

Mission manager Peter Coen told *AIR International*: "We've done numerous studies to try and understand people's response to quiet sounds from supersonic flight. It turns out that if you dive in an F-18 very steeply and go supersonic for a very short time, you can create a sound that's kind of similar to a low-boom sound or quiet supersonic sound, but it's only over a very small area."

The manoeuvre in question started over water at roughly 50,000ft. The F/A-18 conducted a special dive that still created a regular sonic boom, but by the time the soundwaves from the aircraft passing the sound barrier reached land, it had been reduced to a quiet thump.

"We did a number of tests with that dive manoeuvre in some communities at Edwards [AFB] over the years, but the Galveston test was really all about, not so much people's response to the sound, but how we measure people's response to the sound, when we do the community overflight testing.

"The X-59 will be able to create those sounds [in] straight and level flight. We'll be able to expose a much larger population to a much more stable and repeatable sound. [Galveston] was really kind of a dry run for all the pieces of the community testing, and it worked out quite well," Coen concluded.

altitudes [and] slightly different weights to create a variation in the sound... People will receive survey information and we'll gather their response for each flight before our community tests."

During phase three, the X-plane will essentially tour the continental US, with six individual community tests planned in different locations across the country. Current plans are for the first to take place over a community near NASA Armstrong in California, sparing the team from the logistics of having to deploy straight away.

The remaining five test sites have yet to be selected, but the requirements state that each must represent a different climate zone and geographical region. The community in question must also be within range of an airfield that can accommodate the X-59.

NASA will record sound-level data generated by the sonic thumps during the tests, by collecting public surveys and through use of a network of sophisticated acoustic sensors located around the community. These sensors are essentially microphones – albeit not the kind you

might purchase from your local shop. "They're special microphones because they go down lower in frequency," Rathsam explained. "Standard microphones peter off at the lower end of the human hearing range – around 20 hertz – but in order to measure a sonic boom or a sonic thump, you need to go down further... down to one hertz or half a hertz, or lower."

A supersonic future

Lockheed Martin and NASA will have about nine months to complete the X-59's initial ground and flight trials, at the end of which, the aircraft will be delivered to NASA. Following that, NASA will have the next nine months for acoustic validation, proving that the quiet supersonic flight acoustics work as intended, prior to community overflights in 2023.

Although computer analysis and testing look promising for the QueSST completing its mission successfully, whether it will work in real life is still to be determined – those results will not be available until the aircraft is flown.

There is no doubt this X-plane is unique, not just in looks and mission, but in the innovative low-boom and in-cockpit technologies it employs.

Boasting the potential to inform change in current supersonic flight regulations overland, the X-59 could create commercial aviation waves in aircraft design and the future of passenger-carrying flights beyond the sound barrier. **AI**

OPPOSITE: The X-59 will provide the data needed by regulators to change the current rules surrounding overland commercial supersonic air travel.

Image NASA

OPPOSITE INSET: Jonathon Rathsam, a NASA acoustics validation expert on the Low-Boom Flight Demonstration.

Image NASA

MAIN IMAGE: An X-59 concept touch down. Although the aircraft is longer than a business jet, its cockpit is more akin to those used in fighter jets.

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BrisQ

Steps into the future



Four decades in the planning, the new parallel runway at Brisbane Airport landed on time, under budget and with the full support of local communities. **Chris Frame** finds out how Queensland's biggest hub achieved the impossible.

Brisbane



A view that will soon become familiar to pilots flying into the Queensland capital.
All photos via Brisbane Airport Corporation

The departure of a Virgin Australia Boeing 737-800 from Brisbane Airport tends to be unremarkable. Prior to the COVID-19 pandemic, the majority of the hometown carrier's 34 routes were served by its 79-strong fleet of Next Generation 737s. However, when VH-YFW (c/n 41037) 'Turquoise Bay', took off bound for Cairns on July 12, it marked



THIS PAGE FROM TOP: More than 388m cubic ft of reclaimed land had to be dredged from the Brisbane River to create the land on which 01L/19R lies.

The new 10,827ft-long runway and associated taxiways cover an area of 741 acres.

A sign illustrates the scale of the work undertaken since 2012.

a milestone more than four decades in the planning. It was the first scheduled flight to depart on the hub's new parallel Runway 01L/19R.

Even more remarkable was that the new airstrip had arrived on time, AU\$200m under budget and without the usual protests and legal challenges from local residents that usually hamper airport expansions.

Building Brisbane

The current Brisbane Airport site dates to the 1970s when growth outstripped the capacity of the existing facilities at the neighbouring Eagle Farm Airport, previously a US Army Air Force base.

Construction of a new complex involved the creation of a modern airfield and, after years of work, a modern gateway able to cope with the city's needs was opened in 1988. The main runway 01/19 (now 01R/19L) was initially partnered by the smaller cross-runway 14/32 to facilitate turboprops and small jets. However, even as Brisbane opened its doors, there was already an eye to the future and plans to build a parallel runway were well advanced.

Gert-Jan de Graaff, Brisbane Airport Corporation's (BAC) chief executive, explained: "Ever since planning began, a wide-spaced parallel runway system in a north-south alignment has been a key feature of the ultimate development vision. During the construction phase in the 1980s, space was reserved to the west of the then new airport for a parallel runway to be built in the future, when it was needed."

Speaking to *AIR International* in July, de Graaff continued: "The final design of Brisbane's new runway is a nod to the legacy of the early planners in selecting a site and airfield layout that remains the best solution half a century on."

It isn't just the foresight in selecting the airport location near Moreton Bay that paid dividends to Brisbane. De Graaff is immensely proud of his team and rightly so. The AU\$1.1bn project was not only delivered on schedule but also AU\$200m less than the original budget.

"Brisbane Airport now has the most efficient runway system in Australia and one of the best in the world. This brings it up with the likes of major international aviation hubs Singapore and Hong Kong when it comes to capacity," said the BAC CEO. "The positioning and spacing of the parallel system also means the runways can be operated independently, allowing more flights to arrive and depart over Moreton Bay." Such a set-up will see many flights depart over water, reducing the impact on residents, which is particularly important for night-time departures.

Tough terrain

Throughout the first decade of the 21st century, it became clear that the facility would need to set in motion its parallel runway plan to accommodate the continued growth of Brisbane as both a



commercial hub and tourist hotspot.

The Australian government gave the project the green light in 2007, following which BAC ramped up planning and design work in anticipation of the start of construction. A second runway couldn't come soon enough. "As far back as 2012, an unprecedented increase in passenger numbers and flights started to place enormous pressure on Brisbane Airport's runway system, which was effectively operating on only a single main runway more than 90% of the time due to restrictions on the use of the smaller cross runway," said de Graaff, then the project lead for the new airstrip. "As an 'end of the line' airport, we had no capacity during peak periods, severely limiting our capacity to meet the growing demand and causing the build-up of significant delays for passengers and airlines."

A lack of redundancy only compounded Brisbane's capacity woes. Delays during the morning rush had a knock-on effect throughout the day, impacting connections across airline route networks.

Ground was broken for the new runway in August 2012. But while the location was optimal from a flight path and noise

THIS PAGE FROM ABOVE: The first scheduled departure, flight VA781, rotates for Cairns.

Virgin Australia Boeing 737-800, VH-YFW (c/n 41037) 'Turquoise Bay', accelerates down 01L/19R as it becomes the first aircraft to depart from the new runway.

Almost 4,000 people were involved in the runway's construction.

abatement point of view, it presented significant engineering hurdles. Much of the area to the west of Brisbane's existing infrastructure consisted of swampland, while the 10,827ft (3,300m) length of the new airstrip required additional land reclamation of 388m cubic ft (11 million m³), all of which had to be dredged from the Brisbane River. It was then transported to the site for distribution, levelling and settling – an engineering feat unto itself.

Paul Coughlan, BAC's project director, detailed the challenges faced: "The dredge had to be large enough to facilitate the delivery of the sand and water slurry from its mooring location five miles (8km) away in the Brisbane River without the use of a booster pump. This was critical, as it would have been extremely difficult, if not impossible, to position a booster pump in an appropriate location along the pipeline."

The size of the dredging vessel also presented challenges, particularly given the close quarters of the river, which also accommodates ferries, cargo, and cruise ships. "We had to find a location for it





to dock where it was able to manoeuvre without risk of harm to infrastructure or the environment," Coughlan explained. "The final location ended up being within the port's swing basin."

While dredging was ongoing, the team at Brisbane implemented an ingenious solution to assist in the settling and drying process of the massive land reclamation area. More than 325,000 wick drains were utilised, with these drainage paths enabling excess water to leave the reclaimed land in a much faster timeframe than would have

occurred naturally.

Coughlan said that while this phase was "relatively seamless", tight management of the various processes involved was critical to the overall success of the project: "The sequence of this base layer, [involving the] installation of wicks and additional sand placement to the geo-technically designed height, had to occur in a seamless fashion, due to the impact on the timeline that any delay would have on other activities."

When land reclamation was complete, major infrastructure work

and improvements to road access were required. This included building a significant underpass that dipped 16ft (5m) below sea level to link the existing general aviation zone to the rest of the airfield. Coughlan said this work required "an extensive dewatering regime" given the nature of the land it was bypassing, as well as providing adequate support for a taxiway that could accommodate the weight of aircraft for decades.

At the peak of construction there were approximately 200 site personnel working within the underpass, requiring extensive management of resources to ensure their safety. Given that some 3,740 people worked on the runway during the project, safety was paramount at every stage of construction.

Community support

Pressure from the local community can often delay or derail new runway projects. Take London/Heathrow's proposed third runway, which has been plagued by protests, negative media and legal challenges.



Unlike the west London gateway, Brisbane experienced largely positive sentiment and widespread public support for its new runway project. However, it is no coincidence that, since 2005, BAC has engaged in extensive consultation and an education programme to engage with and support the local residents throughout the project.

Another feather in Brisbane's cap is the airstrip's location. De Graaff noted that the airport has the largest buffer zone of "any major capital city airport in Australia", with the closest residential dwellings being 3.7 miles (six kilometres) from the new runway's centreline.

The BAC chief continued: "When the Environmental Impact Study for Brisbane's new runway was released in 2005, Brisbane Airport Corporation commenced an extensive 22-month public engagement programme, including a four-month community consultation period. After approval in September 2007, we continued an extensive public education programme with the indicative flight paths published on the Brisbane Airport website, at community fêtes and festivals across the city, as well as providing community presentations and tours."

From 2009, detailed information on the new runway's proposed flight path was made available to the public, while Brisbane's 2014 master plan included a public comment period. Additionally, BAC opened a dedicated information centre at a major shopping complex within the airport grounds, allowing residents to access information on the project and its impact. As the parallel airstrip system allows traffic to be directed over Moreton Bay when weather permits, Brisbane can reduce the

impact of noise on nearby residential areas, which worked in the project's favour. The robust educational activities coupled with the long-term economic boost that the runway is expected to generate, has led to wide public support for the project, further enabling its seamless delivery without major setbacks.

Readying the runway

With the asphalt laid down by November 2019, the team's focus pivoted over to preparing the airport, airlines and air services to integrate the new airstrip into normal line operations.

Paul Coughlan noted: "It is a common misconception that a runway is ready for its first flight upon the completion of construction. However, there is a whole other project that must be completed between practical completion and opening: the operational readiness and testing process." This phase involved reviewing the operational readiness and testing plan in collaboration with Airservices Australia – which oversees air traffic control (ATC) – and Australia's Civil Aviation Safety Authority (CASA). It includes vital activities such as flights to test and calibrate the new runway's navigational equipment and ATC simulation training. Additionally, carriers must familiarise themselves with the new airspace rules. A task usually done face to face, Brisbane undertook these activities with the aid of video conferencing software due to social distancing requirements owing to the COVID-19 pandemic.

Coughlan said that this phase presented challenges in "the ability to sequence all consequential steps in the operational readiness process, a majority of which

Unlike London/Heathrow, Brisbane [has] experienced largely positive sentiment and widespread public support for its new runway project.



CLOCKWISE FROM TOP LEFT: Brisbane Airport's aircraft rescue and firefighting service provide the customary water salute ahead of the maiden departure.

Queensland Premier Anastacia Palaszczuk headed the guest list invited to the opening ceremony.

Pilots and crew pose by their warbirds following their displays at the opening ceremony.

This Piper PA-30 Twin Comanche, VH-SER (c/n 30-1578), was the first aircraft to use the new facility, doing so on May 4, 2020, to test runway lighting, including precision approach path indicators.



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were heavily reliant on the construction process." However he was quick to point out that the culture of collaboration and teamwork that BAC embedded in the project paid dividends when faced with challenging tasks: "I have no qualms in saying that the people behind the project were the reason for its success. There are a lot of very skilled people in the industry, [but] we selected our team based on not only experience and abilities, but also on a person's capacity to work in partnership and fit the team dynamic."

Coughlan said the project team achieved operational readiness through effective management of the critical path by ensuring the team were working "across all required activities and aware of any possible delays in advance." Such an approach ensured that timelines could accommodate any mitigation measures required to rectify unexpected hurdles without impacting the overall ability to deliver the project on time.

The COVID factor

For much of the past decade, the need to implement the parallel runway system at Brisbane has been an imperative. So it is ironic that the new airstrip opened during a year when airports around the world were experiencing unprecedented low traffic due to the coronavirus outbreak.

Gert Jan de Graaff noted: "The stark impact of COVID on the aviation industry is clearly evident with Brisbane Airport Corporation achieving a record increase in passenger numbers in the first seven months of the Financial Year [July 2019-January 2020], followed by unprecedented declines in the last five months of the year [February 2020-June 2020]."

However, the new runway project has never been about the short term. In fact, while solving Brisbane's legacy traffic

restrictions, the parallel system will ultimately facilitate long-term growth for the airport, something it will surely need in the post-COVID era. De Graaff emphasised this point: "We need to keep in mind that Brisbane's new runway was not built for today or even next year. It was built for future long-term capacity in the decades to come. Brisbane is in an ideal position to take advantage of all opportunities on the road to recovery from COVID. Indeed, this runway is a significant and physical beacon of hope for Brisbane's very bright future, which is now unconstrained, with unlimited room to grow."

Ready for take-off

Runway 01L/19R became operational on July 12, 2020. However, planning for this date had commenced many months before and involved multiple steps before the first aircraft could utilise the newly active airstrip.

Paul Coughlan noted that the "existing main runway, 01/19, was [redesignated] '01R/19L' on November 8, 2019, well in advance of the new runway '01L/19R' becoming operational. By taking this step, pilots were given an opportunity to become acquainted with the [new] left/right [runway] designations."

While considered 'landside' during the construction phase, the new airstrip was designated 'airside' on June 30, 2020, which Coughlan said required the "imposition of various restrictions given its consideration as an airside environment from that time."

Despite being in the middle of Australia's winter season, July 12 was a bright and sunny Sunday morning.

The official opening was presided over by Queensland Premier Anastacia Palaszczuk, as well as BAC's Gert-Jan de Graaff, and included a symbolic ribbon cutting. At the same time, a special time capsule was entombed with items relating to the runway construction and other 2020-era ephemera; it is set to be opened

in 2070. This symbolic gesture demonstrates the forward planning and long term thinking of the parallel runway project.

Guests were then treated to a spectacular air show featuring flypasts and aerobatic displays from vintage aircraft, including a Supermarine Spitfire Mk.XVI, an Aero L-39 Albatros and a North American P-51D Mustang. The Spitfire, VH-XWE (c/n CBAF.IX.4551) 'TE392', became the first aircraft to land on the airstrip.

With the new runway now active, Brisbane has space to grow, allowing the airport to support the continued

evolution of Queensland and its capital with seamless 24/7 operations for decades to come.

Prior to the opening ceremony, de Graaff reflected on the significance of the project: "This is more than just a formality and a slab of very expensive asphalt. When I look at that 3.3km stretch of runway, I see hope. I see hope because I believe, absolutely, that travel is at the heart of modern society and the human need to explore means that ultimately nothing will keep us grounded forever." **AI**



FROM TOP: Several historic military aircraft visited Brisbane as part of the inauguration celebrations.

A time capsule due to be opened in 2070 was buried as part of the runway project.

Aero L-39 Albatros, VH-UKR (c/n 834424) '99', was the first jet to land on the parallel 01L/19R.

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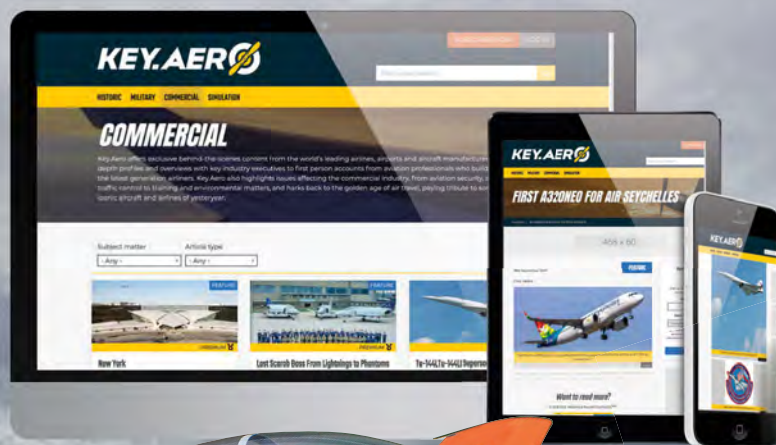
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AS2 Aerion

Described as “safe, stylish [and] sustainable” by US-based aircraft manufacturer, Aerion, the AS2 is set to become the first privately built supersonic business jet in history. Using cutting-edge design and engineering processes, the company aims to spearhead an evolution of enjoyable, quiet supersonic flight that is both carbon-neutral and sustainable.

Aerion boasts that the AS2 will have a “wide, luxurious cabin,” which will be 30ft (9.1m) long, 6.2ft (1.9m) high and 76ft (2.2m) wide. It will have the capacity to carry 8-11 passengers and requires just two crew members (a pilot and first officer) to operate. To provide what the company calls “hyper-luxury,” the aircraft’s interior will feature a modern décor that matches its exterior aerodynamic design. It will also have recliner seats and sofas, with four that can be berthed so passengers can sleep during overnight flights.

Much like Concorde, the AS2 will be restricted to flying supersonic over water and subsonic over land. Despite this, Aerion states that the platform will have a subsonic cruising speed of Mach 0.95 (729mph or 1,173km/h) and will reach Mach 1.4 (1,074mph or 1,729km/h) when flying supersonic. It will have a range of 4,833 miles (7,778km).

Aerion boasts the inclusion of its Boomless Cruise technology, which would allow the platform to fly supersonic over land. This limits the aircraft to flying at Mach 1.2 (921mph or 1,482km/h) but mitigates the sonic boom, depending on atmospheric conditions at the time, such as temperature and wind. The company is seeking to certify the capability, which would make it the first commercial aircraft on the market that can fly supersonic over land.

It will not employ any technology developed for NASA’s Low Boom Flight Demonstrator (Lbfd) programme or the X-59 Quiet SuperSonic Technology (QueSST) experimental aircraft, which being produced for the project by Lockheed Martin Skunk Works (see The X Factor, pg28). “Aerion prefers a silent approach to a less noisy one, and our Boomless Cruise technology is far superior to the “low boom” status quo,” the company states.

With its mission to provide carbon neutral supersonic air travel, Aerion signed a memorandum of understanding with Direct Air Capture (DAC) specialist, Carbon Engineering, to investigate how synthetic fuel (produced by the latter) can be used to power the AS2. Using a DAC process, carbon dioxide (CO2) will be extracted from the atmosphere, water and clean electricity on the ground before being used as the aircraft’s propellant.

Carbon Engineering’s CEO, Steve Oldham, said: “The fundamental value of fuels made from atmospheric CO2 is that they create a circular system of emission. When used in any vehicle, the carbon is returned to the atmosphere as CO2, however, the process then captures it again to make more fuel. So, we continually re-use existing CO2, and little or no new carbon emissions are created.”

Aerion announced the AS2 programme in May 2014 at the European Business Aviation Convention and Exhibition (EBACE) in Geneva, Switzerland – ten years after the company first announced its Supersonic Business Jet (SBJ) concept. The redesigned platform will be larger than the SBJ, with a length of 170ft (52m), a height of 22ft (6.7m) and a 77ft (23m) wingspan. The firm has partnered with a mix of big names in the aerospace industry to develop the AS2, starting with Airbus in 2014. By December 2017, Lockheed Martin had replaced the European aerospace giant and in early 2019, Boeing had taken the place of its US-based rival as the main backer of the programme.

Concept Insight

Originally, the AS2 was going to be powered by two Pratt & Whitney JT8D low-bypass turbofan engines. However, the International Civil Aviation Organization (ICAO) launched new noise standards in 2020 that rules out the use of low-bypass engines as they are too loud during take-off. The platform was redesigned as a trijet and Aerion selected GE Aviation's Affinity non-afterburning medium-bypass turbofan engines. The trijet configuration which offers increased range, better runway performance and reductions in external noise properties. Each powerplant will produce 18,000lbf (80 kN) of thrust. According to the engine manufacturing giant, the newly-developed powerplant provides "balanced performance across supersonic and subsonic flights. It is a twin-shaft, twin-fan turbofan controlled by a next generation Full Authority Digital Engine Control (FADEC) [system] for enhanced dispatch reliability and onboard diagnostics." It also features a high-pressure core that has been developed from the company's CFM56 turbofan engine family, which boasts billions of hours of operational use. The Affinity also employs a non-augmented supersonic exhaust system and a durable combustor with advanced coatings for sustained high-speed usage. "It is purposely designed to enable efficient supersonic flight over water and efficient subsonic flight over land, without requiring modifications to existing compliance regulations," GE said.

A key feature of the AS2 is its supersonic natural laminar flow wing. It seeks to reduce the aircraft's overall drag by 20%, allowing for increased range and lower fuel use. Laminar flow is the uninterrupted, smooth flow of air over the contours of an aircraft's body during flight. If the airflow is interrupted over the wings, it can result in turbulence, more drag and loss of lift. Supersonic-capable aircraft, which traditionally follow very streamlined designs, employ natural laminar flow wing configurations to increase in-flight efficiency.

This concept art depicts the trijet engine configuration of the AS2, having two wing-mounted engines. The third is built into the tail and air is supplied via an S-shaped intake duct. Image Aerion

As per the current development schedule for the AS2, Aerion will begin constructing its new headquarters and manufacturing facility at Aerion Park in Melbourne, Florida, before the end of this year. Production of the first AS2 will start in 2023, with a first flight planned for 2025 and an expected service entry date set for 2027. In November 2015, US-based aircraft leasing and jet card service, Flexjet, confirmed that it had placed a firm order for 20 examples in a deal worth US\$2.4bn. It is currently the AS2's only customer.

"We are committed to bringing people closer together in a more vibrant and compassionate world where distance is no longer a barrier, and to innovation that is kind to our planet."

Tom Vice, chairman, president and CEO of Aerion



Special services by *gyrocopter*

Once the stuff of James Bond fantasies, militarised gyrocopters are now finding a range of applications in Africa, China and the Middle East. **Guy Martin** goes on a mission to find out more





Back in June 1967, cinemagoers were thrilled by the sight of James Bond in *You Only Live Twice* taking on a fleet of heavily armed SPECTRE helicopters with Little Nellie, a tiny gyrocopter equipped with two launchers carrying air-to-air heatseeking missiles. Fast-forward half-a-century and what once seemed like science fiction became reality when video emerged of Iran's Revolutionary Guard Corps firing rockets at a ground target from a Spanish built ELA Aviacion ELA 07S gyrocopter fitted with four rocket

launchers. Then, in October 1, 2019, half-a-dozen Lieying gyrocopters flew through Beijing as part of China's National Day parade.

Increasingly, militaries and security forces are turning their attention to these versatile rotorcraft, which offer far lower operating and acquisition costs than traditional helicopters. Development of China's Lieying was initiated in 2011 by the privately-run Shaanxi Baoji Special Vehicle Manufacturing company (Shaanxi Bao He Defence Technology). This was followed by demonstration flights for the Chinese military, with photos of its testing and

evaluation in 2016 revealing two- and three-seat versions carrying special-forces troops.

Meanwhile, the South African special forces use a gyrocopter called Trojan, which has a payload capacity of about 1,000lb (450kg). It also has the ability to operate in rugged terrain and from unprepared runways.

Trojan is produced by South African firm Wagtail Aviation, which also makes a three-seat version called the Trooper that is able to rapidly deploy special forces personnel.

Similarly, the Kurdistan Region Security Agency operates a number of MTOSport gyrocopters, made by

CLOCKWISE FROM TOP LEFT: Wagtail Aviation has created 30 Trojan gyrocopters to date. Wagtail Aviation

TrixyEye gyrocopter with enclosed cockpit, in camo. Trixy Aviation Products

A Lieying gyrocopter with what appears to be AR-2 missiles fitted. Chinese Internet

A Lieying fitted with missiles and a sensor turret. Chinese Internet

A Milkor 40mm grenade launcher firing from a Trojan gyrocopter. Wagtail Aviation

Side-mounted 7.62mm machine gun and a nine-round rocket launcher. Guy Martin



Germany's Autogyro company. Kurdistan's counterterrorism force and its regional government traffic police also operate the MTOSport, along with two Autogyro Calidus models. Spain's ELA Aviacion has supplied a number of ELA 07S gyrocopters to Iran's police, and the Burkina Faso Air Force acquired four Xenon 2RST ECO gyrocopters in 2009, for surveillance in support of the police.

While gyrocopters have less payload than most helicopters, are slower and more susceptible to the weather, they offer excellent value for money (See What is a gyrocopter?). Being small and nimble, they are adept at surveillance and reconnaissance missions.

Gyrocopters are used in South Africa, Kenya and Senegal for wildlife protection and related tasks such as game counting. For example, the Magni M24 is used by Kenya's Wildlife Works Elephant Protection Trust and, in 2019, the Kenya Wildlife Service Air Wing sent seven pilots for gyrocopter training in the US and Germany ahead of

receiving five gyrocopters for wildlife protection.

The Trojan was proposed by South African special forces for counter-poaching missions in Kruger National Park and performed successfully during trials. However, funding constraints saw the military project halted and the Trojan being used for commercial work instead, with a number of aircraft subsequently sold domestically and overseas. Wagtail said the aircraft has been used commercially for surveillance, patrolling and emergency support.

As it also caters for the commercial/general aviation market, Wagtail is working on the enclosed Light Delivery Gyro (LDG) with a 1,100lb (500kg) payload. This could take the form of two passengers or two 265lb (120kg) boxes, from which supplies can be dropped in the emergency-support role. Another model under development is the three-seat open-cockpit Tourist. To date, the company has sold about three dozen gyrocopters of



all models and hopes to sell more as it expands its presence around the world, including in the United States.

Spy high

In 2010, Trixy Aviation Products of Austria began development of its TrixyEye two-seat gyrocopter with an eye towards surveillance, police, military and general security missions. Turkey's police force use it for observation missions, while in Egypt it assists with border security. Based on the Model G 4-2, the TrixyEye can be fitted with a side-mounted camera and an auxiliary fuel tank or drop-off box. The certified fixture allows almost any type of camera or sensor to be used, with the camera view displayed in the cockpit during flight.

One version of China's Lieying has been observed with a sensor turret and two or four guided missiles, depending on the version of aircraft. These weapons appear to include AR-2 missiles, designed for unmanned aircraft systems and other light aircraft. The semi-active, laser-guided AR-2 weighs around 45lb (20kg), has an 11lb (5kg) warhead and a maximum range of 5 miles (8km).

China's People's Liberation Army (PLA) has numerous Lieying gyrocopters in service, with photos showing 15 in a single formation. The type has been observed performing exercises and demonstrations. The Lieying is mainly aimed at special-forces operations within the PLA, including the insertion of paratroopers. Other tasks include reconnaissance and border patrol – in early 2020, it was reported that the three-seat version was being used for operations along China's southwest border regions, having been tested on take offs from an altitude of 13,800ft (4,200m).

The type is also believed to be in service with the Chinese police in Shaanxi Province.

The first iteration of the Lieying can carry two people in tandem, along with surveillance and communications equipment. According to the manufacturers, the aircraft has a range of 430 miles (690km), a ceiling of approximately 17,400 feet (5,300m) and can operate in temperatures as low as -36 degrees Celsius.

Take-off weight is 1,235lb (560kg) and empty weight is 639lb (290kg), giving a useful load of 595lb (270kg), including 15 gallons (70 litres) of fuel. The powerplant is a 115hp (85kW) Rotax 914 driving a three-bladed pusher propeller, giving a cruising speed of 93mph (150km/h) and a maximum speed of 110mph (180km/h). Take-off distance is 65-260 feet (20-80 metres). Skids can be fitted for operations on snow and ice, or floats can be used for taking off and landing on water, with at least one seen in the latter configuration. A three-seat version has been produced, with two seats side-by-side behind the pilot; in 2016, this model underwent tests, including two parachutists jumping from the aircraft simultaneously. The three-seat Falcon has an uprated engine (135hp/100kW), redesigned fuel tank and stretched rotor blades (28.8ft/8.8m) compared with 27.6ft/8.4m), while take-off weight has been increased to 1,388lb (630kg). The three-seater can carry injured personnel (across the two rear seats), and an armed version has been fitted with guided missiles and a four-blade propeller as opposed to the standard three-blade unit.



What is a gyrocopter?

Also known as autogyros and gyroplanes; gyrocopters have several advantages over fixed-wing aircraft, notably their ability to take off and land in short distances, and unlike traditional helicopters they can glide safely in the event of an engine failure. They are also substantially cheaper to buy and maintain than helicopters, due to far less complexity, including a simpler rotor/transmission configuration and the lack of a tail rotor. They are also much cheaper to operate, with running costs in the order of \$30-50 per hour compared with nearly ten times that for a helicopter.

Gyrocopters are far safer than helicopters – because air flows up through a gyrocopter's unpowered rotors instead of down as in a traditional helicopter, a gyrocopter can safely glide if the engine fails. The aircraft is basically a helicopter in permanent autorotation, pushed by a propeller. An added benefit of the air flowing up through the rotors is that it eliminates brownouts during landing or take off.

One of the disadvantages of a gyrocopter is their inability to hover or take off and land vertically, but very short takeoffs can be achieved using a pre-rotator and companies like Skyworks are addressing the hover problem through technologies such as rotor blade tip drives. Larger and heavier gyrocopters are also being developed, addressing payload limitations.

CLOCKWISE FROM FAR LEFT: Bensen X-25A gyrocopter as trialled by the US Air Force USAF

SnowGoose CQ-10B MMIST

Heliplane Skyworks Global

Cockpit of a modern gyrocopter shows the level of sophistication Guy Martin

A Lieying gyrocopter during trials in China Chinese Inernet

A Kurdish Traffic Police MTOSport The 7 Group



Wagtail Aviation is currently refining an armed version of the Trojan for the defence and security markets and has fitted the aircraft with twin SS-77 7.62mm light machineguns from Denel Land Systems mounted on a universal weapons beam. The company has also test fired rocket-propelled grenades from the aircraft, fitting two nine-round launchers carrying a range of armour-piercing, high-explosive and anti-personnel warheads, with the pilot given the option of firing individual rockets with an effective range of 6,500ft (2km).

Armed and dangerous

Another locally developed weapon that has been tested on the Trojan is a 40mm grenade launcher manufactured by Milkor. This is normally a six-shot weapon, but for the Trojan it has been

fitted with a modified belt-feed mechanism. Wagtail said that other weapons and equipment can be fitted according to customer requirements, with targeting information displayed on a helmet-mounted display. In addition to weapons, the Trojan has been tested with self-protection systems, including chaff and flares – it is likely the Trojan is the first-ever gyrocopter to be fitted with countermeasures.

The Trojan has heavy-duty landing gear (balloon tyres and strengthened suspension) for use on rough fields, and it features aluminium rotors for durability and ease of repair. These interchangeable blades measure from 27.8-35ft (8.5-10.8m) and replace more delicate composite blades. A hydraulic pre-rotator allows high pre-rotating speeds for very short take-offs and Wagtail is also experimenting with a jump take-off system that rotates the rotors to 130% of normal speed. The Trojan, and Wagtail's other gyrocopters, including the Trooper, are powered by a turbocharged Subaru EJ 25 engine, delivering 260hp (193kW) and driving a custom five-blade propeller, which gives 880lb (400kg) of thrust at 5,300 rpm. The Subaru engine was chosen due to its low cost, plentiful spares and the fact that it runs on normal petrol. The powerplant gives a top speed of around 130mph (210km/h), depending on rotor configuration, and a range of 310-430 miles (500-700km) depending on the fuel tank size. In the future, turbine powerplants could be used for heavier machines.

With assistance from Denel Aviation (now Denel Aeronautics) and the state-owned Council for Scientific and Industrial

Research, Wagtail developed the three-seat Trooper for the South African National Defence Force (SANDF) until funding ran out. Development work continues at Wagtail on the platform, which the company aims to use as the basis for a heavier 4,000lb (two ton) gyrocopter.

As Wagtail is one of the few companies producing heavy gyrocopters, it designed the Trooper to have a 2,000lb (one ton) maximum all-up weight (MAUW) and be able to take off within 330 feet (100m). The prototype is powered by a 3.3-litre Subaru engine driving a 35ft (10.8m) rotor, but production models will have a 2.5-litre turbocharged Subaru engine for commonality across the Wagtail model range.

The current trend towards autonomous aircraft includes gyrocopters such as those being developed by UAdventure, MMIST and the German Aerospace Centre (DLR). UAdventure is working on two aircraft weighing 44lb and 220lb (20 and 100kg) respectively, while the DLR has modified a 990lb (450kg) gyrocopter to carry a 44lb (200kg) payload. Canada's MMIST has developed the unmanned CQ-10B gyrocopter.

Wagtail Aviation is determined not to be left out of this market and is working on an autonomous version of the Trojan with a 1,100lb (500kg) payload, which it plans to fly during the course of 2020. The company hopes it will be adopted by entities such as the United Nations, the World Food Programme and the International Red Cross, or in regions where it is too dangerous to place emergency crews. Wagtail is also examining the possibility of operating gyrocopters in swarms. **AI**



Germany's Special Air Mission Wing is currently in the middle of the largest transition in its history. *Air International* visits the unit at Köln-Bonn airport for an update on activities. Words & images by **Ludo Mennes** and **Frank Visser**

From transporting the German Chancellor to airlifting critically ill patients, the Special Air Mission Wing of the Federal Ministry of Defence aims to be all things to all people.

The Flugbereitschaft des Bundesministeriums der Verteidigung (FIBschft BMVg – FBS) celebrated its 60th

anniversary in 2017 and is currently undergoing a major transformation to see it through the decades to come.

Founded on April 1, 1957, at Germany's Nörvenich air base, the unit is well known for providing the official transport for the Chancellor Angela Merkel and her ministers. However, with its fleet of striking white aircraft, the unit offers much more than a

taxi service for high-ranking German officials.

Former commander of the Flugbereitschaft BMVg, Colonel Guido Henrich was in charge until 2019, when Colonel Daniel Draken took over command of the 1,300 military and civil personnel based at the airports of Köln-Wahn and Berlin-Tegel.

Since July 1959, the unit has been based at Köln, near the former West German capital of

Bonn, firstly as the 3rd Staffel of LuftTransportGruppe 62, and, since 1963, as an independent unit. It gained its wing status in 1974.

In an interview shortly before he departed, Commander Henrich explained the different roles of FIBschft BMVg: "We are a unique unit with a number of different tasks to perform. Our fleet of aircraft is, first of all, responsible for the transport of



ABOVE: A340 16+01 photographed at Köln-Bonn Wahn airport with its engine covers on. All Images by Northern Skies Aviation

OPPOSITE: A340 16+02 parked up at Köln-Bonn Wahn airport awaiting the call to action.

INSET: The badge of the FBS.


German ■ wings

officials of the German federal government. Furthermore, we transport freight, passengers and patients. Each aircraft can also be deployed to support humanitarian aid operations and perform medical evacuation flights if necessary. "Another task is aerial refuelling. We deploy our aircraft for training flights, NATO exercises and mission deployments, [during which]

jets of both Germany and other NATO allies can be refuelled in flight. For example, we have been successfully participating with tanker capacity in Operation Counter Daesh [the so-called Islamic State] for the last three years, for which we have had one aircraft permanently



stationed in Jordan." The FIBschft BMVg wing consists of three squadrons (Lufttransportstaffeln) operating a mixed fleet of aircraft. The first unit operates the Airbus A310 from Köln. The second flies several VIP aircraft: the Airbus A319CJ, A321, A340-313X and the Bombardier Global 5000

and 6000 versions, also from Köln. Meanwhile the third squadron, based at Berlin, is equipped with the Eurocopter AS532 Cougar helicopter. Phase one maintenance is carried out at unit level by military technicians. For phases two and three, the aircraft either go to Airbus Operations in Hamburg or Lufthansa Bombardier Aviation Services in Berlin. 

RIGHT: A310 MRTT 10+25 in Luftwaffe grey, pictured on the apron at Eindhoven.

MAIN IMAGE: A310 MRTT 10+23 is prepped for flight at Köln-Bonn Wahn.



Grey fleet

The first squadron flies what is known as the 'grey fleet' of five Airbus A310-304s with ten crews, consisting of commander and co-pilots and Air Refuelling Officers (AROs). One example, 10+23 Kurt Schumacher, is a former East German Interflug passenger and freight aircraft which can transport up to 214 people. The other four are Multi-Role Tanker Transport (MRTT) aircraft, capable of carrying out aerial refuelling as well as transporting passengers, patients and freight. For medical evacuation flights, it can accommodate up to 44 patients lying down, with up to six of them receiving intensive care, while 16 others undergo medium-care treatment.

Medevac operations are overseen by the wing's medical director based in Köln. However, the patient

Evacuation Coordination Centre (PECC) in Koblenz is in charge when it comes to evacuating any German forces' personnel. The PECC is also responsible for organising medical staff, who come from German military hospitals and are kept on a 24-hours alert status.

The other four aircraft – 10+24 Otto Lilienthal, 10+25 Hermann Köhl, 10+26 Hans Grade and 10+27 August Euler – were previously owned and operated by Lufthansa and all the MRTTs are named after famous German aviation pioneers.

They can carry up to 72 tons of jet fuel in four tanks under the cargo hold and can deliver 45 tons to thirsty jets. The Germans use the under-wing 'hose-and-drogue' system, with baskets reeled off from the drum unit on hoses up to 22m in length. The tankers can pump fuel at up to 1,250kg per minute into the recipient jets.

The ARO directs the refuelling from a control station behind the cockpit where two video and infrared camera systems on each side of the fuselage display images on two screens. The officer communicates directly with the pilots of the tanker and the jets to ensure the process runs smoothly.

Since 2012, the operational planning and deployment of the grey fleet has been the responsibility of the European Air Transport Command (EATC) based at Eindhoven air base in the Netherlands.

Al-Azraq, Jordan

The first squadron began its involvement in Operation Counter Daesh – the German contribution to the Combined Joint Task Force Operation Inherent Resolve. One aircraft has been operating permanently from Muwaffaq Salti air base at Al-Azraq in

Jordan, though it originally flew from the Turkish air base at Incirlik. Besides the tanker presence, the German Air Force also operates four Tornado aircraft from the same air location. In April 2019, the squadron flew its 1,000th mission, totalling around 4,700 flight hours and refuelling over 5,200 aircraft.

Captain Rick (name withheld for security reasons), is a co-pilot on the A310 and a qualified ARO, he explained: "We've permanently had one aircraft present in Jordan, together with one crew. The crews change every five weeks; the aircraft every three to four months. Our whole operation within the squadron is focused on this mission – the aircraft always needs to be ready to fly. In case of larger technical problems, which the present squadron technicians cannot fix, a tanker will immediately be



flown in from Germany. So far, we have been refuelling German, French, British and American aircraft on their combat missions.

"The crews fly six days a week and receive their orders directly from the Combined Aerospace Operations Centre [CAOC] in Doha, Qatar. To optimise co-ordination between our crew in Jordan and CAOC, one of the FIBscht BMVg members operates as a liaison officer in Doha. The planning of a tanker mission takes on average about 30 minutes, and is mainly done by the ARO as they must make a fuel plan for the receiving aircraft.

"This plan depends on factors such as type of aircraft and engine capacity – which influences the speed and height for refuelling – as well as the [specific] fuel intake capacity. For example, the German Eurofighters are capable of taking up to 400kg per minute, while the French Rafale aircraft take up to 1,200kg per minute."

Whether or not the squadron maintains its presence in Jordan in the future will be determined by two factors. The first is the political mandate, which will be revisited in October 2020. The second is the introduction of the A400M Atlas tanker to the German fleet.



We are a unique unit with a number of tasks to perform. Our fleet of aircraft is, first of all, responsible for the transport of officials of the German federal government

Colonel Guido Henrich,
Commander of the FBS until 2019

In July 2019, the first A400M was stationed in Jordan as part of the certification process, then, from September 2019, an A400M aircraft of the Air Transport Wing 62 based at Wunstorf took over the aerial-refuelling task.

During the Counter Daesh refuelling effort (between December 10, 2015 and September 23, 2019) 24,267 tons of kerosene were delivered by FBS aircraft over the course of 1,141 refuelling missions totalling 5,371 flight hours.

Airbus A330 MRTT

The current MRTT fleet will be replaced by eight Airbus A330s in the near future. On September 25, 2017, the former German defence minister, Ursula von der

Leyen, signed an agreement with Norway to join the existing Multinational Multi-Role Tanker Transport Fleet (MMF) contract, along with Belgium, Luxembourg and the Netherlands. The MMF project was initially launched in 2012 by the European Defence Agency (EDA).

The five participants will have the exclusive right to use NATO-owned aircraft in a pooling and sharing arrangement, operated by a Multinational MRTT Unit (MMU) based at

Eindhoven. Approximately 1,100 flight hours will be available per year for each aircraft. Germany alone will receive 5,500 hours, once all the aircraft have been delivered.

Five of them will be kept at the Main Operating Base in Eindhoven and three at the Forward Operating Base (FOB) in Cologne. The first MMU commander is Dutch colonel Van der Biezen. The Netherlands will be responsible for the registration and maintaining the airworthiness of the airframes.

The A330s will be configured to transport passengers, including VIPs, and freight, as well as undertaking medevac and in-flight refuelling. They are currently being



built at the Airbus factory in Getafe near Madrid, Spain, and should be delivered between 2020 and 2024. The first two are scheduled to arrive at Eindhoven from June 2020, with the third and fourth aircraft going to Köln.

The first squadron is currently planning to withdraw its A310s in the first quarter of 2022. Initial crews have already started their three and half months' conversion training in Seville, Spain. With the arrival of the A330 MRTT and A400M, the A310s will give up their tanker roles and resume flying their medevac operations.

White fleet

The second squadron at Köln is responsible for transporting government officials. The unit operates a mixed fleet of white aircraft, each adorned with a black, red and gold cheat line and the title 'Bundesrepublik Deutschland' on the fuselage.

For long-range transport (up to 13,500km), the unit has two 20-year old

Airbus A340-313X VIP aircraft available, which were bought from Lufthansa in 2009. Both examples – 16+01 Konrad Adenauer and 16+02 Theodor Heuss – can accommodate up to 132 passengers and can offer conference and sleeping facilities. They can be used for medevac operations and fitted with a maximum of four intensive care units.

In 2013 the unit received Northrop Grumman AN/AAQ-24 (V) Large Aircraft Infrared Countermeasures Systems (LAIRCM) which tracks incoming missiles and jams the IR signal with an infrared laser beam; essentially 'blinding' the incoming weapon.

Airbus A350

In April 2019 the German government decided to add extra long-range aircraft to the fleet and replace the old A340s which had been suffering from a series of malfunctions. Embarrassingly, Angela Merkel, the German chancellor, had to use an airliner to fly to the G20 summit in Buenos Aires,



Argentina, in November 2018, after her official aircraft was forced to return to Germany with technical problems. German media was quick to claim the country had 'lost face' internationally.

Colonel Henrich explained: "The aircraft are getting older and spare parts are increasingly difficult to obtain. People tend to forget we only have two long-distance aircraft with the capacity to host large delegations on board and, unlike regular airlines, we cannot immediately change to alternative aircraft. After that incident we expected that something would happen, but the speed of the decision surprised us all.

"Normally a commercial, off-the-shelf investment of this

size takes around four to five years minimum."

Three new Airbus A350-900s have been bought for €640m, the first of which is currently being fitted out by Lufthansa Technik AG and will enter service later in 2020. The speedy delivery has been made possible owing to cancelled orders from civil customers. VIP cabins will be installed for the politicians, along with defensive systems, as carried by other aircraft in the fleet. The extra requirements bring the total purchase to €1.2bn.

The first aircraft, to be serialised 10+03, will be delivered in the standard commercial configuration with three classes, offering VIPs the required level of comfort. After the other two have been



delivered, the first will be converted to meet FIBschft BMVg standards. With the arrival of the new jets, the A340 will be taken out of service.

Short and middle range

For short- and mid-range flights, the unit can call on two Airbus A319-133X CJs (15+01 and 15+02), a single Airbus A321-200 (15+04), four Bombardier Global 5000s (14+01 up to 14+04) and three Bombardier Global 6000s (14+05 up to 14+07).

The A319, in service since 2010, can carry up to 44 passengers and is equipped with a private cabin and a conference room. It can fly up to 7,600km. If necessary, it can be transformed for medevac operations and carry two intensive care units.

In use since December 2018, the single Airbus A321-200 can transport 86 passengers including 12 in a VIP section. The aircraft, which was purchased from Lufthansa, is 6m longer than the A319, but has an identical cockpit and can fly up to 5,000km. Just like

its 'sisters', it can be used for medevac purposes and carry two intensive care units.

In June 2019, the FIBschft BMVg received its latest Airbus aircraft, A319-133X CJ OH (Offener Himmel - Open Skies), serial 15+04. It will be used mainly as an observation platform for aerial surveillance under the Open Skies Treaty, effective since 1992. Sensors and infrared cameras have been installed specifically for these missions, and the aircraft is available to all the participating treaty nations. If necessary, however, it can undertake medevac flights and passenger transport.

In service since September 2011, after it replaced the CL601 Challenger, the Bombardier Global 5000 is ideal for smaller delegations of up to 13 passengers. Although it operates mostly on short and middle distance flights in Europe, it is capable of flying almost 9,000km non-stop.

In April 2019, one of the Globals (14+01) suffered a crash landing at Berlin-Schönefeld. The aircraft was making its

Configuring for Covid-19

- With the outbreak of the global pandemic in March 2020, the FIBschft BMVg has converted a number of aircraft into the medevac configuration.
- The two Airbus A319s were stripped of their seats and replaced with all the equipment necessary to accommodate two high-dependency intensive care patients per aircraft. One of the A310 aircraft (10+27) has also been converted so that it can host up to six intensive care patients, or up to 38 less high-dependency patients.
- On March 28-29, 2020, the Luftwaffe flew the A310 MRTT to Bergamo to support the Italians in their fight against the coronavirus. Twelve seriously ill nationals were flown to Germany for treatment in hospitals around the country.
- FBS aircraft transported armed forces personnel for health reasons back to Germany from various missions and exercises around the world, such as Red Flag at Nellis AFB.
- Two A400M aircraft were also converted to host intensive care patients. The Luftwaffe assisted France in transporting two patients to Germany for further treatment in hospital.

first flight after undergoing maintenance at Lufthansa Bombardier Aviation Services. Investigators cited human error when they found that parts of the steering system had been installed the wrong way round. The damage to the Global was so extensive that repair was deemed unviable.

With such great demand for air capacity of this kind, in June 2019 it was decided to acquire three additional

Bombardier Global 6000s for €240m. The first entered service in September 2019 and the remaining two were delivered in October and November the same year. The Global 6000 can fly 11,000km non-stop, carrying up to 17 passengers.

For short-distance transport, the wing operates a fleet of three Eurocopter AS532 Cougars, which are based at Berlin-Tegel airport and belong to the 3rd

TOP: Global 5000 14+03 gleams in its hangar at Köln-Bonn Wahn.

MAIN IMAGE: Following the embarrassing G20 incident, new aircraft were purchased and all the aircraft receive the most rigorous checks and maintenance.





RIGHT: The luxurious interior of A321-231 15+04 awaits its VIP guests.

MIDDLE: A340 16+02, Theodor Heuss, is named for the first President of the German Federal Republic (1949).

BOTTOM: A319 15+03 Open Skies on the apron at Köln-Bonn Wahn.

Lufttransportstaffel of the FIBschft BMVg. The helicopters, with a crew of three, can transport up to 17 passengers and are fitted with four VIP seats, plus catering facilities and a washroom.

The Cougars are not due for replacement yet, but the future requirement phase will get under way soon. Contenders and numbers will probably be determined by the move to the newly-built Berlin Brandenburg Airport (BER) which is finally scheduled to open in October. Located 27km from the city centre, politicians will probably have to be flown in and out of Berlin if they are going to avoid its notorious traffic jams. Recently, the German government decided that Berlin-Tegel airport will be used by FBS until 2029.

Future moves

Even though the unit has called Köln-Wahn its home for years, most of the white fleet's duties require it to fly in and out of Berlin, which is why the VIP

aircraft are intended to move to Berlin Brandenburg. The decision to relocate to BER was made in 2008 – ten years after the German government moved to Berlin – and has already been postponed several times owing to continual delays in completing the airport.

The unit will have maintenance buildings and its own passenger terminal on the north side of the airport, and the move will be undertaken in two steps. After the airport opens, the FIBschft BMVg will operate from a temporary platform and building, which will mainly be home to the third squadron and its Cougar helicopters.

Once the permanent infrastructure is constructed, FBS aircraft from Köln will also

move to Berlin. Construction is planned to take four to five years, although the German media seems keen to stress the waste of taxpayers' money, as the aircraft mainly only commute the 289 miles (479km) between Köln and Berlin.



Colonel Henrich points out the importance of these flights: "Although the press prefers to use the German word 'leer' which means empty, we use the word 'lehr' which means learning. For

us, the ferry flights offer our pilots the necessary flight hours. The flying of German officials alone, offers inadequate flight hours to train procedures and build up enough hours to remain current.

Besides the actual flying

hours, the pilots rely on simulators. These are located in Frankfurt for the Airbus aircraft, and in Dubai, with Emirates, for the Global aircraft."

Whatever the future has in store for the FBS, colonel Henrich handed over the unit to his successor, Colonel Daniel Draken, with a sense of pride. "We are in the middle of the largest transition ever in the history of FIBschft BMVg.

The workload of current flying operations combined with the planning and logistics for the arrival of new aircraft is intense.

The training of our personnel, both in the cockpit and cabin, as well our technicians and ground support, while the daily operations continue, make it challenging. However, I am proud to say that every member [within the unit] is extremely committed to realising what FIBschft BMVg stands for, namely, to be ready to offer the best flight service." **AI**



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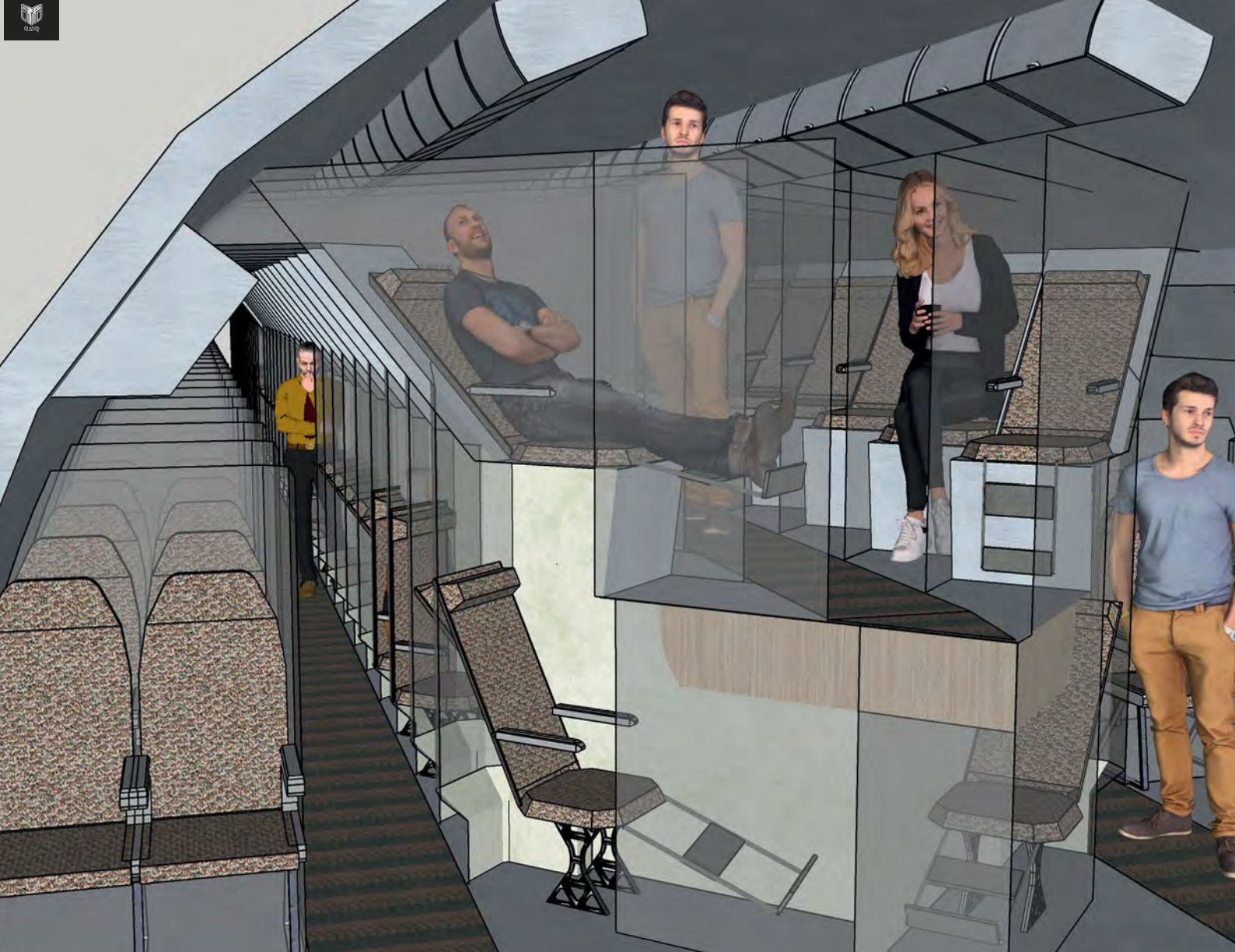


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Companies have rapidly developed prototype seat designs to calm passenger fears of flying while **COVID-19** risks remain. **Mark Broadbent** analyses the contenders and whether emerging measures can reassure air travellers.

Are you

New protocols are being introduced at every stage of a passenger's journey as COVID-19 lockdowns fluctuate, travel restrictions ease and airlines fight to fly again. From clearing customs and security to browsing terminal shops and collecting bags at a destination, the journey environment is constantly changing, and perhaps nowhere more than inside the cabin. Along with social distancing, personal protective equipment (PPE) and more intensive cleaning laid out by the International Civil Aviation Organization (ICAO) *Take-off* guidelines, new measures intend to sanitise surroundings and increase passenger confidence.

Real concerns

Air passengers are understandably nervous, an impression borne out by the latest International Air Transport Association (IATA) traveller survey published in July.

The third such study since the pandemic began showed that 41% of the 5,000 people in 11 countries surveyed said they are "very concerned" about COVID-19's impact on flying. Another 42% are "somewhat concerned" and 33% said they will avoid travel in the coming months to reduce their risk of catching the virus.

Sixty-five percent of respondents said they are worried about sitting next to someone on a flight who might be infected, and 42% are concerned about using onboard toilet

facilities. More than a third of respondents (37%) said they are anxious about breathing cabin air and well over half (57%) think air quality on board is dangerous.

This is despite 55% of respondents saying they understood cabin air quality is superior in modern aircraft such as the Boeing 787 and Airbus A350, thanks to high efficiency particulate air filters and advanced air conditioning systems that draw fresh air from the outside every two to three minutes.

It is clear airlines have a major task ahead to encourage many people to feel comfortable about flying, and IATA CEO Alexandre de Juniac recently conceded: "No environment is risk-free, but few environments are as controlled as the



ABOVE: Safran's Interspace airlines 'lock out' either the central or outboard positions on a seat row.
Safran Seats

OPPOSITE: Vision of the future? IpVenture's bold design for a new cabin arrangement. IpVenture

sitting safely?

aircraft cabin. We need to make sure that travellers understand that."

This wider need for reassurance is why all airlines have been proactive about communicating newly introduced social distancing and sanitisation measures.

'Stacked' seats

The impact of the COVID-19 pandemic on passenger expectations has inspired fresh thinking about the aircraft cabin. Various designs have emerged for protective screens and dividers from the ecosystem of equipment providers in the industry (see panel, *Designs on reducing risk*). There are also grander ambitions from start-ups aiming to revolutionise aircraft seating and the wider air travel experience.


One new concept, released in July 2020 by US firm Zephyr Aerospace, is a 'social distancing compliant' seat. Designed for economy passengers on long-distance flights, the developer reports its patent-pending Zephyr Seat module enables a passenger to lie completely flat, lounge back or sit upright on a 78in-long (1.9m) seat with their legs fully extended in a completely private cabin.

The Zephyr Seat uses what the company calls a 'stacked' seating configuration to increase cabin capacity by 20%. Customisable with optional extras such as memory foam seats, black-out curtains, OLED (organic light-emitting diode) displays and other amenities, it can be retrofitted to any existing seat module.

The company has filed a provisional design and utility patent, conducted technical and design feasibility studies and invested US\$500,000 in building a mock-up in partnership with aerospace design company Style & Design.

Zephyr has also secured a product development partnership with "a reputable seat manufacturing company" and is talking to airlines, aircraft manufacturers and seat suppliers to bring its product to market.

Cabin cubicles

Another bold idea to emerge in recent weeks is a radical concept from IpVenture for "staggered seating" arrangements to "promote proper hygiene in the wake of COVID-19 and create more premium" 

41%

of 5,000 people are "very concerned" about COVID-19's impact on flying

65%

of respondents are worried about sitting next to an infected passenger

42%

are concerned about using onboard toilet facilities

57%

think on board air quality is dangerous

Source: International Air Transport Association traveller survey



space in the cabin by creatively using the space above the passengers".

Drawings reveal "semi-private cubicles" designed to increase passenger comfort, privacy, and accessibility, while maintaining overall seating capacity.

IpVenture states: "No longer do rows of seats sit tightly together. Instead, individual seats are oriented at an angle and partitioned in their own cubicle, with transparent walls that reach up their corresponding ceilings, such as the bottom of the row above. Short staircases along the line lead to a second row of seating set above the first."

Attendants would serve flyers, and passengers access seats without pushing past others, with each seat featuring individual armrests, more legroom and a 45° incline.

The company notes: "With these innovations, passengers will be far better protected from airborne pathogens, even as [economy class] returns to full capacity."

Safran's updated range

While the Zephyr and IpVenture concepts present novel approaches to aircraft seating, retrofitting existing products with new elements seems likelier in the short term.

In May, Safran Seats announced it will develop and manufacture Universal Moment's Interspace portfolio of economy, premium economy and business class seats. Interspace features two 'padded wings' that fold out from the seatback position, enabling passengers to rotate the seat and lean back on a cushioned surface.

Retrofittable on existing seat units, an adaptation called Interspace Lite enables

airlines to reconfigure economy cabins by 'locking out' either the central or outboard positions on a seat row. Safran will also provide a retrofit for existing premium economy seats.

Safran Seats EVP Strategy Innovation Quentin Munier commented: "Interspace is a great innovation for privacy of passengers, even more so in the post-COVID-19 travel environment that's ahead of us."

Safran has also launched Travel Safe to provide social distancing without loss of seats, touchless interaction and virus-free surfaces.

It features a removable partition called Ringfence that isolates neighbouring passengers, touchless door actuation or pedal actuation of backrest recline and coatings to aid disinfection and cleaning. Additionally, Safran has a new design service,





ABOVE: Honeywell's UV Cabin System.
Honeywell Aerospace

RIGHT: Dutch company Aviation Glass & Technology has developed the AeroGlassShield.
Aviation Glass & Technology

BELOW LEFT: French company Vision Systems' split screen.
Vision Systems



"No environment is risk-free, but few environments are as controlled as the aircraft cabin. We need to make sure that travellers understand that."

Alexandre de Juniac, IATA CEO

Create, which works alongside airlines to develop "customised seats adapted to the post-COVID-19 travel context."

'Blocking' seats

Of course, thousands of seats are already in use, so how are airlines ensuring safety to help minimise the COVID-19 transmission risk in cabins?

'Blocking' middle seats to provide more space between passengers to create social distancing has made headlines in recent weeks. Some operators, such as Delta

Air Lines, JetBlue Airways and Southwest Airlines, have chosen to leave some middle seats empty, but others have dismissed the idea. A United Airlines spokesman quoted by *CNBC* in June said such actions are "a PR strategy".

There is no legal or regulatory requirement to block middle seats. As IATA noted in its Traveller Survey: "While passengers are sitting in close proximity on board, the cabin air flow is from ceiling to floor. This limits the potential spread of viruses or germs backwards or forwards

in the cabin." It added: "There are several natural barriers to the transmission of the virus on board, including the forward orientation of passengers (limiting face-to-face interaction), seatbacks that limit transmission from row-to-row and the limited movement of passengers in the cabin."

However, as ICAO outlines in its *Take-off* guidance (published in May 2020 by the agency's Council Aviation Recovery Task Force), passengers are advised to wear a face mask or covering when social distancing is not possible. Many operators subsequently required all passengers to wear masks/coverings during their journey. Other carriers, among them American Airlines, have started to ask customers during the check-in process to certify they have been free of COVID-19 symptoms for the previous 14 days. ➔



Cleaning protocols

It is now mandatory for airlines to undertake regular and comprehensive cabin cleaning to provide a safe and sanitised environment.

As 'high-touch' surfaces, cabin seats are an obvious focus for cleaning and airlines must disinfect each part of the seat, including buckles, tray tables and seatback in-flight entertainment (IFE) and connectivity touchscreens. Passengers are provided with hand sanitisation wipes.

Carriers' staff use electrostatic sprayers/fogging devices to apply spray inside the cabin to kill viruses and bacteria. Firms are required to increase

the frequency of cabin cleaning and other places under their direct control, such as gate areas, ticket and passenger services counters.

ICAO's *Take-off* guidance says: "Airframe manufacturers recommend the use of a 70% aqueous solution of isopropyl alcohol (IPA) as a disinfectant for the touch surfaces."

It notes that adequate ventilation and PPE are required when applying disinfectant. The document states: "Apply [IPA] with pre-moistened wipes or single use wetted cloth and use limited bottle sizes on board to minimise the risk of spilling the solution. Do not spray IPA in the cabin. Do not allow the liquid to pool or drip into equipment

[such as IFE electronic boxes]. IPA is flammable, so precautions should be taken around potential sources of ignition."

Operators must "periodically inspect the equipment to ensure that there are no long-term effects, colour shift or damage over time", the guidelines add, with specific care taken over application to leather and other soft goods.

ICAO states: "Airlines may wish to review their operating procedures to minimise the number of personnel who need to contact high-touch surfaces such as access panels, door handles, switches, etc."

The Future Travel Experience consultancy, part of the Airline Passenger Experience Association, noted in its April 2020 report, *The Post-COVID-19 Travel Experience*, that other measures to reduce transmission risk could include removing printed materials and undertaking additional deep cleaning of the interior when the aircraft is off the line.

Removing germs

A requirement to provide a higher level of onboard hygiene has led to technology developments.

Honeywell offers an ultraviolet (UV) cleaning system, which, the company claims, "significantly reduces certain viruses and bacteria on aircraft cabin surfaces".

The UV Cabin System – originally developed by Dimer and called the GermFalcon – can treat an aircraft cabin in less than ten minutes. Roughly the size of an aircraft drinks trolley, it features 'arms' that extend over the top of seats and shine UV light over an area.

Pricing of the system will vary based on the quantity ordered, Honeywell reports, but adds that for mid-size to large airlines

Designs on reducing risk

Several physical dividers or screens designed to be installed to existing seats have been developed to reduce the risk of exposure to COVID-19.

AeroGlassShield

Developer: Aviation Glass & Technology

A glass screen fitted between seats, AeroGlassShield is lightweight, scratch- and ultraviolet-resistant and fireproof. The manufacturer says it is 50% thinner and 25% lighter than traditional optical screens, while meeting aviation authorities' safety requirements. It expects to finalise certification for the product by mid-2021.

Jamco Soft Divider

Developer: Jamco America

Described by its manufacturer as having a "soft eyebrow-type hanging" design, the Jamco Soft Divider is designed for narrowbody single aisle aircraft. It is a leather-wrapped flexible divider. It bends so it will not restrict a reclining seat, with minimal encroachment into the space of other passengers. Jamco says its product, which can already be integrated with provisions certified for current Boeing 737 divider systems, is due to receive approval for the Airbus A321 later in 2020.

Lufthansa Technik seat divider

Developers: Lufthansa Technik/Krueger Aviation GmbH

As part of a wider range of innovations designed to make the in-flight experience more comfortable (including the TITANO sanitiser), Lufthansa Technik offers a lightweight transparent polycarbonate seat divider. It is inserted into the magazine compartment and clicks onto the table mounting in an upright position to secure it to the seat. One shipset of dividers can be installed within a few hours, said Lufthansa Technik, with no impact on the air conditioning. The process of acquiring a supplementary type certificate has started.

Personal Protection Window

Developer: RAS Completions

London Biggin Hill Airport-based interiors specialist RAS says its Passenger Protection Window (PPW) that can be mounted between seats is "a simple but very effective piece of equipment... designed to help airlines avoid the financial pain they are feeling, and operate a normal service". The company says the screen "is suitable for all aircraft types". Existing seat recline, tray tables and IFE screens are unaffected, and there is full access to drop-down oxygen masks.

Quick-Split System

Developer: Vision Systems

Brignais, France-headquartered Vision Systems has produced what it calls a "fast and easy barrier solution against COVID-19". The company says its 'plug and play' system can be mounted and dismantled without modifying the existing seats and is adaptable to any type of armrest. It is designed for durability and easy maintenance and cleaning, and its dimensions and shape are customisable, depending on a customer's specific seat.

Sentinel/Sentinel Shield

Developer: Aerofoam Industries

A removable 'seat blocking' partition that uses the existing seat and passenger restraint system, the basic configuration Sentinel is a clear plastic screen in place of a middle seat and the Sentinel Shield is a clear divider that attempts to provide a sanitary space between passengers. Both configurations incorporate what the company calls a "functional design", providing adjoining passengers with additional cup holders and recessed compartments to store phones or other loose items.



with hundreds of jets, the system “could be applied to their aircraft for less than US\$10 per use”

Medical studies have found the system reduces various bacteria and viruses, including SARS and MERS, the company said, although a statement pointed out there has been no testing on the protection it offers against COVID-19.

Among several new products offered by Lufthansa Technik to improve the cabin environment is a sanitiser called TiTANO, developed by the German company Hecosol.

Applied by an electric spray, TiTANO reduces the survival rate of bacteria and viruses to below 90% within five minutes. The treated surface is germ-free within 24 hours and its effect lasts for one year, which Lufthansa Technik maintains makes it “very efficient” for removing germs from cabin surfaces such as armrests and trays.

Adhesive films

Separately, July 2020 saw the French companies ADHETEC (an adhesives supplier) and PYLOTE (a mineral and ceramic industrial chemistry specialist) launch two adhesive films, ADHECAL and ADHEFILM, to provide a protective layer for seat armrests, handles, shells, tray tables and IFE screens.

These products have been specifically qualified against coronavirus (and other viruses) by the Toulouse-based Fonderephar biological research organisation. Surfaces with coronavirus present were treated with the films and compared to untreated surfaces.

After one hour of activation they had reduced the ‘viral load’ on the treated area by more than 90%, with 99.9% of particles gone after 24 hours, the companies report.

Another developer, Recaro Aircraft Seating, is developing its antibacterial ‘hygienic seat’ coating that received

ABOVE: RAS Completions’ Personal Protective Window is installed here in an Airbus A320 cabin.
RAS Completions

ABOVE LEFT: Jamco’s Seat Divider is already certified for the Boeing 737.
Image Jamco

BELOW: Many of the new seating developments, including Interspace seen here, are retrofittable.
Safran Seats

a German Innovation Award in 2018. A company spokeswoman told *AIR International*: “We have created a handful of new products that will support [cleaning] measures. Each customer is approaching [seat hygiene] differently, so we are collaborating closely with them to develop customised protective features for our products.”

New cleaning products must meet airworthiness requirements, for example in terms of flammability, before they are approved and put into service. Certifying new components, such as the various screens and dividers for existing seats, is dependent on the specific seat model and aircraft type and varies on the intended solution. Any physical modifications must be easy to install and not add significant weight to the product, she added.

Towards a new experience

The COVID-19 pandemic is a crisis for the airline industry, but presents an opportunity for the cabin interiors market. Although proposals for the more radical seating arrangements are still at a nascent stage, the industry’s new biosecurity reality due to COVID-19 is inspiring fresh thinking about new products and services.

Interiors specialists were already having to respond to increasing demands for lighter, slimmer seats that help aircraft performance, reduce operational costs, offer increased passenger comfort and provide the connectivity flyers now demand.

These ongoing requirements, together with the need to provide a safe and clean cabin, suggest a further seating evolution is on its way. **AI**

“While passengers are sitting in close proximity on board, the cabin air flow is from ceiling to floor. This limits the potential spread of viruses or germs backwards or forwards in the cabin.”

IATA Traveller Survey



Blue Amazon Warriors

Protecting the 3.5 million square miles of the Brazilian coastline is a fleet of six S-70B Seahawks. **João Paulo Moralez** and **Santiago Rivas** chart the navy's acquisition and operation of the type



Both HS-1 hangars were modernised to receive the fleet of six helicopters and related equipment.

PROIBIDO FUMAR FILMA
E FOTOGRAFAR



Brazil ranks as the country with the 16th longest coastline in the world, spanning 17 states and more than 400 cities, known

as the Blue Amazon. The maritime area under its responsibility amounts to 3.5 million square miles (5.7 million km²), equivalent to 67% of the national territory or approximately twice the size of India. From there, 85%

of the country's consumed oil is extracted, along with 75% of the natural gas, and it accounts for 45% of fishing. When the Brazilian Navy received its first two Sikorsky S-70B Seahawks on July 30, 2012, it ended an era of 42



The full glass cockpit of the S-70B Seahawk allows more accurate situational awareness and agility.

the upgrade and the costs involved would be high, making the second option – buying new equipment – the most appropriate at that time.

The Navy evaluated the options on the market and composed a list of three finalists: the Airbus Helicopters AS532 (now H215M) Cougar, the EH-101 Merlin and the Sikorsky Seahawk. Military personnel travelled to Chile to study the operation of the then sonar-equipped AS532SC, which could deploy up to two Exocet anti-ship missiles per mission and a wide range of weaponry including torpedoes. The type was also very similar to the AS332F1 and AS532SG already operating with the Brazilian Navy on utility missions, giving commonality on spare parts and maintenance.

The selection process considered various aspects such as price, availability, after-sales support, logistical support, compatibility with the Navy's existing fleet and the HS-1 squadron's own ground infrastructure. Each of these requirements had a distinct value, which together gave the Navy a good idea of the best option.

Training begins

On May 28, 2008, Brazil signed a Letter of Acceptance to initiate the process of purchasing four Sikorsky S-70Bs through Foreign Military Sales (FMS) for a total cost of US\$194.7 million, including spare parts, pilot and mechanic training, maintenance related equipment and other ground systems to support the operation of the aircraft. On June 20, 2011, two further S-70Bs were acquired for US\$94 million.

Following the purchase, a series of actions were taken to begin the process of introducing the Seahawk into service, even before its arrival at the squadron. The first was to create a decommissioning schedule for the last Sea King still in operation and establish what would be required to keep it operational until the new helicopters arrived.

Work also began on adapting the infrastructure necessary to receive the Seahawk. Finally, there was the selection of personnel to receive training to

years of Sikorsky SH-3 Sea King operations with HS-1 squadron. Based at the São Pedro da Aldeia Naval Aviation Base in Rio de Janeiro, the squadron's mission is to patrol Brazilian waters, support and protect naval forces and conduct anti-surface (ASuW) and anti-submarine (ASW) warfare.

By 2002, the SH-3s had exceeded their level of obsolescence, suffering poor availability of their in-flight systems, sensors and armaments, which did not work to their full extent. Many helicopters were grounded and ASuW and ASW missions could only be carried out during the day and with severe limitations. In addition to these restrictions, the flight hour cost had risen due to the complexity of maintenance and the lack of spare parts.

Faced with these complications, the navy began studies to define the future of its SH-3s. They came to the conclusion that there were two options.

The first was to modernise the existing Sea King fleet which would allow its operation for another 15 years. The capacity of SH-3 at the time would allow it to undertake other missions, not just ASW and ASuW. With huge internal space, it was possible to carry cargo, troops and conduct search and rescue. It was robust and versatile.

The modernisation would raise the SH-3's operational capabilities to a technology standard never seen before for such aircraft in the Brazilian Navy. However, after several analyses, it was concluded that the time to carry out



The pilot monitors the MH-16 parameters during a hover to track submarines in an ASW mission. The on-board system controls the hover automatically.



The APS-143 and AN/AAS-44 V operator located in the centre of the helicopter.



The sonar operator station, on the left-hand side of the MH-16.



operate the MH-16, which was to be the designation of the S-70B in Brazilian Navy service.

Staff training was divided into different phases and locations. Two pilots were selected to take the theoretical and practical course with the US Navy's HS-10 squadron 'Warhawks' flying the SH-60F, which has many similarities to the model purchased by Brazil. The first six months were devoted to enhancing English language proficiency at the Defense Language Institute, with emphasis on aeronautical technical terms and standard words used in aircraft internal and external communication.

The two pilots then went to Pensacola, Florida, to take the Helicopter Underwater Escape Training course, and finally to HS-10 based at Naval Air Station North Island, San Diego, California, for a flight training session of about 22 weeks. The Brazilians flew approximately 60 hours each on the SH-60F and another 40 hours in a flight

simulator. The training included basic manoeuvres, day and night ASW missions, search and rescue, external cargo transport, flights over mountainous terrain, and day and night onboard landing with night-vision goggles.

Across the Atlantic, at 3° Gruppo Elicotteri in Maristaeli Catania, Italy, two crew members took the L3 Communications Helicopter Long Range Active Sonar (HELTRAS) operation training course. It took approximately 23 weeks, comprising classes, simulator instruction and 40 hours of flight in the Marina Militare Italiana EH-101.

On return to Brazil, both pilots and sonar operators began to act as instructors, spreading the knowledge absorbed in the US and Italy.

Another ten pilots went through ground school at Sikorsky and spent time in the S-70A simulator, which is very similar to the aircraft in the Brazilian fleet. Of these, eight received training in the first two

Brazilian helicopters at HS-1 headquarters in Rio de Janeiro from August 2012, along with 44 mechanics and eight radar, sonar and EO/IR operators.

In Brazil, the MH-16 pilot qualifying flights began on September 25, 2012, and were divided into stages covering familiarisation, mission systems, flight instructors and maintenance test pilots. In these stages, 577 hours were flown over 230 missions.

Sikorsky, in turn, transferred some pilots, mechanics, technicians and sensor operators to Rio de Janeiro to assist the Brazilians in this transition phase, until the mission could be assumed with full autonomy.

Coming into service

Having been one of the last countries in the world to acquire the older model of Seahawk, Brazil has benefited from all the developments the project has undergone since it entered service with the US Navy in 1984. The Brazilian version is now one of the most modern in operation worldwide.

MH-16s are equipped with flight and voice data recording, an inertial navigation system, secure communication via HF and V/UHF, datalink, satellite communication and advanced flight management. All systems and sensors are integrated in the MIL-STD 1553 digital databus.

ASuW mission radar is the 400km-range Telephonics APS-143 (C) V3 OceanEye with target detection and

identification capabilities even under harsh marine conditions, including the capacity to detect a submarine periscope at full range. The radar works in weather and surface search modes, with Automatic Identification System capability, which tracks merchant vessels by name, position, speed, cargo and country of origin.

Through the Inverse Synthetic Aperture Radar (ISAR), which uses the doppler effect of sea wave movement, it is possible to generate a picture of the contact's silhouette and analyse its characteristics by defining if the target is a merchant or military vessel.

Another feature is the Raytheon AN/AAS-44 V EO/IR system, which has a range of up to 27 miles (40km), providing conventional colour (TV) or infrared images. With it the crew can perform monitoring over long distances, preventing their presence from being detected by ships in the region.

In addition to the two pilots, there are two sensor operators. At the central station is the APS-143 and AN/AAS-44 V operator; at the left station is the L3 DS 100 HELTRAS sonar operator for the ASW missions. Being a low frequency sonar, the system has eight arms where the receivers are installed. Each arm is 8.5ft (2.6m) in diameter and has 12 hydrophones (96 in all). There are also eight ladder-shaped transmitters, which provide the distance from the sea bottom, preventing the equipment



TOP: Although limited by internal space, the squadron can conduct search and rescue missions using the external hoist, which is certified for up to 600lbs (272 kilos).

THIS IMAGE: With the S-70B Seahawk, the squadron resumed flying around the clock, both in training and operational missions. Some of the night ASW missions were of up to three hours.



ABOVE FROM TOP: The Sikorsky Seahawk was projected to require little ground infrastructure to operate, including climbing to reach important systems and carry out inspections.

After the return of each mission, the MH-16 Seahawk must be washed to clean off the saltwater so as not to damage the sensors and structure of the helicopter.

The tiny space at the cabin compartment is divided among two sensors operators, the HELRAS sonar and a series of avionics consoles.

The AN/AAS-44 V E0/IR sensor provides both conventional and infrared images up to 24.8 miles (40km) from the target. Close to the taxi and landing light is one of the Electronic Support Measures ESM LN-100 antennas.

from touching it. The transmitters are 20.3ft (6.2m) long vertically and the total sonar weight is 331lbs (150k).

Depending on the depth and temperature of the water, the sonar can provide an average radius of 14.2 miles (23km) over 360°. The helicopter is kept in the hover at 82ft (24m) above sea level, day and night, and the operator can lower the HELRAS to a depth of up to 1,640ft (500m).

On the SH-3 Sea King the sonar range was barely five miles (8km), with the helicopter capable of hovering for a maximum of six minutes. Today, this overflight can be up to an hour, so there's a lot of HELRAS information for the operator to analyse.

In terms of electronic warfare and self-protection systems, there are two chaff/flare launchers located on either side of the fuselage. There are also infrared countermeasures (IRCM) and electronic support measures (MAGE ESM LN-100), the latter being a passive sensor that captures all electromagnetic radar emissions, analyses the waves and determines the position of the target and whether it is a ship or submarine, its class and type of radar being employed.

The MH-16's cockpit is all-digital, with four 7.9x10in (20.3x25.4cm) multi-functional colour displays, compatible with third generation AN/AVS-9 night-vision goggles, along with an improved aircraft management system.

Armed and ready

On December 23, 2008, the Brazilian Navy purchased eight AGM-119B Penguin Mk 2 MOD.7 anti-ship missiles for €15.7 million, including loading and handling equipment, manuals, training and spare parts.

Being a fire-and-forget weapon, the missile carries the target information provided by the MH-16 radar prior to its launch. Part of the initial trajectory uses the inertial navigation system, which activates infrared guidance in the final phase of flight to the target.

The range is 25nm and navigation is at a maximum height of 150ft above sea level, reaching supersonic speed (Mach 1.2). The Penguin weighs 847lbs (including a 265lb of

warhead), has a 4.5ft (1.4m) wingspan, is 10ft (3.06m) long and has an electronic countermeasure proof system.

The Mk.46 MOD 5 torpedo is part of the Seahawk weapons inventory, which features an active and passive sonar guidance system, 5.9nm range, weight of 518lbs and can travel at depths of between 50-1,500ft (15-457m).

There is also a door-mounted 7.62mm MAG 58M machine gun with 250 shots to provide helicopter protection when approaching ships and vessels or for use in actions against piracy.

Another feature of the Seahawk is its multi-role capability. It can carry an AGM-119B Penguin missile, a Mk.46 torpedo and a 450-litre external fuel tank simultaneously, enabling accomplishment of long-range anti-submarine and anti-ship missions. In an operational theatre where both threats are present, this versatility gives the squadron more responsiveness against the enemy.

Going to work

On July 30, 2012, MH-16 N-3034 and N-3035 arrived semi-assembled aboard a United States Air Force Boeing C-17A Globemaster III at Cabo Frio Airport. Both were put into operation after being transferred to the squadron by air.

On August 26 of the same year, N-3032 and N-3033 were handed over to HS-1. The remaining two helicopters – N-3036 and N-3037 – acquired in 2011, were received on August 10, 2015.

With the increase of qualified crew and the number of aircraft received, the squadron gradually resumed some routines and missions that had previously been abandoned due to obsolescence and deactivation of the HS-1. One such flight was between São Pedro da Aldeia and Vitória, Espírito Santo State, on October 18, 2012, with the crew flying entirely on instruments – something that had not taken place since 2007. On November 7 of that year, MH-16 N-3033 carried out the first landing aboard a ship, the Landing Ship Logistic *Almirante Sabóia* (G-25). In all, 30 landings and take-offs were undertaken as the *Almirante Sabóia* sailed 13nm south of Ilha Rasa, off the coast of Rio de



Janeiro, training HS-1 military personnel in the necessary skills for shipborne operations. On March 21, 2013, the unit completed its first night ASW mission, the squadron's primary role in terms of doctrine and employment. One of the high points of the training came on May 9, 2013, when, for the first time, a Seahawk visually detect and locate the periscope of the BNS *Tikuna* (S-34) submarine sailing south of Cabo Frio Lighthouse, Rio de Janeiro State. Controlled by the frigate *Niterói* (F 40) and employing the Raytheon AN/AAS-44 V, the MH-16 was supporting the Qualification Stage for Future Submarine Commanders.

Then, on June 5, 2013, Sikorsky ended the HS-1 military qualification course, declaring the unit fully capable of employing and maintaining its aircraft on a variety of missions, including search and rescue, external cargo lift, logistical support and shipborne operations. Of the eight trained pilots, four were qualified as instructors and maintenance test pilots.

With Full Operational Capability (FOC) obtained, HS-1 began the use of aircraft weapons in various operations performed by the Navy. The first firing of the AGM-119B Penguin missile took place on December 10, 2014, by N-3034 during Operation ADEREX II.

At MISSILEX 2016, held from April 11-20, 2016, during an exercise aimed at training Brazilian naval power, the hull of former Inhauma Class corvette *Frontin* (V-33) was sunk at sea. Two MH-16s each launched an AGM-119B missile at the target, causing major damage. The ship was later sunk after being hit by other weapons, including an Exocet anti-ship missile.

Between July 24-28, 2017, again during the MISSILEX operation, the former frigate *Bosísio* (F 48), a Type 22 of the Greenhalgh Class, was attacked by an AGM-119B missile and then a Mk.46 torpedo. The Seahawk involved

took off from the *Bahia* (G 40) Landing Platform Dock to make the attack, the first time the type had departed from a ship rather than their home base for this type of mission.

Finally, in April 2018, the 5,000-flight hour milestone was reached by HS-1 with its Seahawks. Since being inducted into service, the helicopter had dramatically transformed Brazil's combat capability for the anti-surface and anti-submarine warfare role.

Although no more Seahawks are expected to be purchased in the short term, the prospect for 2031 is that another eight such helicopters will be acquired in two batches. **AI**



TOP: The combination of sensors and avionics allow missions to be carried out by day, night and in adverse weather conditions.

LEFT: A sensor operator crew conducts an external walkaround prior to an ASW night mission.

RIGHT: The MH-16 Seahawk constantly operates on board the Navy's main fleet in open sea, day and night.





Aviation's COVID-19 paradigm shift

Standard operating procedures (SOPs) are the foundations on which commercial flying is built. Airbus A320 captain **Jeremy Feldman** explains their use and details how the on-going coronavirus pandemic has, in some cases, necessitated their change.

Forming an essential part of a commercial pilot's working day are standard operating procedures (SOPs). Everything from the walkaround inspection, cockpit set-up and briefings, to take-off, landings and even non-normal situations are governed and regulated using SOPs. They govern almost all aspects of the day to day operation, from the seemingly obvious how to read a checklist to the more complicated management of a multiple hydraulics failure at high altitude. Operating a complex aircraft means there



CLOCKWISE FROM TOP LEFT: Most modern airliners are equipped with high efficiency particulate air (HEPA) filters which remove 99.7% of particles from the air.
Image Emirates

Standard operating procedures are an integral part of commercial aviation operations.
AirTeamImages.com/4x6zk-moni shafir

How regularly and how thoroughly an aircraft cabin is cleaned has changed considerably since the outbreak of COVID-19.
Vietnam Airlines

can be a lot of information that a pilot has to be able to remember and manage at the same time. In abnormal situations where a crew is under high pressure, the adherence to SOPs can vastly help to reduce the workload, allowing a pilot more mental headspace to think and enhance their decision-making, leading to a safer outcome.

The SOPs will have been designed on the ground in conjunction with test pilots, aircraft engineers and manufacturers. These will encompass additional requirements from the safety regulators and will be generally further enhanced by the individual airlines or operators.

Vast amounts of time is invested in

designing the SOPs and they usually include solid risk assessments, consideration of commercial viability and a certain amount of legalese in their design.

Human error

Aircraft manufacturing and technical durability are now at an incredibly high standard. The likelihood of an aircraft developing a technical malfunction that leads to a significant or catastrophic outcome is incredibly low. Unfortunately, although these still occur, the evidence overwhelmingly shows that the greatest cause of significant outcomes involves some form of human error. It could be the

engineer certifying an individual aircraft as fit to fly, but mistakenly signing off the wrong technical log before a flight. For example, in the case of Air France flight AF447 in 2009, the widebody was delivering incorrect flight data (technical), but the aircrew were slow to recognise the aircraft had entered a stall and to initiate a recovery (human).

As a result of the AF447 tragedy, in which all 228 on board were killed, safety regulators identified that the simulator training that airline pilots were receiving for handling stall recovery was insufficient. Consequently, many carriers now routinely train their crews to practise these procedures and SOPs



in the simulator. By practising these stall recovery SOPs, if pilots were ever to need to recover from a stall in the future, they should be able to carry out the safe handling drills promptly and safely.

However, there is an entirely new set of threats and risks that have recently emerged, following the SARS-CoV-2 virus outbreak. What and how have airline SOPs changed to manage this?

One of the big concerns regarding transmission is that the virus is transmitted via the air. Most modern aircraft use high efficiency particulate air (HEPA) filters, which have a greater than 99.7% filtration rate and can filter out very small particles, including the virus.

In-flight, the Airbus A320 will entirely replace the air in the cabin every two to three minutes via the HEPA filters.

On the ground, air conditioning is typically supplied either with external ground air or via usage of the auxiliary power unit (APU). The APU is a high-performance engine, typically mounted in the tail of the aircraft, which can supply electrical, hydraulic and pneumatic power and pressure to the aircraft. The APU is also used on the ground to provide heating and air conditioning during boarding. Due to the relatively high noise level of running an APU (typically 85-90db), many airports have restrictions on how long an airline can run the APU before departure. Consequently, the aircrew will typically start the APU no later than ten minutes before pushback.

However, the latest advice from the European Union Aviation Safety Agency (EASA), is that air conditioning systems that use a HEPA filtration system should be run when passengers and crew are on board and certainly the APU should be started not more than 15 minutes after boarding begins.

This will, of course, increase the amount of airport noise and also the financial expense on the operator, as an APU can



CLOCKWISE FROM TOP LEFT: The use of auxiliary power units (APUs) prior to departure has been reconsidered following the coronavirus outbreak.

AirTeamImages.com/Tim de Groot

Increased social distancing needs has meant operator proficiency checks (OPC) and licence proficiency checks (LPC), which would usually be valid for one year, can be extended by up to eight months.

British Airways

Previously, major incidents including the loss of Air France flight 447 on June 1, 2009 have been responded to with changes to standard operating procedures.

AirTeamImages.com/Philippe Noret

To protect pilots from potentially catching COVID-19, it is likely that dispatchers, refuellers and other essential ground personnel will have to communicate with the pilots via the cabin crew instead of directly.

American Airlines

Cabin air is filtered between 15 and 30 times per hour.

AirTeamImages.com/Andrew Hunt



burn around 264lb (120kg) of fuel per hour.

Interestingly, the International Civil Aviation Organization (ICAO) recommends that in-flight, the Environmental Control Systems are operated with packs in NORM mode, rather than HIGH. The previous advice suggested that operators run the in-flight air conditioning at a high flow rate, but evidence now suggests that this does not result in a more efficient air exchange between the HEPA filters and that it is more efficient to run the air conditioning on a normal setting.

The guidance is also to limit the use of passenger individual air supply vents to reduce the amount of air moving up and down the cabin, rather than from ceiling to floor.

Ask any airline pilot how clean their flight deck is, and you will most likely get the same answer and a raised eyebrow expression.

The accumulation of dirt, dust, grime, crumbs and other detritus that typically lingers around, on and between the instrument panels is seldom if ever cleaned. One rare positive to arise from the outbreak of the virus is that operators must now deep clean their cockpits daily. The workspace has probably never been so hygienic and, in addition to daily deep cleans, pilots will clean all touch points at the beginning and end of every work shift.

On board, aircrew cannot increase their distance from colleagues – social distancing – as the cockpit seating position is fixed; pilots will have to decide whether to wear a face mask throughout the duty. The decision needs to be carefully considered, as the prolonged discomfort of wearing a face covering can lead to them being mentally unfocused and distracted.

Communication is vital in a cockpit working environment, not just among cockpit colleagues, but also with air traffic control (ATC), cabin crew and passengers. Wearing a face mask may inhibit the quality of the communications and lead to repetitions being required and so to distractions. Furthermore, in the event of a rapid decompression, pilots must don an

emergency face mask within 15 seconds at high altitude. This can be very disorientating at the best of times; to have to remove a headset, then a paper or lightweight face mask and then don the emergency mask in such a short period of time may lead many pilots to decide that the risks of wearing the mask actually outweigh the risks of not wearing one, and choose not to wear a face covering at all when present in the cockpit.

Cabin crew must wear face masks at all times once on board the aircraft, so delivering 'service with a smile' may be a slogan that needs rewording in the future.

Certainly, one of the most disappointing but unavoidable SOP changes is that the flight deck will be restricted to essential visitors only. This likely means that staff, dispatchers, refuellers and other essential ground personnel will not be allowed to visit the flight deck and will communicate with the aircrew via the cabin instead.

Very disheartening

Unfortunately, pilots will not be allowed to accommodate passenger visitors to the cockpit on the ground for the foreseeable future either. This is very disheartening.

Cockpit visits have always been encouraged by aviators; it may have been a cockpit visit or two that inspired some of us to start flying.

To be able to pass on that experience to the next generations is something we are generally only too happy to do.

The impact of coronavirus has extended beyond the usual cockpit SOP changes. Due to the reduced availability of simulator facilities and licensing personnel, the Civil Aviation Authority (CAA) has issued exemptions to the usual licence expiry dates. Medical licences that were due to expire after March 23 this year can be extended until November 22, 2020, assuming the pilot has not experienced a reduction in medical fitness. The extension also applies to operator proficiency checks (OPC) and licence proficiency checks (LPC), which would usually be valid for one

year and are certified in a simulator, but in this case, can be extended by up to eight months. It may sound like a free pass but aircrew will have to compensate for their delayed training package by increasing their usual amount of self-study at home to remain sharp and focused.

The worry and anxiety many pilots will face when returning to the skies will not be insignificant. A prolonged time away from work means it may take a bit longer to get back into work routines. Added to this is the pressure of COVID-19 and its associated SOP changes, not to mention the ever-present uncertainty over the viability of the airline and future employment status. However, you can take comfort that airline pilots are trained to an exceptionally high professional standard.

Despite all the 'background noise', pressure and stress, pilots are trained to correctly prioritise what is important during all stages of flight. Ultimately, maintaining safety standards to the highest level will be the main aim. If this means now incorporating a new standard of biosafety, then so be it.

The good news is that most of the COVID-19 changes affect the way things are managed on the ground. Once the cockpit door is closed and engines start up, it is more likely be business as usual.

Well, apart from the in-flight service, or lack of it... **AI**



The Argentine Federal Police Aviation Directorate deals with federal crimes across the country, and has one of the most modern helicopter forces in the region, as **Santiago Rivas** reports

Argentina is a federal country, having dedicated police forces for each province. As the capital city, Buenos Aires, was a federal territory until 1994, the government created the *Policía de la Capital* in 1880, which was not only a police force for the city, but also dealt with federal investigations all over the country. In 1943, the force became the *Policía Federal Argentina*, but kept the same responsibilities. While there were some failed attempts to create a police aviation unit, the official Aviation Department was not inaugurated until 1970.

The first airplane was a locally built FMA IA-50 G II for transport, but four MBB Bo-105As were ordered for patrol missions over Buenos Aires. Also, a heliport was built on Demarchi Island in Buenos Aires harbour. From 1978, the Bo-105As were joined by three Bo-105CB-2, with a

Bo-105CBS-4 joining in 1994.

A year later, the fleet was augmented with a BK-117C-1 for medical evacuation duties and an AS-365N2 Dauphin for VIP duties, the latter being transferred to the Coast Guard in 2003.

For the fixed wing fleet, the force purchased a Cessna 500 Citation I transport in 1978, which is still operational today, and sold the G II to the Argentine Air Force in 1981. In 1995, a Cessna P-206C Super Skyline was transferred to the police from the Justice Department, after being confiscated from drug dealers. In 2001, two more confiscated A182L Skylines were donated, although one didn't make it into operation.

Modernisation

Plans to renew the ageing fleet started a decade ago. The Bo-105As and one CB-2 were retired by 2007 and needed replacing, while the remaining fleet of Bo-105s were close to the end of their operational life. In 2009, the first steps were taken with the purchase

of a Eurocopter EC-135T-2+, followed by two more in 2011 and 2014, and an EC-145T-2 was bought in 2013, along with another in 2015.

In the meantime, Buenos Aires changed from being a federal district to become an autonomous city in 1994, with a status similar to a province. At that time, the Federal Police was mainly divided into two areas, one in charge of the security of the city and the other focused on federal crimes, such as drug and people trafficking, kidnappings, environmental and economic crimes, interruption of communications, transport offences and terrorism.

The Buenos Aires local government petitioned to take sole charge of the security of the city, but the federal authorities opposed this, so instead the Metropolitan Police was created, beginning operations in 2010.

When the Argentinian government changed in 2015, the new president, Mauricio Macri, authorised the policing of the capital to be handed to the city authorities. In 2017, the *Policía de la Ciudad* (City's Police) was created, merging the Metropolitan Police with the relevant departments of the Federal Police, which included almost all the police stations in Buenos Aires and most of the personnel. The Federal Police remained a force dedicated only to investigating and combating national crimes, much like the FBI in the US.

As the new city force also



wanted to have its own aviation fleet, the last two operational Bo-105s were transferred to them, as well as one of the EC-135s, while the other Bo-105 was retired and, in early December 2019, was donated to the National Aviation Museum.

To replace the retired helicopters, two new machines were delivered in September 2018: an Airbus H-145D-2 and H-155B-1. The latter is dedicated to presidential flights and has a unique white colour scheme.

Organisation

Comisario Mayor Cayetano Burzi, commander of the Federal Police Aviation Direction, is currently the head of the entire aviation force and explained how they are organised: "It's an autonomous [division] that answers directly



ighting criminals all over Argentina

to the second commander of the Federal Police. It has three departments: an aircraft one based in Ezeiza, a helicopter one that is in charge of purely police operations and a transport department that is [used by] the presidential or state authorities." For this last mission they use the H-155 and one of the EC-145s.

The Direction also encompasses the Police Aviation School, equipped with a Frasca 142 fixed-wing simulator and Cicaré SVH-3 and SVH-4 simulators, which are basically a helicopter attached to the ground by a base, making it possible for new pilots to learn the basics of rotorcraft flying without risk. The SVH-3 was acquired in the 1990s, while the much-improved SVH-4 is on loan from the civil aviation

authority. For flight training, a Robinson R-44 was delivered by the Justice Department in July 2019.

Currently, the Helicopter Department of the Air Operations Division operates the BK-117, two EC-135s, the EC-145 and the H-145, all for multi-purpose tasks. It's divided into the Metropolitan Operations Section for missions in Buenos Aires, and the Interior Operations Section for flights over the rest of the country, but they have no aircraft assigned to them. Also, the department has the command of the heliport in Buenos Aires and the Helicopter Maintenance Division.

The Aircraft Department is based at Ezeiza International Airport in the suburbs of Buenos Aires, and the Airplanes Air Operations Division has

the Citation, the Cessna 206, the Cessna A182L Skylines used for training, a Beech Baron recently delivered and for training on twin engine operations and light transport, and on 29 October 2019 arrived to their base in Ezeiza a DHC-6-400 Twin Otter, the first plane purchased new since the Citation more than forty years ago. Also, they expect to receive a single Diamond DA-42 that belonged to the Army, which will be equipped with a Fixview FV-300 sensor turret for surveillance missions and new engines. The Department also has a maintenance division with a security and services section.

All the training is done by them, from personnel selected from their police schools, the pilots coming from the officers' school and the mechanics [▶](#)

CLOCKWISE FROM ABOVE: The H145 meant a big improvement for the force in terms of technology. As with the other EC145 it's used for a wide variety of missions, including patrol, transport, medical evacuation and firefighting.

All images Santiago Rivas

The old Cessna Citation of the force is mainly used to carry prisoners across the country.

The new Twin Otter is the main acquisition on the fixed wing area in 40 years, received in 2019, boosting considerably the transport capacity of the force, now that they are increasing their operations across the country.



equipped with a Leo Cassidian Ultra Force 350 camera and a Trakka-Beam A800 searchlight. When they operate with the camera, they carry a communications officer from the Federal Communications Prefecture as a crew member on the rear cabin. Those officers are also based at the heliport and operate a squadron with drones for security on public activities, a mission carried out with helicopters in the past.

The Airbus H-145D-2 meant a big step for the force, with more power, better performance, a four-axis autopilot, radar, Helionix avionics and other improvements. For them, one of the main advantages is that they can take off vertically with full load and fuel, which is very important for operations on confined areas as is a city.

Against drug trafficking, they recently took part on two big operations, one near the city of Paraná and one near Córdoba, in coordination with the GEOF, against drug carrying aircraft. For almost three months, they were working to detect where the planes landed to leave the drugs and catch them when they were on the ground. At Córdoba they operated from the Military Aviation School of the

from that of the petty officers.

After a short training and flying the Cicaré and Frasca simulators, they are divided into helicopter or airplane pilots. Then, all are prepared as private helicopter or airplane pilots with the Coast Guard and, once back at the force, the fixed wing pilots continue training to receive the commercial pilot licence flying the Cessna A182 and the Baron. The helicopter pilots make a short training with the Robinson R-44 before converting to the other models.

Missions

With the changes on the organisation of the force, after they lost the mission of protecting Buenos Aires, the aviation focused on operations all over the country, mainly to support the ground forces. "What once served for ordinary security missions disappeared, such as demonstrations and football matches" explains Burzi.

"However, we continue with some functions, such as the security over railway lines, which are federal territory. In drug operations, intelligence missions are done, the helicopter goes with the camera, the place is filmed and the operation is planned for entry of the ground forces."

An expansion is being made inside the country and there is the idea of making a base in the city of Tucumán, northwest Argentina, but currently they deploy all over the country. For that they have a ground support team including two

trailers with 1,800lt tank for JP-1 fuel. "In cities like Rosario we operate a lot, against drug trafficking" tells Burzi about the second largest city in the country, where there's a lot of activity of traffickers, mainly because it is the main harbour of Argentina.

In addition, helicopters are widely used to carry special groups, mainly of the GEOF (Grupo Especial de Operaciones

with a Carl Zeiss Optronics/ Leo III HD camera, with a diurnal camera with 80x zoom, one with fixed lens, a medium band infrared camera, a laser pointer, a laser illuminator and a rangefinder. The camera can work with the Boeing Spectrolab Nightsun SX-16/IR as slave, able to operate on IR mode when the camera is on the same mode, making it impossible to see the light



CLOCKWISE FROM LEFT: Screen of the Carl Zeiss Optronics/ Leo III HD installed on an EC135. The helicopters of the force operate regularly all-day round on all kind of missions. During the COVID-19 emergency they perform patrol operations over the main cities of the country.

The H145 of the Federal Police flying over their main heliport in the harbour of Buenos Aires.

One of the EC145s of the force flying over Buenos Aires harbour. The force has two of the type, with the other painted in white and used for VIP flights.

The force still uses its single BK117 for medical evacuation, mainly in the city of Buenos Aires. They also have an EC135 dedicated for this mission.

The force received in 2019 a Robinson R-44 that was confiscated, for use on training.

Federales, Federal Operations Special Group) for raids, which can include their deployment using fast rope or rappel or as a platform for snipers. They also take part after the operations carrying the personnel for the scientific police to perform investigations.

Subcomisario Leandro Bardi, in charge of the Helicopter Department, explains that they also support the ground operations with one of the EC-135 especially configured

from the ground.

As the EC-135 and H-145 are compatible with NVG, they can use the IR filter when they operate with them.

The rangefinder can determine the position, distance and heading of the point selected with the camera, and transmit the images to the Police Central Department. Also, they have trucks to relay via satellite the information if the helicopters are deployed far from Buenos Aires.

The new H-145D-2 is

Argentine Air Force, waiting for the information about the landing of the aircraft. Once they get it, they took off with two snipers, reached the landing zone, but the drug traffickers attempted to escape on a pick-up trucks. Seven members of the GEOF boarded the helicopters and landed in front of the truck with the snipers aiming at the occupants, which were arrested.

On special operations, sometimes the white EC-145 is used for surveillance and for insertion of GEOF members, as occurred on December 2015, when they infiltrate commandos near the small town of Franck, in Santa Fe province, during the chase of three criminals that had escaped from jail. During that operation, the commandos were protected by two snipers deployed before by one Bo-105CBS and the area was being monitored by the EC-135 equipped with the camera. Another Bo-105CBS and EC-135, as well as the other EC-145 were used on the operation to transport the criminals once they were captured.

During the G-20 summit in Buenos Aires on December 2018, they not only operated with their own forces but also



together with other security organisations and collaborated with forces from other participant countries, especially with the US Secret Service, which used them for vigilance.

To the rescue

Medical evacuation of police personnel is among one of their most important missions and on 1 November 1999 was created the Police Medical Air Unit, despite they were performing such missions since long before. They have a helicopter permanently on alert to perform rescues over Buenos Aires and its suburbs,

but in some cases, they also make them in other parts of the country. The operations centre of the police is the one that receives the request for a rescue and they immediately inform the crew in alert, which comprises a pilot, a mechanic, a doctor and a nurse.

As they have to land in any place of the city, this is not easy and constantly they perform surveys to inspect the potential landing areas and check that those already in use were not altered with obstacles. In downtown Buenos Aires, most hospitals don't have heliport, making things difficult, but on the suburbs, as most hospitals are new, they have facilities. In any case, usually the flight from any part of downtown Buenos Aires to the Police Hospital or those that have a heliport is less than five minutes.

The BK-117 is mainly used for that mission but replaced by one of the EC-135 when it's in maintenance. Anyway, all the others could be used too, receiving the dedicated equipment in less than 40 minutes.

They too operate with the BEFER (Brigada Especial Federal de Rescate, Rescue Federal Special Brigade) and the Federal Police Firemen, on rescue missions and supporting firefighting. For all the fleet they have different models of rescue cranes too. On 2019 they recovered the firefighting capabilities, using Bambi Buckets, while they also trained on the deployment of firefighters. They had the buckets since 2014, but until now they were added to the National Fire Management

Service once they were fully trained for the missions. Usually, Argentina has forest fires on the Patagonian Andes and the hills of Cordoba province, but also in some other areas of the country.

Fixed wing

The fixed wing department is mainly dedicated to transport personnel, cargo or convicts, but with the new Twin Otter they expect to increase their capacity, especially when they need to deploy special forces to a city across the country. Also, will be equipped in the near future with a water tank of 1,900lt for firefighting missions, being the first Twin Otter to be equipped with that, de-icing and oxygen equipment.

All aircraft operates within the ANAC (the Argentine Civil Aviation authority) regulations in what are ratings and certifications, while their workshop is certified by them. "All maintenance is done by us, except for some issues that are sent to other workshops," explains Burzi.

For the future, the force is planning to open more bases in other cities across the country to expand their operations on an easier way. With the expected arrival of the Diamond DA-42, maybe in 2020, they will increase considerably their surveillance capacities, while the new Twin Otter is bringing better capacities on a wide range of missions. On the helicopter area, no purchases are expected for the short term, but they are considering adding more H-145D-2s. **AI**



An Australian Army Air Corps (AAAC) S-70A-9 Black Hawk is prepped before departing Shoalwater Bay Military Training Area, Queensland, during Exercise Talisman Saber in 2007. The AAAC still uses the platform in a supportive role for special operation assignments. Commonwealth of Australia - Department of Defence/Cpl Michael Davis



The Australian Defence Force is seeking a new light helicopter to support special forces operations under its Project LAND 2097 Phase 4 programme. **Khalem Chapman** looks at the contenders

To recapitalise its special operations fleet, the Australian Defence Force (ADF) is looking to procure up to 16 proven commercial- or military-off-the-shelf (COTS/MOTS) light helicopters as part of its Project LAND 2097

Phase 4 programme. The aircraft will augment the Australian Army Air Corps' (AAAC's) NHIndustries MRH-90 Taipan fleet in replacing its Sikorsky S-70A-9 Black Hawks.

The Black Hawk has been in service since 1988 and *AirForces Intelligence* data shows that, as of June 29, 32 examples remain with the

AAAC. These are employed by the 6th Aviation Regiment (171st/173rd Aviation Squadron), which is headquartered at Holsworthy Barracks, New South Wales, with a detachment at the Oakey Army Aviation Centre in Queensland.

Australia launched Project LAND 2097 Phase 4 in October 2018, when it issued a request

for information (RFI) for the new light helicopter. The RFI outlined a number of requirements for the platform, which will "enhance the [ADF's] special operations aviation capability." They will be used to perform domestic/ maritime counterterrorism, combat search and rescue (CSAR) and special forces insertion/extraction missions.



al Ops

on the hunt

It adds that the aircraft must be able to operate in dense urban environments and be “fitted with simple, proven intelligence, surveillance and reconnaissance (ISR) equipment and weapons systems.” The selected aircraft will be in the four-tonne (4.4 US ton) weight range and must be capable of being

rapidly deployed four at a time by a single Boeing C-17A Globemaster III heavy-lift strategic transport.

The ADF is scheduled to issue a formal request for tender by the end of this year. Final selection is expected in late 2021 and first deliveries in 2022, with a planned entry-into-service date in 2023.

The ADF has outlined that a capability extension – which could include the procurement of additional aircraft, munitions and equipment – may take place later in the decade.

A number of defence contractors, including Airbus, Babcock Australia and Hawker Pacific, have announced plans to contend for the contract.

An H145M solution

In March 2019, Airbus Australia Pacific’s managing director, Andrew Mathewson, confirmed that the company was submitting its militarised H145M light utility helicopter to the competition: “The Airbus H145M helicopter is the military version of the H145 – the most advanced member of [the company’s] multi-purpose twin-engine category. It is based on a [COTS] platform with military-specific modifications and is an operationally proven, affordable and low-risk option for Australia.”

As part of its offer, Airbus will work with selected industry partners and will provide “training, maintenance, logistics and engineering activities,” Mathewson added. “A comprehensive transfer of technology and skills will make Airbus Australia Pacific a regional centre able to proactively support Australian operational needs and export this knowledge back into the wider H145M community.”

On July 10, 2020, Airbus announced the formation of Team Nightjar, a consortium of more than 20 Australian-based industry partners, to propose the H145M to the ADF. This team includes QinetiQ Australia, Safran Helicopter Engines Australia and Kratos Australia. According to Airbus, Team Nightjar’s proposal will help generate more than AU\$250m of economic benefits and create more than 170 jobs.

“We recognise the importance of working with Australian companies on this programme, with each partner offering niche capabilities to the Commonwealth” said Mathewson. “Building on our established commitment to Australian industry, Team Nightjar will have a strong focus on Australian industrial support and innovation.”

Described as “modern and versatile” by the company, the H145M is a proven multi-mission capable platform, capable of conducting light attack, ISR, maritime security, troop/equipment transport, medical evacuation (medevac) and general utility tasks. Its high rotor clearance and shrouded Fenestron





anti-torque tail rotor allow it to operate closer to obstacles in comparison to traditional helicopters designs, an aspect that will be beneficial for operations in urban environments. Airbus claims the H145M offers "excellent access and cabin space" combined with "high availability; reliable and robust systems; a small logistic footprint" and is "proven by operations in similar [configurations], roles and environments."

The H145M features Airbus' Helionix avionics suite and comes with a variety of mission equipment packages (MEPs), including hoists, fast rope systems and cargo hooks, that can be fitted and removed rapidly. It will also come equipped with the company's HForce weapon system, which

comprises a range of air-to-air, air-to-ground and air-to-surface munitions, along with ballistics and guided axial armaments.

It is powered by two Turbomeca Arriel 2E turboshaft engines with dual-channel full authority digital engine control (FADEC), a computer-managed control system that manages the powerplant's performance digitally to reduce pilot workload, enhance in-flight safety and lower operating costs, while increasing performance and optimising fuel efficiency.

The platform requires two pilots and can carry up to ten passengers. At its maximum take-off weight (MTOW) of 8,378lb (3,800kg), the H145M has a cruising speed of 240mph (149km/h). It has a range of 397 miles (639km) and an endurance

of three-and-a-half hours when using its standard fuel tanks.

Airbus says the H145M is well suited for special operations missions because "teams can quickly access t its spacious cabin, which has two large sliding side doors and double clamshell doors at the rear."

The H145M has grown in demand in recent years, having entered operational service with the German Air Force, Hungarian Air Force and Luxembourg Armed Forces. The type has also been ordered by the Ecuadorian Air Force.

Bell's big presence

Bell has not directly offered a platform for the contract, but has teamed up with two Australian-based companies that have selected its products to pitch. Babcock Australia and

Hawker Pacific have submitted a militarised variant of Bell's 429 GlobalRanger, with Hawker Pacific also offering the 407 GXi.

Babcock Australia announced that it had downselected the GlobalRanger as its bidding platform on May 28. The company stated that it opted for the helicopter after it had "completed a comprehensive assessment of the platforms available in order to provide the most capable, low-risk solution."

Graeme Naylor, managing director of Land at Babcock Australia, said: "The Bell 429 has a relatively new paramilitary design, with high levels of safety, role flexibility and performance that will meet the demands of [the] Australian Special Forces... Working together, Babcock and Bell draw on a global track record of successful helicopter operations to deliver a trusted solution."

Hawker Pacific selected the Bell 429 and 407 GXi for its bid last summer, before launching an Industry Capability Network (ICN) Gateway, which sought additional industry partners and suppliers for its campaign.

Managing director of Bell's Asia Pacific region, David Sale, said: "Bell is in a strong position to offer reliable, cost-effective global support for the ongoing maintenance and sustainment of the ADF's special operations helicopter fleet.

"The Bell 429 is rugged and reliable. It is operationally robust and favoured by pilots and crew throughout the world, with more than 330 aircraft exceeding 330,000 hours of operation... With an open architecture system and global support in place, the [platform] has the capacity to perform consistently and adapt rapidly to new technologies and evolving requirements."

The platform employs Bell's BasiX-ProTM avionics system, a fully integrated glass cockpit with four high-resolution LCD multi-function displays (MFD) that offer improved situational awareness. At its maximum gross weight (MGW), the helicopter can reach speeds of up to 172mph (278km/h), has a range of 473 miles (761km), an endurance of four-and-a-half hours and a service ceiling of 20,000ft (6,096m). The GlobalRanger





CLOCKWISE FROM TOP LEFT: Australia has previously operated the 429 GlobalRanger in a military role, serving as a training helicopter for the Royal Australian Navy (RAN) until April 2019. Its selection under the Project LAND 2097 Phase 4 programme would see the type make a return to the ADF.

Commonwealth of Australia – Department of Defence/Cpl David Said

The Airbus H145M offer includes the company's HForce weapons package, which provides guided and unguided munitions, such as air-to-air/ground missiles, laser-guided rockets, a 20mm cannon, 68 and 70mm unguided rockets and a 12.7mm machine gun.

Image Airbus

Bell says the 407 GXi is "proven and powerful", sharing lineage with the company's OH-58 Kiowa family, which has been a hugely successful platform with air arms across the world, including the US Army.

Image Bell

A glimpse of the future? Bell's 429 GlobalRanger, registration YH-MJI (c/n 57043), has been painted in ADF colours as Babcock Australia pushes to win the Project LAND 2097 contract.

Image Babcock

only requires a single pilot and has the capacity to carry up to seven people.

The Royal Australian Navy (RAN) operated four GlobalRangers under lease from Raytheon Australia until April 18, 2019. In RAN service, the aircraft were employed by 723 Squadron and used as training platforms.

Hawker Pacific is also offering the Bell 407 GXi, which is much smaller in size in comparison with the GlobalRanger. The platform features Garmin's G1000H NXi integrated flight deck, which employs synthetic vision technology and its Helicopter Terrain Awareness and Warning System (HTAWS). This comes with two high-resolution LED screens and offers optional night-vision goggles (NVGs) and forward-looking infrared (FLIR) compatibility. It is powered by a single Rolls-Royce M250-C47E/4 turboshaft engine with dual-channel FADEC.

At its MGW, the helicopter has a cruising speed of up to 153mph (246km/h), a range of 389 miles (624km), an endurance of four hours and a service ceiling of 18,690ft (5,697m). The platform also employs a cargo hook, which is capable of carrying

a 3,100lb (1,406kg) payload. As with the 429, the 407 GXi requires a single pilot to operate and has the capacity to carry up to six passengers.

While both platforms fit the requirements of the programme, the GlobalRanger is larger, more flexible and offers greater performance characteristics compared with the 407 GXi, which may work in its favour as the campaign progresses. Whatever the case, Bell is in a strong position, given that two contending contractors have offered its products to fulfil the ADF's requirements.

Other contenders

Leonardo Helicopters and MD Helicopters (MDHI) have platforms that fit the Australian requirements but have yet to formally announce their intentions to participate in the competition. Both firms declined to comment on the programme and their plans surrounding it when approached by *AIR International*.

In May 2019, Boeing said that it would offer its AH-6i Little Bird light attack/observation helicopter. However, these intentions have since changed. "After careful review of the Australian

Army's requirements for its Special Operations Helicopter replacement [programme], the Boeing Company has decided not to bid the AH-6 Little Bird for this project," a company spokesperson told *AI*. "Boeing is currently talking with a number of other international customers [who are] interested in the capabilities and technologies the AH-6 has to offer. These

include countries in the Asia Pacific region, Middle East and Europe."

As Project LAND 2097 continues to develop ahead of the formal request for tender, only time will tell whether Leonardo and MDHI will submit proposals. If not, the competition will continue to be a two-horse race between Airbus and Bell. **AI**





Technology pushes design boundaries



“Companies will come up with an idea and the regulators say ‘No, you can’t do that.’ We don’t have that issue because our team of designers is so skilled and we’ve been doing it for so long that we know what works and what doesn’t.”

Nigel Goode,
co-founder of PriestmanGoode

CLOCKWISE FROM OPPOSITE: PriestmanGoode has an extensive customer base within the aviation industry. Image PriestmanGoode

One of the Qatar Airways’ Q-Suite products is referred to as ‘the quad’. Using movable panels, this design can transform into a social space for business workers or a group of family members. Qatar Airways

Qatar Airways’ Q-Suites have been introduced on certain types. Before the onset of COVID-19, it had installed them on all of its Airbus A350-1000s and Boeing 787-9s in addition to some A350-900s, 777-200LRs and 777-300ERs. AirTeamImages.com/John Kilmer

Airlines and aircraft manufacturers alike rely on technology and design to propel themselves ahead of the competition. **Lee Cross** speaks with **Nigel Goode**, co-founder of PriestmanGoode, to discuss how COVID-19 may herald a change in work practices.

PriestmanGoode is a name that may not be familiar, but it’s a fair bet that most airline travellers will have come into contact with the design agency’s products in some form. With an extensive list of aviation clients, the company has been at the forefront of the industry for branding and design for many years. We caught up with Nigel Goode, co-founder of the London-based firm, from his home during the COVID-19 lockdown.

PriestmanGoode’s initial contract in the aviation sector began in the late 1990s after winning a pitch to create a lie-flat seat for Virgin Atlantic’s new Upper Class cabin. This marked the start of carriers using design as a competitive advantage, as Goode explained: “When we entered the aviation market there had been stagnation for so long. But Virgin [Atlantic] was trying to change this and get ahead of their rivals. Our work with them... well, there was

nothing out there quite like it and it was received really well.”

Buoyed by this success, the company was approached by Airbus to create a “concept model for their A380 full size mock-up.” It was a major project where they had free rein to create a totally new design for an aircraft that was set to revolutionise the passenger experience. “We then started to pick up work with Lufthansa and Malaysia Airlines and built a rapport with various other carriers, [from which] it’s grown organically.”

The whole design process from a creative idea to the finished product can take several years: “We get involved early on. There are various ‘milestone’ meetings which begin with the Initial Technical Meeting [ITM], where everyone starts the process. Then there’s the Provisional Design Review [PDR], followed by the Critical Design Review [CDR]. We then have our first article inspection to check the finished product before delivering

it to the company. There are these key milestones you work towards and we do not move on until each one is completed.”

Design certification

Each new design and product that PriestmanGoode creates must be certified by the relevant authorities, which Goode describes as “a bit of a headache.” “Certification is always evolving and that can be challenging,” he said. “You can start a programme and then [suddenly] something is passed and so you have to adhere to a new rule that can change everything.”

One such challenging certification process was for the award-winning Qatar Airways Q-Suite, introduced in 2017: “The Q-Suite is part of a trend we are seeing towards [a] more fully enclosed private cabin – great for the passenger but a nightmare for authorities. We had a lot of twists and turns with that to get it certified, due to the addition of doors and privacy panels which, of



course, could impede an evacuation. It's such a specialist area and there are so many regulations.

"Companies will come up with an idea and the regulators say 'No, you can't do that.' We don't have that issue because our team of designers is so skilled, and we've been doing it for so long, that we know what works and what doesn't and this builds confidence in our services."

This expertise led Brazilian manufacturer Embraer to employ PriestmanGoode's services when creating their next-generation family of E2 aircraft: "Working with Embraer was a great opportunity for us. It's a regional jet and so it's small, but it was also a brand-new type, so we were able to look at the whole structure from overhead lockers

to lavatories, galleys and bespoke fittings."

Collaborating with the aerospace manufacturers' in-house engineering team, both parties wanted to create a sense of space in the cabin: "If we take the overhead bins, for example, usually when you board an aircraft they're all open and it can feel very restricted as you walk through the cabin. But with the E2 we were able to redesign it so that when they're open, they give the appearance of being part of the ceiling. Combined with new lighting, it gives the feeling of so much more space."

It's not just aircraft interiors or airline seats that the consultancy creates, as Goode explained: "What has been good for us is that we have moved on from doing just internal bits on board to encompassing the whole passenger journey, as seen with

our projects with United [Airlines] and, more recently, Aegean Airlines, where we worked on the branding, livery, cabin products and inflight service.

"We try and make air travel as stress-free as possible by introducing familiarity. We like to focus on the complete journey. From leaving home to the airport experience, boarding, in-flight service and arriving at your destination. It makes everything seem more cohesive, more together, giving a much better experience to passengers. We like to look at the bigger picture and there are not many companies that do that. One will focus on branding, another looks at interiors, detailing and so on. But we can span the complete area and that is definitely the future. It makes sense and I'm proud of our work with that."

Environmental concerns

One of the big talking points recently has been how to make aviation more environmentally friendly. Spurred on by the UK government's pledge to ban all single-use plastics by next year, Goode and his team have focused on how to reduce onboard waste, of which an estimated 6.2m tons (5.7m tonnes) is generated each year. Goode observed that "everyone was talking about it, but no one had actually joined up the dots."

Get Onboard: Reduce Reuse Rethink



"I feel that a lot of the things that are going to come out of this crisis would probably have come anyway – coronavirus has just accelerated this change."

Nigel Goode, co-founder of PriestmanGoode



was the name of an exhibition created last year by PriestmanGoode for the Design Museum in London to raise awareness of waste in air travel. The company developed a selection of compostable meal trays made from sustainable materials such as banana skins and coffee grounds, plus multifunctional pieces of cutlery and soluble capsules to replace the plastic pots usually holding milk or juice.

"There has been a big push in this area," said Goode. "We showed lots of airlines round the exhibition and have had a tremendous response. The [ones] we spoke to really want to move this way. But there are so many restrictions around aviation that it is going to take time. It's early days but we're very excited by it."

Goode noted that there is much scope for sustainability within aviation, not just from on board waste: "Many people forget that a lot of materials that make up an aircraft



CLOCKWISE FROM TOP LEFT:

Crawley-based Virgin Atlantic was the first airline to recruit PriestmanGoode in the 1990s.

AirTeamImages.com/The Samba Collection

PriestmanGoode has played a pivotal role in the rebranding of Athens-based Aegean Airlines. This included designing a new logo, livery, digital products, cabin interiors, amenity kits and meal services.

Image PriestmanGoode

Despite COVID-19 bringing the industry to its knees, Goode says PriestmanGoode has been resilient and continues to work on many design contracts.

Image PriestmanGoode

The firm has created a series of compostable meal trays to reduce the use of waste and reliance on single-use plastics.

Image PriestmanGoode

PriestmanGoode's products have not just been limited to airlines, as it has also worked with aircraft manufacturers, including Embraer to give a sense of space on its new E2 jets.

Image Embraer

Nigel Goode has suggested that COVID-19 may accelerate the use of touch-free technology to reduce contact with surfaces "which are full of germs".

United Airlines

are from recycled aluminium. But we want to push this further, rethinking seats, rethinking galleys. What are they made of? What could they be made of? What could they look like?"

Enter coronavirus

The COVID-19 pandemic has threatened the aviation industry like no other crisis before it. Thankfully, work for the PriestmanGoode team has continued: "A lot of airlines we are working with are still pushing ahead with their programmes. Aircraft orders happen a few years in advance, so we are in the middle of [several] projects which started before the [outbreak]. Hopefully by the time these are [online], coronavirus will be a long and distant memory."

This optimistic view doesn't change the fact that the pandemic will have a massive impact on air travel, so Goode and his team are looking ahead to see how they can help the industry adapt: "At the moment, everyone is thinking about short-term measures to rebuild passenger confidence. But I feel that a lot of the things that are going to come out of this crisis would probably have come anyway - coronavirus has just accelerated this change. For example, being a little more segregated on board [is] already happening in the premium classes and now I can see how we will have to think of ways to adapt economy, to change it up. It's how we can adapt our products now to fit this 'new normal.'"

Fast-thinking future

So what does Goode think the future holds for aviation design? "I can see a lot more touch-free technology being introduced. We're already looking at using your phone to control seat settings or inflight entertainment screens, to avoid having to use touch screens which are full of germs. Change was already in the air. Where are first and business class going? Where are premium economy and economy going? How can we further improve certain areas on board an aircraft, such as the galley? There is massive scope and aviation is such

a great industry to work in. It is so exciting and we have been lucky to work on some amazing projects. Long may it continue."

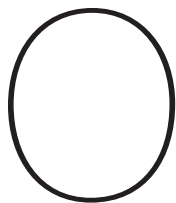
While the pandemic continues to cripple the aviation industry, Goode has echoed a sense of confidence about the future of air travel: "People enjoy travelling, so the demand will always be there. I think we were already entering a new phase, with a new wave of products and new ways of doing things on the horizon. It's a case now of making sure airlines understand that while they are trying to survive they need to be thinking about the future." **AI**





To be or not to Be-200?

The Russian Navy has just received its first BE-200 amphibious craft. **Piotr Butowski** explores its chequered history and considers how it will be used



On July 14, 2020, the first Be-200ChS amphibious aircraft built for the Russian Navy

was officially handed over to the 859th Combat Training and Flight Crew Conversion Centre at

Yeysk on the Black Sea.

Previously only civil rescue and fire services have used the Be-200, so what is the navy doing with it?

The Be-200 evolved from a different aircraft. In the 1980s, the Beriev design bureau of Taganrog developed a heavy, 76 tonnes (84.6 tons) military

amphibian A-40 (NATO reporting name Mermaid), intended for anti-submarine warfare in the ocean zone.

The first of two prototypes made its maiden flight on 8 December 1986, and it proved to have good aerodynamic qualities, which is rare in amphibians. The A-40's

lift-to-drag ratio at Mach 0.55 (typical patrol flight velocity) was 16, making it similar to land-based aircraft, and significantly better than other amphibious aircraft, such as the Be-12 at 12.7, and the PS-1 Shin Maiwa at 11.0.

During Mikhail Gorbachev's period of openness (perestroika), Russia offered the A-40 as a civilian aircraft (it was shown at the Paris Air Show in 1991), but it soon became obvious that there were no civilian customers for such a large amphibian.

The company then decided to duplicate the A-40's configuration in the form of a civilian aircraft that would weigh half as much, so in 1990 the A-200, later designated as the Be-200, project was created.



CLOCKWISE FROM THIS IMAGE:
A BE-200 flies alongside a Beriev A-40
(numbered 20). The A-40 has the
same configuration as the BE-200.
All photos Piotr Butowski

A BE-200 leaves the water using a
boat ramp. Truly amphibious.

A BE-200 ChS makes its way to
land with its front hatch open.



A small A-200 model was shown at Le Bourget in 1991 and a year later a full-size mock-up was made in Taganrog.

Birth thanks to Irkut

The project was ready to roll, but there was no money for its implementation. Moreover, at that time, Beriev design bureau was in conflict with its neighbour, Taganrog Aviation, which would have been the obvious choice for building any aircraft they had developed. Today, it is all one Beriev company.

Meanwhile, Irkutsk Aviation Production Association (IAPO) – today's Irkut Corporation and one of the few profitable aviation industry companies in Russia – was operating in Irkutsk on

Lake Baikal. Although it was 2,500 nautical miles (4,600km) away, IAPO had cash earned from export deliveries of Su-27UB and Su-30 fighters and it wanted to diversify production. It was seeking a civilian product and, tempted by positive predictions for the Be-200 market, Irkut became involved.

That's the only reason the Be-200 exists today.

On September 24, 1998 at 4:50 pm, the first Be-200 made its 27-minute maiden flight in Irkutsk, piloted by Konstantin Babich with the help of co-pilot Vladimir Dubenskiy, and onboard engineer Alexander Ternovoy.

Earlier, the plant had made two

non-flying prototypes. In March 1995, an airframe for static tests was transported from Irkutsk to Taganrog on board an An-124; in 1997 it was followed by another airframe for fatigue testing.

Firefighter

The Be-200's first role was firefighting. A plague of





Beriev Be-200ChS Specification.

Dimensions	
Wing span	32.78m (107ft 7in)
Length	32.05 m (105ft 2in)
Height	8.90 m (29ft 2in)
Wing area	11744 m ² (1,264 sq ft)
Cabin volume	80.8 m ³ (2,853 cu ft)
Weights	
Maximum flight weight (after water scooping)	43,000 kg (94,799lb)
Maximum take-off weight from land	41,000 kg (90,390lb)
Maximum take-off weight from water	37,900 kg (83,555lb)
Maximum landing weight, on land	35,000 kg (77,162lb)
Maximum landing weight, on water	37,900 kg (83,555lb)
Empty operating	28,500 kg (62,832lb)
Maximum fuel	12,500 kg (27,558lb)
Payload	5,000 kg (11,023lb)
Performance	
Maximum cruise speed at 8,000 m	378kts (700km/h)
Economic cruise speed at 8,000 m	297kts (550km/h)
Take-off distance to 10.7m (35ft), from land	1,400m (4,593ft)
Take-off distance to 10.7m (35ft), from water	1,400m (4,593ft)
Landing distance to land, from 10.7m (35ft)	750m (2,461ft)
Landing distance to water, from 10.7m (35ft)	1,400m (4,593ft)
Maximum wave height	1.2m (4ft)
Required water depth	2.6m (8ft 6in)
Service ceiling	8,100m (26,575ft)
Range with 5,000kg (11,023lb) payload, 1 hour reserve	837nm (1,550km)
Range with maximum fuel, 1 hour reserve	1,701nm (3,150km)

forest fires regularly affects Russia, Siberia and the far eastern regions and, while there are many water reservoirs here, there are few airports and roads. On December 8, 1990, the Soviet government adopted a resolution to create a special amphibious aircraft to extinguish fires and this officially began the Be-200 project. In August 1996, Beriev converted an old military Be-12 amphibian into a Be-12P-200 experimental aircraft, which tested a new water-filling system, practised firefighting tactics and prepared pilots for future Be-200s.

The Be-200 holds 10.8 tonnes (12 tons) of water in eight tanks under the cabin floor, as well as 1,200 litres of a foam-generating agent in six tanks along the sides of the hold. The entire load can be dropped as a single salvo within one second through doors in the hull. Water can be loaded either while static at an air base or on a lake while travelling at speeds of up to 103kts, 190km/h – an H₂O touch-and-go. Using the latter technique, the Be-200 can scoop up to 12 tonnes (13 tons) of water in 14 seconds.

However, the concept was much broader. In addition to fighting fires, the Be-200 was to be a full-fledged 72-seat regional passenger jet aircraft, able to carry cargo and perform patrol and rescue operations. Therefore, its fuselage was divided into

an upper part constituting a hermetic compartment measuring 18.7m x 2.5m x 1.9m (61ft 4in x 8ft 2in x 6ft 3in) and a non-hermetic lower part, where water tanks were located.

The aircraft is powered by two Ukrainian Ivchenko D-436TP turboprop engines with 16,535lb/ft (73.6kN) of thrust, providing a cruising speed of 378kts (700km/h).

Be-200 avionics

The Be-200 utilises Allied Signal avionics, integrated by the Russian NIIAO Institute within the ARIA-200M system (American-Russian Integrated Avionics). It includes NSI-2000MT inertial navigation, combined with a Glonass/GPS receiver, ARK-32 radio direction finder, A-053 radio altimeter and other devices. The aircraft has Ukrainian-made Buran-A200 (early models from Irkutsk) or Russian Kontur 200-A813Ts (later planes from Taganrog) weather radar. The 'glass' cockpit is fitted with six 6 x 8in (152 x 203mm) multifunction displays. Communication devices include two Orlan-85ST UHF and one Prima-400 HF radios, as well as Prima-DMV-1B UHF/VHF radio for communication with ships.

The modern fly-by-wire EDSU-200 control system was created in Moscow MNPk Avionika. The only version that is produced is the

ABOVE: A BE-200 in 'firefighting mode' drops Russian flag-coloured water on a demonstration flight.

BELOW: The BE-200 can scoop up 12 tonnes of water in 14 seconds! It then releases it from these belly tanks in the fuselage.



Be-200ChS (Chrezvychainykh Situatsiy, emergency situations; izdeliye A-201), a combination of firefighting and search-rescue aircraft capable of carrying up to 43 passengers. It features a gyro-stabilised, electro-optical search turret (Israeli IAI/Tamam Division AOS in Irkutsk aircraft or NPO Karat Lanner-M in Taganrog aircraft) mounted under the port wing and a multifunction indicator and video display at the observer's position in the aircraft cabin, as well as a data-recording system. The aircraft also has an SX-5 Starburst searchlight and SGU-600 loudspeaker system. Workstations for two observers are located in the cargo cabin, equipped with blisters for visual searches. An Orion-25S inflatable boat is also located there.

In 2003, Be-200ChS received a Russian certificate confirming it meets AP-25 standards. This has been updated many times. In January 2007, it was certified to carry 43 passengers then, on September 7, 2010, the Be-200ChS-E version (or Be-200ES, emergency situations) was awarded the European EASA certificate.

The first order, for seven Be-200ChS aircraft, was placed by the Russia's Ministry of Emergency Situations on January 15, 1997. The planes were to be delivered by 2002, but slow production meant that six were received between 2003 and 2011. The seventh aircraft was sold to Emercom of Azerbaijan in 2008.

Overestimated demand

At the start of the programme, the manufacturers predicted orders for 400 aircraft in its pessimistic forecast and 800 when being optimistic. Irkut estimated the needs of the Russian market alone at 110 to 115 by 2010, not including possible military orders.

Sadly, hopes for a passenger version of the Be-200 proved to be unfounded. The Russians had expected that a 70-seat amphibious aircraft would be in great demand in tourist destinations. Years later, in December 2009, Alexei Fedorov, head of the Irkut Corporation, admitted: "We were naive from the point of view of marketing and thought that as soon as the world sees this unique aircraft, hydromotors, ramps and other necessary installations will be immediately built."

In fact, in tourist destinations popular enough to justify a 70-seater amphibious aircraft, airports already existed. In 2009, Alexei Fedorov downgraded the forecast: "We estimate the capacity of this market for 50 to 70 aircraft over the next 15 years worldwide," he said. Eleven years on, it seems this forecast may have been over-optimistic, too.

In July 2004, Irkut together with EADS (European Aeronautic Defence & Space Co, now Airbus) formed the EADS Irkut Seaplane joint venture, for the promotion of the Be-200 aircraft to foreign markets. In 2016, the company was liquidated by a joint decision of the partners.

Move to Taganrog

On seeing the poor Be-200 sales, Irkut decided to withdraw from the project. In 2004, it bought the Yakovlev design bureau together with the design of the MC-21 airliner that it is currently manufacturing.

The plant in Irkutsk completed the first order for seven Be-200s, after which the production line was moved to Taganrog, where the assembly of the last two 'Irkutsk' aircraft, 301 and 302, had already been carried out. In line with the move, improvements were made to the aircraft, including partly new avionics, a Russian-made weather radar and EO turret and the hydraulic system.

On 25 May 2011, the Russian Ministry of Emergency Situations ordered another six Be-200ChS aircraft from Taganrog, to be delivered by 2014. The contract value was 8.724bn roubles (US\$295.5m) for six aircraft, or, at that time, US\$49.25 million for each one.

However, the Taganrog plant had ceased aircraft production (Tu-142s) in 1994. After that, it only dealt with repairs and modernisations of older aircraft. New production tooling was received from Irkutsk for the Be-200, but the plant struggled to build the planes, and the first Taganrog-made aircraft (303) didn't fly until September 2016. The sixth one was made in 2018.

Fighting fires worldwide

In June 2020, two Be-200ChS aircraft flew to Turkey, where they will be on duty for four months, extinguishing fires around Antalya, Izmir and Bodrum and will be operated by Russian



ABOVE FROM TOP: KAS-150 rescue capsules are mounted underneath the Be-200 wing.

A Be-200 being maintained between flights. This activity is rarely seen, but shows the engine blades being washed to remove corrosive salt after a sea landing.

An earlier iteration of the BE-200 cockpit.

BE-200 pilots in the cockpit with its multiple digital displays.

Unrealised projects



A development model of the BE-200

Be-200T is a transport aircraft designed to deliver 7.5 tonnes of cargo over a distance of 1,700 km, to destinations such as islands without airports, floating oil rigs and ships. In the combined variant, you can take three tonnes of cargo and 19 passengers.

Be-200V is a business jet amphibian.

Be-210 is a passenger amphibian capable of carrying 72 passengers over a distance of 1,850km (1,150 miles).

Be-220 (Be-200MP, Morskoy Patrulnyi, maritime patrol) is to be an Anti-Submarine Warfare (ASW) and surveillance aircraft with an advanced mission system including radio sonobuoy, magnetometric, electro-optical and electronic intelligence subsystems. Weapons options include depth charges and ASW torpedoes carried in an internal armament bay, as well as on six underwing pylons. The Be-200MP version is to be based on a strengthened airframe and powered by uprated 80.4kN (18,078lb/ft) engines providing for an increased take-off weight of 45,000kg (99,208lb) from shore bases; ferry range is 3,900km (2,423 miles).

Be-250 is a Beriev proposal for an airborne early warning and target indication amphibian aircraft. The advantage of Be-250 would be the ability to control the airspace not only in flight, but also when on the sea.

Be-300 is being designed as a shore-based derivative of the Be-200 amphibian with a completely new fuselage without the boat-shaped hull.

The wing, tailplane and engines will remain unchanged while the undercarriage will undergo modest modifications.

Be-300MP is similar to the Be-200MP, but with the fuselage of the Be-300. It was offered to the Indian Coast Guard.

Be-310 is a regional airliner intended to carry 102 passengers over a distance of 2,100km (1,305 miles) at a cruising speed of 750km/h (466mph).

flight and ground personnel. Turkish President Recep Tayyip Erdoğan had seen the Be-200 in action at the MAKS exhibition in Russia in 2019 and it had also participated in Teknofest 2019, in Istanbul. The Russians hope that this latest development will

prompt future purchases of Be-200 by Turkey.

Be-200 has been carrying out similar missions for almost 20 years. In May 2002, it appeared in France, Greece and Germany and then, in summer 2004, it performed a firefighting role in

Sardinia. The airplane spent about 90 hours in the air and made 255 water drops with a total weight of 1,800 tonnes (1,984 tons), mostly during presentations and training sessions. The Be-200 extinguished four real fires by dropping 324 tonnes (357 tons) of water during seven hours of flight.

In both 2004 and 2005, the Be-200ChS was leased by the Italian firm SOREM, the official operator of the fire technology of the Italian Civil Protection Department (Protezione Civile). The aircraft was piloted by mixed Russian-Italian crews.

In the following years, Be-200 visited Asia, Africa and, in 2010, both Americas. Its biggest advantage in these situations was the large capacity of the water tank, its high speed and its ability to operate in poor weather.

The Russians hoped these leases and presentations would bolster sales to Western countries. For almost ten years, at numerous G8 summits, they proposed the creation of a pan-European rescue centre with an air squadron of up to 15 Be-200s. However, none of this came to pass and numerous agreements, even those announced as firm contracts (with Chile, China, Indonesia, the USA and many other countries) proved to be invalid.

Multi-task concept

After years of trying, the Be-200's manufacturer finally had to admit that fighting fires was to be its plane's sole function.

However, with

a large pressurised cargo and passenger cabin, the Be-200 is twice as heavy as its firefighting competitors. When compared to Canada's amphibious CL-415 and CL-215 aircraft, it consumes 32% and 62% more fuel, respectively, for each 1.1 ton of water dropped.

Another major problem was an insufficient number of lakes and reservoirs large enough for the Be-200 to access. For example, during an operation in Portugal in 2006, there were only 13 such reservoirs available to the Be-200, while smaller Canadian amphibians could operate from as many as 63. Using the ocean was almost impossible, as the choppy Atlantic was often too rough for amphibious aircraft.

Ironically, the Be-200 is rarely used in Russia for the same reason. Extensive forest fires occur in Siberia every year, but, according to Russian data, from 2017 to 2019 the Be-200 flew only 42 firefighting flights.

It's just not easy to find an obstacle-free water source of the required dimensions: 2,700m x 150m x 2.6m deep



(8,858ft x 492ft x 8ft 6in). But if a Be-200 is flown to a suitable lake, say, 10km from the fire, it can drop 69 tonnes (76 tons) of water per hour on it. That's much more than the CL-215 (23 tonnes/20 tons) or the CL-415 (27 tonnes/24.5 tons).

Be-200 to the Navy

There are currently 14 Be-200 aircraft in service. Russia's Ministry of Emergency Situations has 11, Azerbaijan has one and Beriev operates another.

The latest, 311, belongs to the Ministry of Defence of Russia (MoD) and it has considered purchasing Be-200 aircraft on two occasions. Back in May 2013, six were ordered. Two aircraft were to be standard production Be-200ChS versions, while the other four were the simpler Be-200PS search-and-rescue variant, without the firefighting function.

They were to be divided between the Naval Aviation evaluation centre at Yeysk and the Navy's Artyom-Knevichi air base, and delivery was due in November 2014 and

November 2016. The value of the order was 8.408 billion roubles (then US\$275m), or almost US\$46m per aircraft. But due to a lack of skills and qualified staff, and issues mastering the new production tooling, none of these aircraft were delivered and the contract was terminated in 2017 by the MoD. Beriev had to return the advance, a total of 6.726 billion roubles (US\$108m).

Nevertheless, the navy did not give up on the amphibians. It is not known when the next contract for three aircraft was concluded although it was probably in the second half of 2018. Russia's deputy defence minister Alexey Krivoruchko said in August 2018 that the MoD "would soon order the first batch of three Be-200 amphibians". Aircraft in standard Be-200ChS configuration were purchased.

The aircraft for the Russian Navy has the KSO-200 (Kompleks Spetsialnogo Oborudovaniya, special equipment suite) search system by the Kontur-NIIRS company of St Petersburg.

This includes the Kontur 200-A813Ts weather

All Be-200 aircraft

C/n	Present registration	Proper name	First flight	Notes
001	-		-	Static tests
002	RA-21511		September 24, 1998	
003	21512	Konstantin Babich	August 27, 2002	ex. RA-21512, RF-21512; Be-200ES
004	-		-	Fatigue tests
101	RF-32765	Ivan Borzov	June 17, 2003	ex. RF-21515, RF-32515
102	RF-31360	Ivan Sukhomlin	February 26, 2004	ex. RF-32516, RF-32766, RA-21516
201	RF-32767	Vasiliy Rakov	July 28, 2005	ex. RF-32517, RF-32767, RA-21517, RF-31120
202	RF-31370	Evgeniy Preobrazhensky	September 2006	ex. RF-32768
203	FHN-10201		June 2007	Azerbaijan's Emercom; ex. RF-32769
301	RF-31121	Pyotr Streletsky	July 14, 2010	
302	RF-31130	Ivan Shamanov	April 3, 2011	ex. RF-31361
303	RF-32766	Alexander Razgonin	September 16, 2016	First built in Taganrog
304	RF-31120		July 2, 2017	
305	RF-31140		November 27, 2017	
306	RF-31380		March 12, 2018	
307	RF-32768		August 25, 2018	
308	RF-31390		December 19, 2018	
311	RF-88450	Alexander Mamkin	February 14, 2020	Russia's Navy

radar, fitted in the aircraft's nose and a Kontur Albatross gyro-stabilised electro-optical turret, mounted under the port wing. Four droppable KAS-150 or UKAS-200 rescue capsules can be carried under the wing, each weighing 150kg (331lb) or 200kg (441lb) respectively. A dinghy or

tasks, prefers larger platforms, such as Beriev's Be-42 and Tupolev's Tu-214P, as these are able to carry more equipment and weapons.

At Farnborough 2012, the Russian arms trade company, Rosoboronexport, and Finmeccanica, (now

life raft, as well as medical, radio and other equipment necessary for the survivors can be stored inside these containers.

Beriev's portfolio now includes a more advanced military version Be-220 (Be-200P or Be-200MP, Maritime Patrol, depending on equipment) with a specialised mission system and armaments. However, the Russian Navy, for its patrol and anti-submarine

Leonardo-Finmeccanica) of Italy, signed an agreement to co-operate in the development of the Be-220 This will feature the Selex ES Airborne Tactical Observation and Surveillance (ATOS) mission system, backed up with mechanical Gabbiano or electronically scanned Seaspray E surveillance radars, intended for export to third countries. This project is currently frozen. **AI**

A BE-200 taking off from water is certainly an impressive sight.





Next month

October's issue... on sale
September 24* includes...

Two Secapem Defence Training Solutions (SDTS) A-4N Skyhawks and an MB-339CB making an early morning transit flight. A detailed feature on the French aggressors will appear in the October edition of *AIR International*.
Henri-Pierre Grolleau

- **Skyhawk Aggressor**
This nimble 1950s jet still holds its own, playing the 'baddie' in naval exercises
- **Blue-sky Thinking**
Exploring the long-haul passenger routes that push existing technology to the limit
- **C-17 Makeovers**
We tour Boeing's C-17 maintenance centre in San Antonio, Texas
- **The 'Flying V'**
A pioneering partnership in the Netherlands rethinks the way we fly
- **Sky-high Finance**
Italy's Finance Police take delivery of a hot new surveillance helo, the AW169M
- **Facts in a Box**
Flight data recorders are invaluable to accident investigators, but what lies within 'the black box'?

(*UK scheduled on sale date. Please note that overseas deliveries are likely to be after this.)

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