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29 OCTOBER-4 NOVEMBER 2013

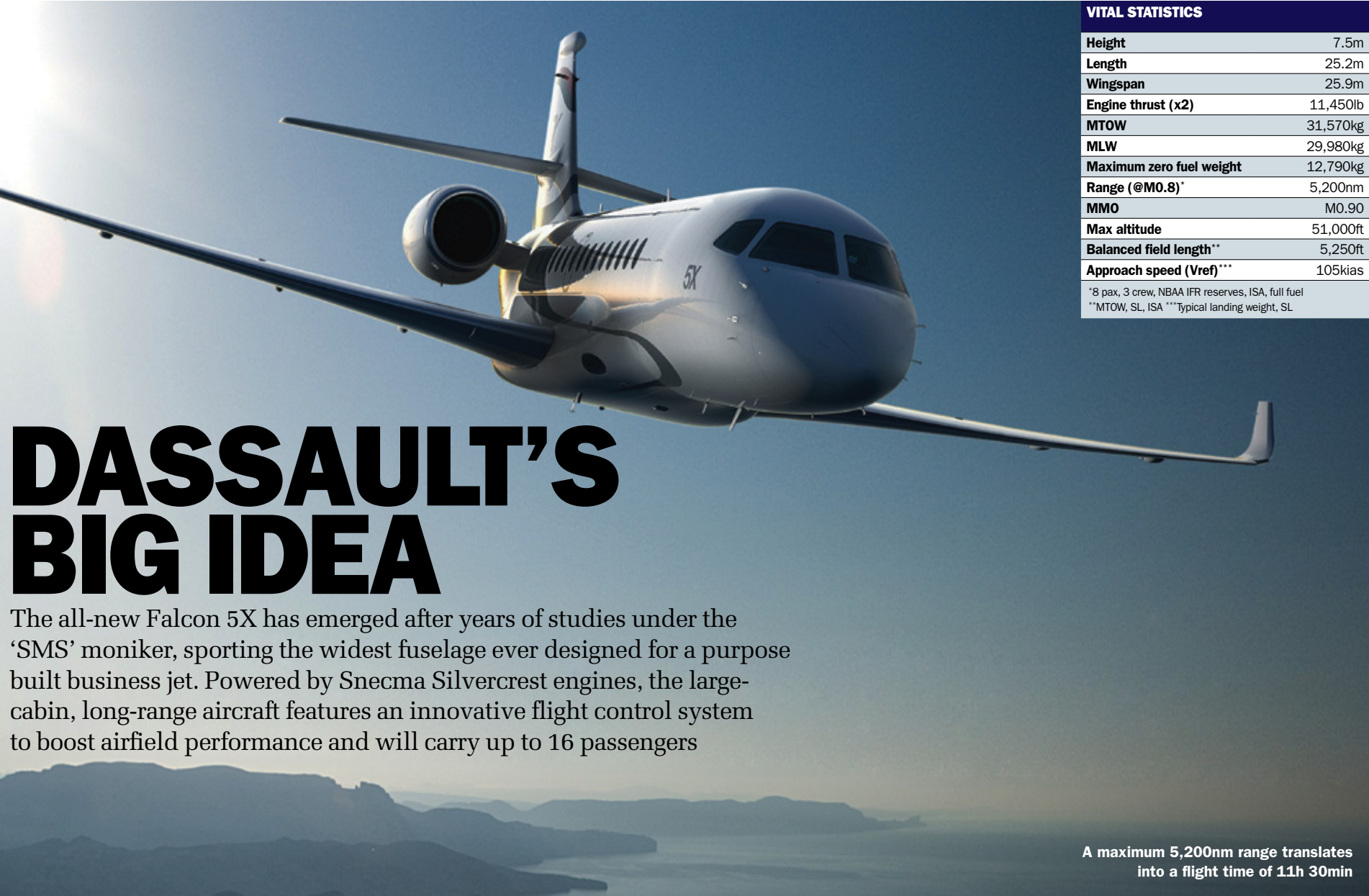


NBAA SHOW REPORT

DASSAULT'S BIG SECRET

Undercover Falcon unveiled at last





VITAL STATISTICS	
Height	7.5m
Length	25.2m
Wingspan	25.9m
Engine thrust (x2)	11,450lb
MTOW	31,570kg
MLW	29,980kg
Maximum zero fuel weight	12,790kg
Range (@M0.8)*	5,200nm
MMO	M0.90
Max altitude	51,000ft
Balanced field length**	5,250ft
Approach speed (Vref)***	105kias
*8 pax, 3 crew, NBAA IFR reserves, ISA, full fuel	
MTOW, SL, ISA *Typical landing weight, SL	

DASSAULT’S BIG IDEA

The all-new Falcon 5X has emerged after years of studies under the ‘SMS’ moniker, sporting the widest fuselage ever designed for a purpose built business jet. Powered by Snecma Silvercrest engines, the large-cabin, long-range aircraft features an innovative flight control system to boost airfield performance and will carry up to 16 passengers

ANDREW DOYLE ST CLOUD, ARGENTEUIL AND VILLAROCHE CUTAWAY DRAWING TIM HALL

The secret is finally out: the newest member of Dassault’s Falcon business jet family – the long-range, large-cabin 5X – will be ready to enter service by 2017. The latest flagship has been in the works for several years under the codename “SMS”, and at last the wraps have come off a raft of new features designed to ensure the French manufacturer preserves its reputation for leading the field in technical innovation.

“The Falcon 5X is the new benchmark for the

creative use of advanced technology in business aviation,” says Eric Trappier, chief executive of Dassault Aviation. “With design and manufacturing software and systems pioneered by Dassault, we are able to build a larger, more comfortable and more capable aircraft.”

The twin-engined, 16-passenger 5X will be the biggest Falcon yet developed, boasting a fuselage diameter of 2.7m (8.86ft) compared with the 2.5m cross-section employed for the Falcon 2000 family and 7X trijet. With eight passengers on board, the new model will offer a range of 5,200nm (9,620km), around 800nm less than the top-of-the-range 7X.

“The 5X will be in the same vein as the 7X, with the advanced flight controls that have

made the reputation of the 7X,” says John Rosanvallon, chief executive of Dassault Falcon Jet. “It’s a new generation in terms of cabin comfort.”

Despite the 5X offering greater range and cabin space than the three-engined Falcon 900, which made its debut in the mid-1980s, Rosanvallon expects the LX variant of the latter to remain in production as total deliveries approach the 500 mark.

HOME-GROWN POWER

“We plan to continue the Falcon 900 for a number of years, as long as the market accepts this aircraft,” he says.

Equipped with an all-new wing, the 5X is

A maximum 5,200nm range translates into a flight time of 11h 30min

design to this new environment.”

The 5X has been designed to provide a cabin slightly taller and wider even than ultra long-range types such as the Gulfstream G650.

The 5,200nm maximum range at typical operating conditions translates into a flight time of 11h 30min, cruising at M0.8 at up to FL450 (45,000ft) with three crew and eight passengers. This means cities including Buenos Aires, Lagos and Moscow are within non-stop range from New York, while Los Angeles and Tokyo can be reached from London. Taking off from Beijing, the available direct destinations include Paris, Sydney and Seattle.

The wingspan of the 5X, at 25.9m, is 0.3m less than the 7X but the new model boasts a greater wing area of 72.4m² (779ft²), compared with the latter’s 70.7m². The 5X’s maximum take-off weight is just over 31.5t, but the aircraft can land at 95% of this weight (just under 30t). “As with other Falcons, you can take-off with full payload and fuel and [land to] pick up another passenger almost immediately,” says Villa. “The comfort comes with no trade-off” in terms of airfield performance, he adds.

The new wing enables the twin-engined 5X to offer broadly similar low-speed performance to that of the three-engined 7X, with V_{ref} approach speed predicted to be 105-106kt. This ensures the 5X will be capable of operating into and out of London City airport in the UK. Compared with the Falcon 900LX, the 5X will be able fly approximately 20% further taking off from runways between 4,000-5,000ft in length. The industrial programme partners signed up for the 5X are broadly similar to those used on previous Falcon programmes.

TOP PRIORITY

“That’s a policy of the company,” says Villa. “The number one priority is quality – we don’t go to low-cost suppliers.”

Rosanvallon says the 5X is being priced at around \$45 million for “a very well equipped aircraft”, including cabin. Dassault is not revealing precise development costs for the 5X, but “typically, if you look at an aircraft of this kind, the order of magnitude is in the range of €1 billion [\$1.37 billion] of investment”, says Rosanvallon.

Trappier says the 5X “represents our biggest programme investment since the beginning of the Falcon programmes.”

The initial production rate is yet to be finalised, but in an effort to ease the production ramp-up, the first 40 aircraft will be sold at a fixed discount with largely standardised cabin configurations. “There will be the choice of a few upgrades,” says Villa.

Three 5X development aircraft will be built. Serial production will take place at the same assembly facility used for the 7X at Mérignac in southern France. ■



DESIGN Creature comforts

A wider fuselage, bigger windows and higher ceilings will offer scope for interior innovation in the type’s airy cabin

The introduction of a wider fuselage cross-section for the Falcon 5X has heralded a fresh approach to the design of the interior for the 1.98m-high cabin, which offers a total volume of 50m³ (1,760ft³) compared with the 7X’s 44m³. The 5X’s cabin is a full 25cm wider than that of the 7X, as well as 10cm taller.

“We are the first to bring to this segment the level of comfort of the global jets,” says Villa. “Looking at the cross-section, we compared the market. We decided to do better than all the existing aircraft.”

“The 10cm more [cabin] height makes a huge difference. Even compared with the [Bombardier] Globals, we have a significant difference. Every curve has a purpose.” Villa says the 5X’s cabin is also longer and taller than the Gulfstream G650’s.

A key feature of the 5X is the use of cabin windows 10% larger than their counterparts in the 7X and a full 30% bigger than those of the Falcon 900LX.

“Part of the comfort is the light inside,” says Villa. “We decided to go a step further»

» with the 5X, with 30% more window area for the cabin compared with the Falcon 900. They are smaller windows than the G650 but there are more, which gives more flexibility for the floor plans.”

The 5X boasts 28 cabin windows, compared with the just 12 for the G650. For added comfort, the cabin altitude at FL410 will be equivalent to 3,900ft. This rises to 6,000ft at a cruise level of FL510.

“When you enter this area you are looking at the sky – you’re already travelling!”

AGNÈS GERVAIS,
Aircraft interior designer

The cabin – which has been in development for the past two years – is designed to make maximum use of the wider fuselage cross-section by introducing more spacious aisle clearances.

“We had to innovate through shapes and lines, but also through colour and trim,” says Agnès Gervais, aircraft interior designer.

A notable innovation in the entryway/forward galley area is a dimmable roof-mounted skylight, introduced following feedback from flight attendants.

“We wanted to do something a little bit different with the entry galley,” says Jim Hurley, vice-president sales for eastern USA and Canada. “This is a bit like walking into the foyer of your office or the hallway of your home.” Gervais

adds: “When you enter this new area you are looking at the sky – you’re already travelling!”

There will be several new seat designs, which Gervais says will “simpler and cleaner”. She says some customers felt the seats in previous Falcon models were “very classical”, adding that they wanted “something new”.

It is possible to create “nearly a king size bed” in the rear cabin, says Gervais.

Two complete cabin mock-ups will be used for customer demonstrations. The first will remain in the USA after the NBAA show for a year-long customer tour.

A second mock-up, currently under construction, is a “sports car design: more technical and more masculine, to show the customers what we can do. The mock-ups will help us get feedback from customers. We’ll take customer reaction into account – it’s a work in progress,” says Gervais.

Hurley adds: “Mock-up one meets the taste of the North American buyer. With the second mock-up we wanted a little bit more ‘wow factor’.”

The second mock-up will be based at Dassault’s Le Bourget hangar and will make its show debut at next year’s EBACE convention in Geneva.

A vacuum toilet will be standard in the rear lavatory and an option for the front.

As with existing Falcons, it will possible to access the 5X’s baggage compartment during flight. The design also permits a single person to load and unload the baggage compartment on the ground. “We believe that’s quite important,” says Villa. ■

SYSTEMS

Slimming down

The 5X’s wings are made significantly lighter by the addition of flaperons and advanced control technology

The Falcon 5X’s new-generation wing is equipped with three slats on the leading edge each side, and features a curved trailing edge with inboard flap, flaperon and outboard aileron as well as a pair of air brakes. The trailing edge moving surfaces will all be supplied by GKN Aerospace.

“We could have kept the same wing and flight control system as the 7X,” says Villa. “That would have been easy, but we went one step further.”

The flaperon is an innovation more commonly seen on advanced military aircraft, and is a first for a business jet.

It brings significant performance benefits – as well as better visibility and comfort during steep approaches – despite increasing the complexity of the new-generation digital flight control system, which is being developed and manufactured by Dassault itself.

“The flaperon can act as an aileron, flap or spoiler,” says Villa. “It can complement all of these surfaces to bring more capability and better control of the aircraft.”

François Dupré, head of flight control system and handling qualities, says: “We had the opportunity to introduce new control surfaces, and the traditional functionality of each flight control surface has been totally rethought.

“We could have kept the same system as the 7X, but we went one step further”

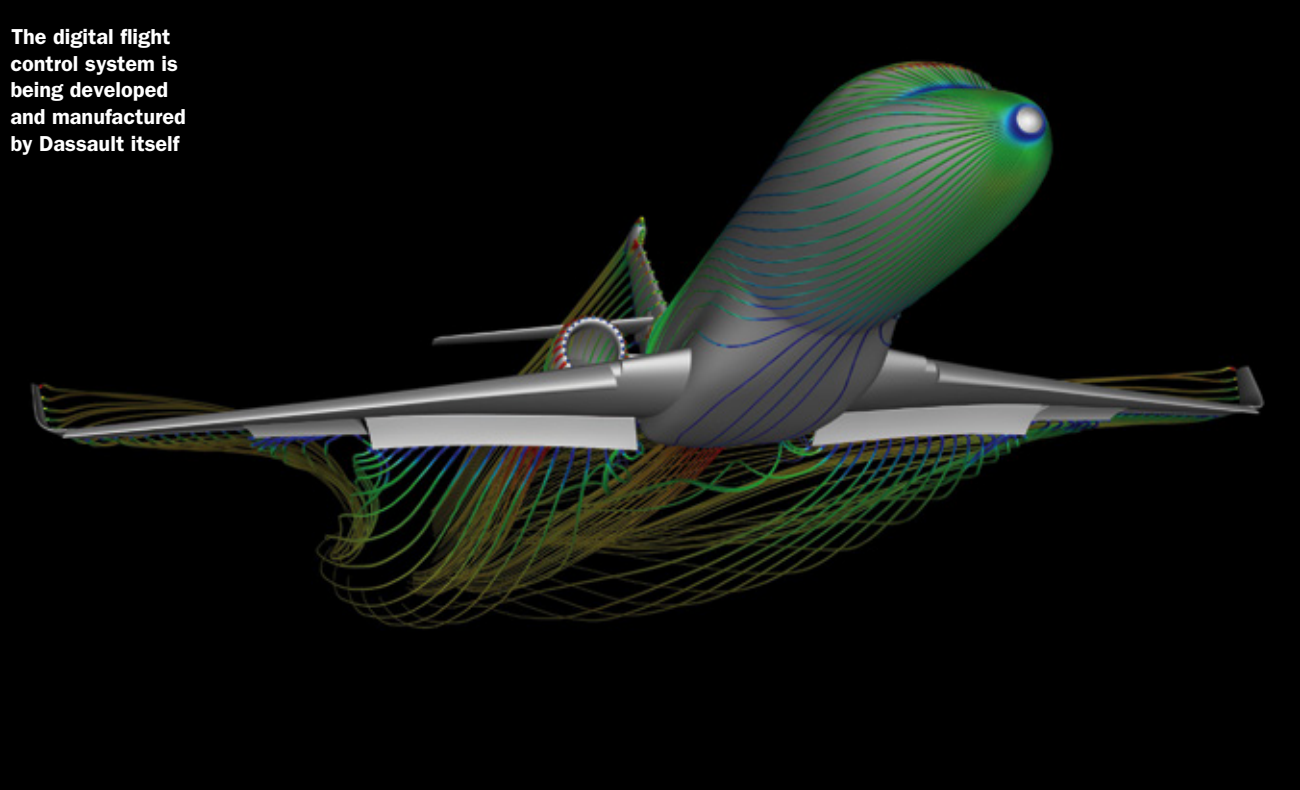
OLIVIER VILLA
Senior vice-president for civil aircraft, Dassault

“The flaperon is able to control roll through differential deflections, is able to be used as a high-lift device and can also be used as an air brake.”

Dassault has experience of flaperon design and development thanks to its military fighter programmes, including the Rafale.

During a steep approach, the ailerons can be deflected upwards while the flaperons act as an additional pair of trailing edge flaps. The ailerons and flaperons meanwhile combine to provide roll control. The result is a significant

The digital flight control system is being developed and manufactured by Dassault itself



François Dupré headed up the development team working on the new type’s avionics

increase in drag with no lift degradation, in order to maintain a low approach speed.

The advanced control system helps to reduce aerodynamic loads and means the 5X wing can be made around 500lb lighter, says Dupré.

The 5X has the same level of envelope protection as the 7X, which is similar to that applied for Airbus fly-by-wire airliners minus any limit on bank angle. The 5X will be the

first Falcon to have electrically-actuated trailing edge flaps. The landing gear, supplied by Héroux-Devtek has “a classical architecture, with trailing arm for comfort.

“What’s new is the nose landing gear doors. When the gear is extended the doors close back to minimise noise,” says Villa.

The undercarriage is equipped with a fully redundant brake-by-wire system, controlling new-generation carbonfibre brakes.

The air data system comprises four electrically-heated “smart” probes, and is based on an architecture derived from the 7X. Dassault says the system is capable of providing back-up speed indication even in “extreme” icing conditions.

The 5X’s hot bleed-air ice-protection system, meanwhile, is activated on the ground and operates automatically after take-off, protecting the wings and nacelles.

The fuel system is “nothing really new for Falcons. We’ve made sure fuelling will be very fast and accurate,” he adds.

The cabin air system is supplied by Liebherr and the air conditioning can be controlled in three zones. Also included is “an emergency ram air scoop on the front of the aircraft which is new to the Falcon, for redundancy”, says Villa.

Eaton supplies the hydraulic system, which comprises two main circuits and two sub-circuits.

The 115V AC electrical system is designed to increase available power for engine starting and de-icing, while reducing crew workload in terms of network management.

A digital flight control system test bench has been set up at Dassault’s St Cloud headquarters to gain certification credit in advance of flight testing. This is linked to an “iron bird” comprising the DFCS hardware, as well as a cockpit simulator equipped with the 5X’s avionics system. ■



Two complete cabin mock-ups will be used for customer demonstrations

FLIGHTCREW

Room with a view

A wider cross-section allows for a larger cockpit, featuring the latest technology and – most importantly – comfier seats

The 5X's wider fuselage cross-section allows a more spacious cockpit design with better head clearance for the pilots and larger windows.

"There is more room everywhere and the aesthetics are great," says Villa.

The cockpit is equipped with the latest iteration of the EASy flight deck – based on Honeywell Primus Epic avionics – with Honeywell flight management systems. It will eventually be offered with dual head-up displays (HUD) integrating synthetic and enhanced vision systems.

The 5X is the first Falcon to feature class 2 electronic flight bag (EFB) screens integrated into the main instrument panel. Another enhancement is that the crew's emergency masks have a "saver" function, says Villa. "You will not waste oxygen unless the crew needs it."

Dassault chief test pilot Philippe Deleume says the 5X's revised cockpit windows are optimised for steep approaches.

The overall aim of the cockpit design, he says, is to "keep full consistency with other Falcons. For the pilots it's full consistency for instrument and control position, and



The type's revised cockpit window design is optimised for steep approaches

operating method."

The 5X introduces the third generation of the EASy cockpit concept, and Deleume says class 2 EFBs were selected because they are "a lot easier to develop and certify", than class 3 (which would be fully integrated with the aircraft's avionics).

He says it is also easier to upgrade class 2 EFBs, while some class 3 EFB-type functions like electronic charts and checklists are already integrated into the EASy avionics.

The HUD technology, provided by Elbit Systems, combines enhanced and synthetic vision (EVS/SVS) to enhance situational awareness in darkness, fog or dense haze. EVS uses infrared sensors to display terrain in darkness and reduced visibility. SVS uses a global terrain database for the same purpose. In the 5X they will be combined for the first time on the head-up

display to provide a high fidelity view of the outside world even in zero visibility.

Initial 5Xs will be certificated with a single EVS/SVS HUD for the pilot in the left-hand seat. Eventually the aircraft will offered with upgraded HUDs for both pilots and Dassault aims to certificate these for use as primary navigation displays, which would be a first in the business aviation market.

IMPROVING EFFICIENCY

"We are working hard with EASA and we are in the proof of concept phase. The goal is that when the aircraft is on the ground we have enough vision to taxi out without any assistance, which is not the case today," says Deleume.

"We are also working very hard with Elbit to integrate the three EVS sensors for better aerodynamics and less noise, to improve overall efficiency."

There will be a new type rating for the 5X, but Dassault believes "only a short period of training" will be required for pilots transferring from other EASy-equipped aircraft.

The pilot seats feature larger head rests and can be reclined by up to 50 degrees for improved comfort during rest periods. Meanwhile, much attention has been paid to improving the design of the supernumery crew seat. "A constant complaint from pilots [of existing Falcons] is that it's very awkward to put the seat into the take-off or landing position," says Deleume. The third crew seat will now move "very very easily".

The "very classical moving throttle" unit offers a "soft" or mobile detent capability to reduce pilot workload when performing take-offs at de-rated thrust settings, as well as noise abatement procedures.

"There is a magnet inside to set the hard point at any position in the throttle angle range," says Deleume. ■



The 5X will feature the third generation of the EASy flight deck

ENGINES

Indigenous propulsion

Snecma's Silvercrest will power the 5X, after Rolls-Royce's RB282 lost out to the France-based powerplant manufacturer

The Falcon 5X is the second announced platform selection for Snecma's Silvercrest, after Cessna revealed it was fitting the powerplant to its Longitude business jet. However the 5X will be the lead application in terms of service entry.

"The engine characteristics match exactly what we wanted to do with this aircraft," says Villa.

Dassault had originally selected Rolls-Royce's proposed RB282 to power its SMS concept in 2007, but reversed that decision two years later.

"We had contracted with Rolls," says Villa. "But as the environment changed we came to an agreement that it was better to open the competition again. There was no contractual issue regarding that."

CLEAN-SHEET DESIGN

As well as being the first Falcon to be equipped with a French engine, the 5X also marks the first time that Dassault has launched a business jet with a clean-sheet engine design.

Snecma is providing the complete propulsion system for the Falcon 5X, encased within a "longer, mixed-flow nacelle for fuel efficiency", says Laurence Finet, Snecma's general manager for the Silvercrest programme.

"We are supplying Dassault with a more or less 'plug and play' propulsion system," she says. "The thrust rating is basically the same between the Cessna and Dassault aircraft – it's the same engine," says Finet. The Cessna variant of the engine is designated the 1C, and the Dassault version the 1D.

The Silvercrest was designed specifically to cover the 9,500-12,000lb (42-53kN) thrust range, powering super-midsize, large-cabin and long-range business jets, with a thrust-to-weight ratio of 5:1.

Snecma is targeting 15% lower fuel burn and carbon dioxide emissions compared with current engines. NOx is expected to be 50% less than the CAEP/6 standard.

"There will be a requirement to land at very demanding airports," says Finet. "The noise footprint is reduced by 50% compared with current engines in this class. There was no



Ease of maintenance is a major design focus for the Falcon 5X

SUPPORT

JOINED-UP THINKING

"WE'VE PUT a special focus on the availability of the aircraft," says Villa.

"We are starting with the absolute rule that there will be 800h or 12 months between inspections, which is 30% better than previous Falcons."

To ensure that any operational problems can be rectified quickly, the 5X's automatic fault management system can "detect the failure

of any component", says Villa. "For the 5X we will have thousands of parameters that are monitored on each flight. "It's a revolution in fault management on a business jet."

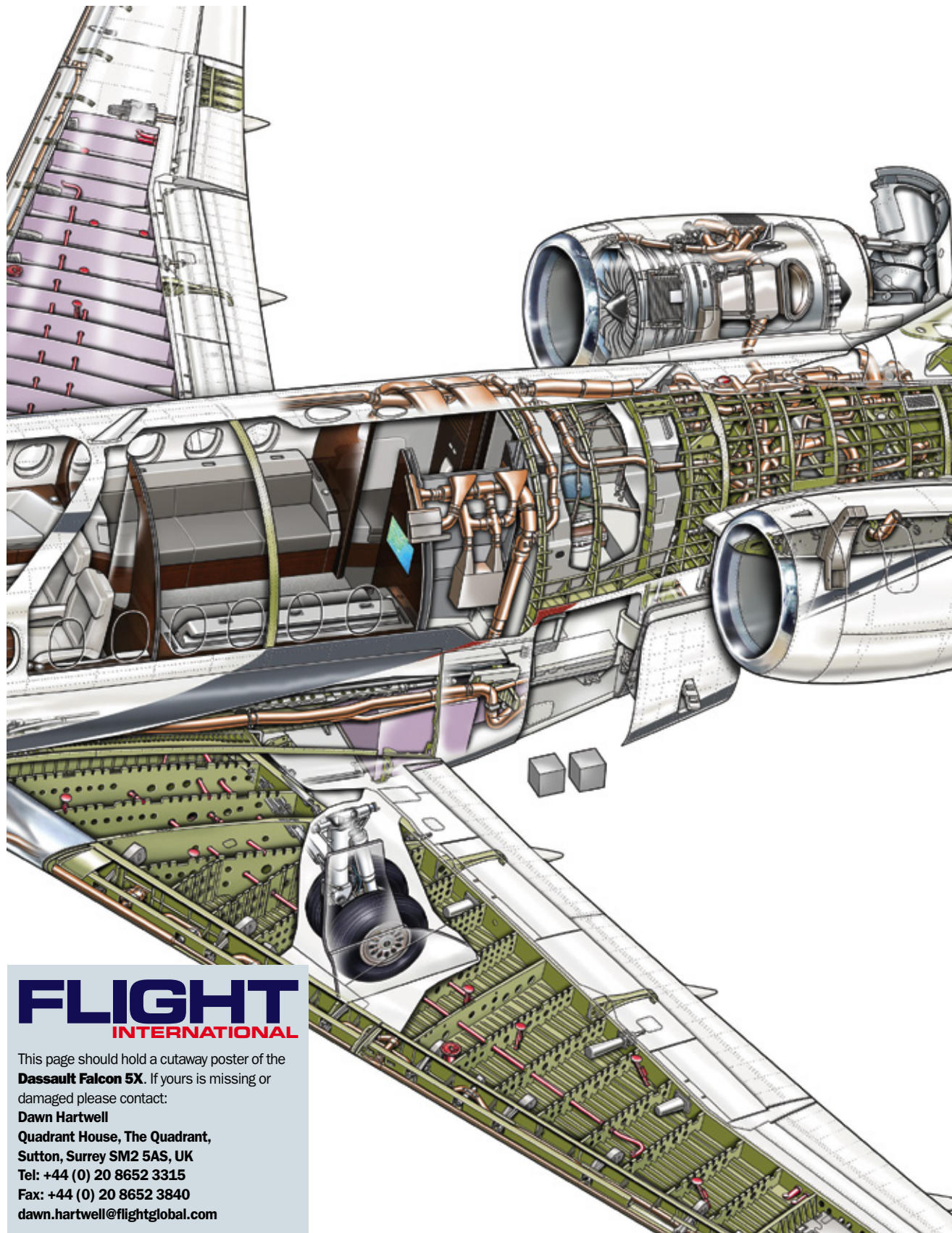
The maintenance management system is connected to all of the aircraft's systems, and collects and stores data in real time.

The resulting data can also

be transmitted to the ground in real time.

"With this system on board we are sure to identify the root cause," says Villa.

For "mature" aircraft such as the Falcon 900 and 7X, "our goal is 99.8% despatch reliability, but it's way too early to give a guarantee for the 5X. We will be able to provide a better estimate as the development progresses." ■



FLIGHT INTERNATIONAL

This page should hold a cutaway poster of the Dassault Falcon 5X. If yours is missing or damaged please contact:

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» existing competitor in this market segment, so for a new entrant like Snecma it is a good way to go.”

Although there are now two announced airframe applications, “we will go for more – there is no question”, she says.

The use of an axial/centrifugal compressor is designed to reduce parts count, thereby cutting weight and improving reliability. The “on-condition” maintenance philosophy for the Silvercrest means there are no fixed limits for “time on wing” and hot section inspections. “You don’t have to remove the engine when it’s done a certain number of hours of operation,” says Finet.

The French company has gained significant experience with this approach, as there are already some 5,000 CFM International CFM56 engines covered by Snecma’s in-flight monitoring programme. For the Silvercrest, more than 150 parameters will be monitored.

CONSTANT VIGILANCE

“If everything is right, just keep flying. That, I would say, is the basis for on-condition maintenance. Among the main things we will monitor are bearings for unusual vibration. We will also monitor any unusual vibration from the fan and correct that on the ground,” says Finet.

“We don’t want to force the operators [to sign up to automatic data monitoring], but we believe it will make a significant difference. We believe it’s a very good asset for business jet operators – we believe they will feel confident and we have had a good response from

them. We have done a lot of work on our support network to cater for the needs of the business aviation market.

“We are currently working on the ‘power by the hour’ maintenance programmes that we will offer to operators.”

The target is to offer 180min ETOPS capability at entry-into-service.

The Silvercrest has a 42.5in (114cm) diameter titanium fan with wide-chord, 3D aero-designed blades. The relatively small size of the engine means opting for a composite fan would have resulted in thicker, less aerodynamically efficient blades.

The “very compact” high-pressure compressor (HPC) comprises four axial blisk stages and a single impeller (which replaces two further axial stages), while the single-stage high-pressure turbine features active tip clearance control.

“Using active clearance control in the HPT is unique in business aviation,” says Finet.

Snecma first developed compressor blisks for the M88 engine that powers the Rafale fighter, and they have subsequently been employed on the Boeing 777’s General Electric GE90 and the PowerJet SaM146 for the Sukhoi Superjet.

Testing of the Silvercrest core began in 2008 and full-scale engine development was

“The engine characteristics match exactly what we wanted to do with this aircraft”

OLIVIER VILLA
Senior vice-president for civil aircraft, Dassault

launched in 2010. The first full-engine ground test was completed last year and flight tests are due to commence by the end of 2013.

Series production is scheduled to get underway in 2014 ahead of engine certification in 2015 and entry into service powering the Falcon 5X by early 2017.

TEST PROGRAMME

Four engines are currently undergoing ground tests, and full take-off thrust has already been exceeded.

Completion of the first phase of endurance testing means the engine has secured its permit to fly.

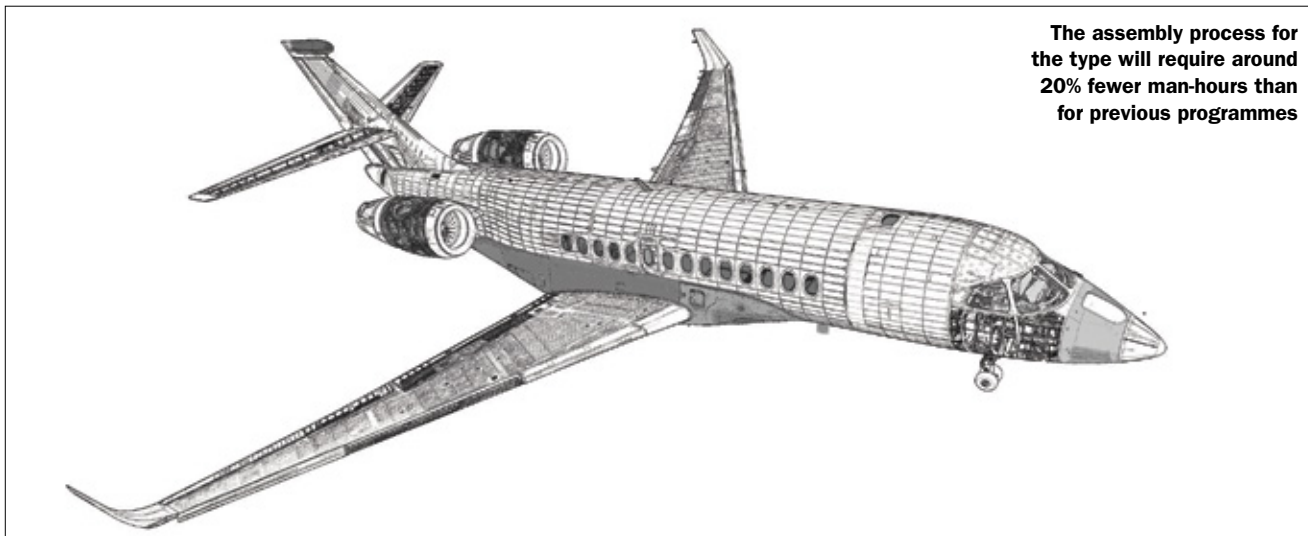
“We are starting the performance and reliability tests and we have quite good results so far,” says Finet. “The engine is very quiet with very low vibration. It’s very easy to balance, which is very good for cabin vibration and customer acceptance.”

Snecma in 2011 acquired a Gulfstream II to serve as the flying testbed for the Silvercrest. The aircraft will be based at the company’s flight test centre at Istres in southern France after undergoing modification in the USA.

“We decided not to go with an airliner as the GII will allow us to go up to 45,000ft,” says Finet.

The engine will be assembled at Snecma’s Villaroche facility near Paris. “We have selected all of our manufacturing suppliers,” says Finet.

In addition to the main engines, the 5X is equipped with a tailcone-mounted UTC Aerospace Systems ground auxiliary power unit. ■



The assembly process for the type will require around 20% fewer man-hours than for previous programmes

CONSTRUCTION

Nesting grounds

Dassault's high-tech Argenteuil manufacturing plant will once again lead the way in assembling the company's new flagship

One of Dassault's primary locations for sub-assembly production is Argenteuil near Paris. The factory provides forward fuselage sections (known as "section T12") for all Falcon business jets, and this site is at the forefront of the advances in production technology being introduced with the 5X.

Argenteuil is also used by Dassault as an experimental development centre for new

processes in areas such as composites production, non-destructive testing and quality control and friction-stir welding. In addition, it acts as a test centre for the qualification of new materials.

"There are about 5,000 new primary parts that will come into our shop" for the Falcon 5X, says Fabrice Demelier, head of the Argenteuil facility.

Completed subassemblies are transported to Biarritz for joining with the rest of the fuselage, which then moves to Mérignac for systems installation and final assembly.

"The geometries of the parts come straight from the design office," says Pierre Bru, Dassault's deputy vice-president for industrial operations and digital manufacturing.

"It's another step in integrated digital processes. We have more digital manufacturing thanks to [Dassault Systèmes PLM V6 product lifecycle management design software] and new digital technologies on the shop floor,"

he says.

PLM was used for the 7X, but the 5X takes this "a step further". For the first time, the design and manufacturing systems are linked to a common database.

"We have got more manufacturing data in the system right now," says Bru.

Another major advantage of this approach is that suppliers can link their own digital manufacturing systems to Dassault's PLM database. An initial batch of 5X parts – including structural elements for the static test aircraft and pipes for the aircraft systems test bench – have already been manufactured at Argenteuil, says Jérémie Dugauguez, factory co-ordinator for the 5X.

Dassault estimates that the assembly process for the 5X will require around 20% fewer man-hours than for previous programmes.

"We are introducing more and more new technologies onto the shop floor," says Bru. "For example, we are doing plastic parts with 3D printing, and experimenting with metallic parts." The international supply chain for the 5X will be broadly similar to that used for the 7X, says Dassault industrial programme manager François Guyon. However GKN Aerospace is a notable addition to the aerostructures supplier base for the 5X.

Dassault has meanwhile taken the "whole part of the secondary flight control system" back in-house for the 5X, says Guyon.

With greater use of automated assembly processes, "the key point for us is to have very good accuracy", he says. Robots are being deployed on the assembly line to automate production of fuselage and wing sections for the 5X. This approach also means that parts for several aircraft types can be produced on the same assembly line. ■



An initial batch of 5X parts have already been manufactured



Read further analysis and monitor the progress of the 5X as the new jet takes shape: flightglobal.com/bizav