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DASSAULT FALCON 7X

FULL FLIGHT TEST INSIDE

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Full on Falcon

Dassault's Falcon 7X is a technological tour-de-force but what's it like to fly? Former fighter pilot Nick Heard takes on the fly-by-wire business aircraft

Photography Remy Michelin

Falcon 7X is one of a select few aircraft certifioed to operate in and out of London City.

IN the 1970s when I was growing up, I remember a TV programme called *The Aeronauts*. The series followed the adventures of two French Air Force pilots flying the Dassault Mirage III.

Being mad keen on aircraft I was an avid fan of the programme; I can still hum the theme tune.

Many years on, after various encounters with Mirages during my RAF time, I finally got the chance to fly a Dassault aircraft.

It was not a Mirage, but an aircraft which has been produced after years of Dassault fighter aircraft development: the Falcon 7X. I was able to fly the 7X at the Dassault test centre at Istres, near Marseilles.

> Yet it has the ability to operate into small airports

Left: P1's Nick Heard at Dassault's Istres, France test centre where he flew the 7X with Chief Test Pilot Jean-Louiis Dumas.

The flagship of the Dassault range of business aircraft, the Falcon 7X is the first business aircraft to use fly-by-wire digital flight controls. With a new high-transonic wing, the 7X has a range of around 6,000nm but with the fuel efficiency of much smaller aircraft – even with three engines. Yet it has the ability to operate into small airports, meaning it can make several small hops collecting passengers before heading off across an ocean or continent.

With a wingspan of 86ft (26.2m), a length of 76ft (23.2m) and a height of 25ft (7.8m), the 7X is larger than many other business jets. The cabin is 39ft long (12m), 92in (2.34 m) wide, and 74in (1.92 m) high, with up to 12 seats available depending on customer preference. Max Take-Off Weight is 69,000lb, with Max Landing Weight 62,400lb and Equipped Empty Weight 33,200lb. Vmo/Mmo are 370kias/0.90M respectively.

PERFORMANCE

The Falcon 7X is an ultra-long range aircraft, with a quoted maximum range of 5950nm, based on full fuel, 3 crew, 8 passengers plus bags, 0.80 M cruise and zero wind, with NBAA IFR reserves (one approach and go-around, 5 minute hold, 200nm diversion, 30min hold at 5000ft). This range gives the potential for non-stop from Paris to Tokyo, Hong Kong, and US west coast; from Dubai to Europe, Asia, Africa, and western Australia; and from Los Angeles to most of Europe and all of Latin America.

Under the same performance conditions, balanced field take-off distance required is just 5505ft (1678m), with landing distance required (with the NBAA reserves) just 2262ft (689m) from a Vref of 104kt. These are fabulous figures for the business jet operator.

Like other business jets the 7X can get up to FL510. The cabin is maintained at a remarkable 6000ft, a pressure differential of around 10psi. As a long haul pilot myself, I would never like to spend too much time at that sort of level. Any loss of pressurisation would require very rapid actions to get to a sensible level, and cosmic ray absorption would be a very real long-term health concern. Again, these are not problems exclusive to the Falcon 7X, but merely an observation about business jet operation generally.

However, some other interesting performance figures are worth looking at for the 7X. Initial maximum cruise at high weight is around FL390, so the 7X can immediately clear the busiest airspace (the low to mid 30s) to get the best available direct routings. Unfortunately there are still many parts of the world where direct routings are still difficult to get due to rigid ATC structures, but at least the potential is there. ▶

With three engines, options are better in the (highly unlikely) event of an engine shut down in flight. With a two-engined aircraft, lose one and you really have to land soon. With three engines, the loss of one should mean that you can continue to the planned destination, subject to increased fuel burn at a lower level and en-route terrain clearance. Even in the worst case, the 7X can maintain FL250 with one engine inoperative, so the latter consideration is still taken care of in most parts of the world.

The 7X has recently been certified for the steep approaches at London City and Lugano airports. The short runway at London City naturally leads to a regulated take-off weight, but even so leaves the 7X with around 8 hours of fuel - enough to get to the Middle East and much of the USA, with the same eight passengers.

The 7X naturally has the full range of modern navigational requirements certified, such as RVSM and RNP. It is also certified for Cat 2 All Weather Operation, with Cat 3A potentially available should customer demand warrant it.

FLYING THE FALCON 7X

The aircraft to be flown was the first 7X to be built, and which remains a test aircraft. Thus there was no standard cabin fitted as such – just a few seats and a lot of test equipment. After a full detailed brief of the sortie profile, test pilot Jean-Louis Dumas showed me around the 7X before settling into the flight deck. The cockpit is beautifully presented with an uncluttered look (always helped by sidestick controls – just look at any Airbus cockpit).

Dominating the flightdeck are the four 14-inch displays of the EASy Flight Deck avionic system, with standard radio and communication boxes mounted below on the pedestal. Here sits the three neat thrust levers, fuel switches, parking brake, landing gear and flap levers. The trackball-type cursor controllers fit comfortably to hand on the lower panel as well. Immediately above the screens is the Guidance Panel, comprising flight director and autopilot controls. Overhead, the panel again neatly arranges the controls for fuel, hydraulic, electrical, air conditioning and pressurisation...

The EASy system is set up through a simple arrangement of menu icons for take-off, climb, cruise, descent and landing. With the aircraft at 47,500lb, including 10,100lb of fuel, and Met conditions of +25 deg C and QNH 1012, V1 came to 99kt and V2 113kt for runway 33 at Istres, with flaps set at the SF2 position.

Engine start is simple, turning on the fuel control switches and selecting start for the respective engine. Full autostart capability means the FADEC will cope with hung starts or hot start if necessary. On releasing the park brake the 7X started to move away on residual idle thrust. Taxying turns using the rudder pedals required smooth input, as did the brakes, and all was very straightforward.

As we got near to the holding point, the Runway Awareness and Advisory System (currently under trial) politely called 'Approaching Runway 33'. We lined up and selected full power on the roll. Engine spool-up seemed slightly slow, but a satisfying push in the back as the power bit quickly reassured me that all was well. Acceleration was tremendous, and after cross-checking speed at 80kt, we were soon at V1 and rotating. Take-off run was around the expected 900m. With positive rate of climb the gear was raised, followed shortly after by the flaps.

The flight path vector flight director (FD) guidance was easy to follow, both on the PDU (by following the magenta command bar with the green FPV bar) and the HUD (by following a small green FD circle with the larger circle of the FPV).

The FD commands anticipated the initial level-off altitude of 2500ft, but strict following of the commands was necessary given the initial high rate of climb to avoid busting the level. Climb thrust was set by moving the thrust levers back to a detent from the full power position. Never having flown sidestick before, I was pleased to find that it was all very comfortable, with small smooth inputs required. The autotrim function was also simple to get used to, such that any attitude selected was trimmed out quickly.

Further climb clearance to FL150 to the west was given by ATC, and Jean-Louis selected the FD commands for the climb. Once again, FD guidance was easy to follow, and I was enjoying the flying by spending most of my time using the HUD, reminding me of a previous life on the Tornado. The basic symbology in both ►

> We were urged to 'Increase Speed' by the audio warning system

The 7X is high-tech in every way, from initial design to manufacture and continued operations and full support.

the HUD and the PDU was intuitive and easy to follow and interpret.

At FL150 we accelerated to 300kt for some general handling. I flew 60 deg AOB (Angle of Bank) turns (2g), and these could be flown accurately to +/-50ft, again using the FPV. I found better accuracy using the FPV on the PDU rather than the HUD for these manoeuvres. Releasing the sidestick whilst in the steep turn gave the DFCS the chance to automatically reduce bank angle.

We then slowed to check the DFCS speed protection. As we entered the Low Speed Cues (LSC) speed range (amber strip of the PDU speed tape), we were urged to 'Increase Speed' by the audio warning system. With the autothrottle disconnected, further slowing towards the redline stall indication, with the sidestick now fully aft, resulted in a lowering of the nose a few knots above the redline stall indication. There was noticeable buffet at this point.

Carrying out the same exercise with autothrottle now connected gave the same lowering of the nose plus a load of power to assist with regaining speed.

In the approach configuration (flaps to SF3 and gear down) we repeated the low speed exercise. The amber LSC began at 108kt with the stall indicated at 90kt. Once again the DFCS lowered the nose as we attempted to decelerate to the stall.

Equal protection is provided at high speeds. In a gentle descent we accelerated up to and then slightly through Vmo (370kt). The DFCS raised the nose to prevent further excursion beyond Vmo, and (with autothrottle connected) closed the throttles.

We set up a return to Istres, generating a Vertical Navigation descent path at 250kt which was followed using FPV flight director command. The long recovery to Istres gave us the chance to view the various EASy displays, including synoptics, navigation, and particularly the vertical profile, a highly intuitive display at the bottom of the MFDU, which shows the aircraft's profile relative to both the Standard Arrival routing and to terrain. I could see that this would be a really ►

Nick turns the 7X back towards Istres and engages in some 2g steep turns over the Med.

Final approach to Istres and nick is hands on. Right, back of the test aircraft filled with measuring equipment.

useful feature for situational awareness when one is descending into any unfamiliar airport.

Establishing on a long final approach for RW 33, it was here that I remembered just how easy it is to fly approaches using a HUD and FPV: simply place the HUD FPV symbol on the aiming point of the runway and the job is essentially done, within reason. With gear down and flaps to SF3, the throttles were closed at 50ft radalt (automatic call-out) and the flare initiated at 30ft. Thanks to the trailing link main gear, the landing was smooth. The nose had to be lowered what felt like quite a long way to get nosewheel contact on the runway. Jean-Louis reconfigured the flaps during the roll-out, and we re-applied power for a further circuit.

With sidestick and HUD, it was in the circuit that I really enjoyed the fighter-like feel of the 7X. Tight visual circuits were comfortably flown, selecting SF1 downwind, gear down abeam the touchdown point, and final flap selections around the finals turn. Speed control throughout all the circuit work was made easy by using the energy chevron. On the final landing, after nosewheel touchdown I selected idle thrust reverse and we decelerated gently without testing the full capability of the carbon brakes.

> I really enjoyed the fighter-like feel of the 7X

OPERATIONS

After this short flight test it was very clear that from a pilot's perspective the Falcon 7X is a great aircraft to fly. Pure handling on the sidestick requires small and smooth inputs, but the results are very satisfying,

RANGE ROVER

The fuel efficiency of the Falcon 7X gives it astonishing range as these range maps produced by Dassault show. They use three different cities to show possibilities: Paris, New York and Dubai.

FLIGHTDECK

The avionics system on the Falcon 7X requires explanation in its own right. Dassault designed the Enhanced Avionics System (EASy) from years of development of cockpits for its Mirages and Rafale. Transferring the task-reduction designs from its fighters to the 7X business jets has brought about a whole new concept to cockpit layout.

Based around the Honeywell Primus EPIC avionics suite **(1)**, Dassault adopted a clean sheet approach to the flight deck of the Falcon range of aircraft, based on improving crew situational awareness, reducing pilot workload, and achieving better crew coordination. The emphasis was placed on graphical visualisation, the limiting of stand-alone switches and buttons, and a layout that would prompt head-up flying and crew coordination.

The result is a fully integrated system which features four large format LCD screens **(2)** with data input from pilots via a track-ball **(3)**, called a Cursor Control Device (CCD). In many ways this method of data entry is similar to the common PC, thus pilots quickly become familiar with the concept of moving the crosshair-shaped icon around the screens.

The four screens are arranged in a T-configuration. The screen in front of each pilot is known as the Primary Display Unit (PDU) **(4)**, and contains all information pertaining to piloting the aircraft.

The Multi-Function Display Units (MFDU) **(5)** are installed vertically in the middle of the panel, and are dedicated to mapping, flight management, electronic checklist displays, and systems management.

The great advantage of this large-screen system is that anything that one pilot does can easily be monitored by the other, greatly helping with the crew coordination aspect; there is no need to lean over to check what the other pilot has done. The whole concept of the flight deck is based on a common workspace, easing the crosschecking process that is so essential for efficient two-pilot operation.

The other major new concept with EASy is that of flying primarily by reference to Flight Path rather than pitch attitude. Flying by reference to a Flight Path Vector (FPV) symbol removes an enormous amount of pilots' efforts in maintaining a desired profile. To maintain level, simply put the FPV on the horizon line – any speed, configuration, weight, throttle setting, etc. Similarly, intercept an ILS glideslope, select 3 deg nose-down on the FPV, and you will maintain the glidepath.

Couple FPV and ILS guidance in a Head-Up Display (HUD), and then not only are you flying an accurate glidepath but you are already looking through the windscreen, ready to convert to the visual transition to complete the landing – a particularly useful feature when the weather is on minimums. Even en-route, a HUD FPV is useful. If the FPV is buried in a large build-up of cloud 100 miles away, then you know that you will eventually fly through it if you don't take any action.

Associated with flight path display is the energy chevron and Thrust Director display. The green energy chevron gives an instant display of acceleration and deceleration, and the magenta Thrust Director tells the pilot or autothrottle where to place the throttles to achieve a desired speed. Together, these displays provide the pilots with information on the aircraft's total energy state, another inheritance from the Dassault fighters.

> Data entry is similar to the common PC

The EASy allows each pilot to know what the other has done.

and the DFCS does its job beautifully. The flight deck is a delight to be in, with extremely well organised displays and low noise levels. With FPV as primary reference coupled with a HUD, any pilot should quickly feel at home with this different yet highly intuitive way of flying.

There can by major differences, of course, between just flying an aircraft and operating it around the world. However, I don't believe that this would be a problem for the Falcon 7X. With proper training, pilots should quickly become familiar with the EASy flight deck, such that operations can run smoothly and efficiently wherever they may be in the world. Dassault have invested a great deal to ensure long term reliability of the aircraft, and the service backup (including three new technical backup centres) are in place to sort out technical issues quickly.

It's obviously an aircraft that can fly for some 11-12 hours at a time, so pilot comfort is clearly something to consider. A crew rest area is an option that I don't suppose will be installed on many aircraft, but at least the cockpit area is quiet and comfortable.

The Falcon 7X is clearly an aircraft that we will see a great deal of, and orders are holding up well through the worldwide slump. It is a real 21st Century pilot's aircraft, and certainly one to be proud to fly and operate.

> Pilots should quickly become familiar with the EASy flight deck

SYSTEMS

Constructed from metal alloys and composite materials, the Falcon 7X has three rear-mounted Pratt and Whitney Canada 307A engines, controlled by dual Full Authority Digital Engine Control (FADEC) and each producing 6,400lb of thrust at ISA conditions.

The centre engine includes a clam-shell thrust reverser which can be used down to full stop without reingestion problems, and which can also be used for backing up. Autothrottle function is included, and the engines meet modern FAA/EPA emission requirements.

Fuel is contained in the wings and the centre and aft sections of the fuselage. The lateral engines are supplied by fuel from the respective wing tank and centre tank, with the centre engine supplied by the centre and aft tanks. However, ultimately any fuel tank can feed any engine. Total fuel capacity is around 32,000lb.

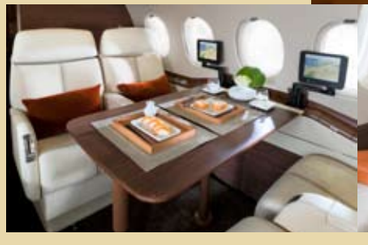
The three hydraulic systems (A,B, and C) are powered by combinations of engine and electrical stand-by pumps to provide redundancy to the necessary services (flight controls, flaps, landing gear, brakes, and thrust reverser). A Ram Air Turbine (RAT) is also installed under the right forward fuselage in case of total loss of hydraulic pump pressure. Flight controls comprise two ailerons and two spoilers, a single rudder, two elevators and trimmable stabilizer, six leading edge slats and four trailing edge flaps, and four airbrakes used jointly with roll spoilers for lift dump and aerodynamic braking. The Digital Flight Control System (DFCS) includes three primary and three secondary computers, together with a back-up analogue computer for direct operation of the flight controls.

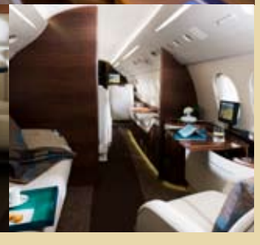
Each landing gear leg has two wheels, with the main gear using trailing link arms. The nosewheel is steered via the rudder pedals only. A manual override allows the landing gear to freefall if required. Carbon disc brakes are fitted, together with antiskid, and the braking system also provides signals for automatic airbrake activation during landing or rejected take-off.

The electrical system is 28V DC, with power provided from two batteries, three engine-driven alternators, the APU starter generator, and the RAT. External power can also be connected. The APU, in the aft fuselage, is available for ground use only.

WELCOME ABOARD

Dassault's Falcon 7X is a high-end business jet and interiors are specified to VVIP tastes. Notice how much room there is, right. At this year's EBACE, Dassault unveiled a new cabin interior designed in collaboration with BMW Designworks USA – see photos below. They said, "The new Falcon 7X cabin introduces subtle curves throughout the interior. Curved bulkheads visually expand the main cabin volume while subtle curves in the galley and main cabin create better flow. Cabin lighting techniques feature up-wash and down-wash ambient lights as well as light strips. The final result is elegant and styled cabin fused with function."





FACT FILE
DASSAULT FALCON 7X
CATEGORY Long-range large jet
BASE PRICE $45ml
MAX CRUISE 515kt
MAX RANGE 5950nm
CEILING 51,000ft
TAKE-OFF DIST 5505ft (ISA, 8 pax)
LANDING DIST 2,262ft (ISA, 8 pax)
MTOW 69,000lb
EMPTY 34,272lb
MAX PAYLOAD 6728lb
PAYLOAD WITH FULL FUEL 2988lb
FUEL CAPACITY 31,940lb
WINGSPAN 86ft
CABIN LENGTH 39ft 1in
CABIN HEIGHT 6ft 2in
CABIN WIDTH 7ft 8in
ENGINES 3 x Pratt & Whitney PW307A turbofan
POWER 3 x 6402lb thrust
AVIONICS Dassault EASy
MANUFACTURER Dassault Aviation, France