

Status Report: Falcon 900EX

The third-generation Falcon 900, slated for April 1996 deliveries, will have a 4,500-mile range, new avionics and lower operating costs.

By **FRED GEORGE**

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Dassault Aviation created quite a stir at this year's NBAA convention when it announced the Falcon 900EX. The newest widebody, trijet Falcon, although virtually indistinguishable from the 4,000-nm range 900B, will be able to fly eight passengers 4,500 miles with NBAA IFR reserves, when production deliveries begin in April 1996.

The range increase, notably, will give the 900EX about a 300-nm advantage over its prime competition in the under-\$30-million business aircraft class. Dassault has been craving that performance edge for years for its aerodynamically slippery, large-cabin business aircraft.

Similar to the 900B, the Falcon 900EX owes its performance gains primarily to evolutionary improvements in its AlliedSignal TFE731 turbofan engines. (See sidebar.) The 900EX's new second-generation -60 engines, compared to the -5B turbofans of the 900B, offer a triple bonus: more takeoff-rated thrust, more high-altitude cruise thrust and more fuel efficiency. Just as important to operators, the -60 engines are flat-rated to ISA+17°C compared to ISA+10°C for the -5B turbofans, which will result in excellent hot-and-high runway performance—already one of the Falcon 900B's strong suits.

The low- and high-altitude thrust increases will enable the Falcon 900EX to almost match the 900B's runway and climb performance, although the 900EX's MTOW will be 2,800 pounds more than the 900B's. Two additional fuselage fuel tanks—one forward of the wing and one in the aft fuselage section—will increase the 900EX's fuel capacity by 1,660 pounds, thereby helping to boost range by 500 miles compared to that of the 900B.

Most of the Falcon 900EX's other weights also will increase. For example, the larger, heavier, more powerful engines add 267 pounds. The newest Falcon will have larger outboard engine nacelles, a reshaped S-duct for the center engine, plus a new thrust reverser. (All Falcon 900 aircraft use a single-thrust reverser on the center, fuselage-mounted engine.) Dassault estimates, though, that the Falcon 900EX's airframe will weigh only 385 pounds more than the 900B's, even with the added weight of the extra fuel tanks.

Dassault designed the original Falcon 900 in the early 1980s with adequate structural margins to accommodate as then unforeseen improvements, so the 900EX's other weights—BOW, MTOW, max ramp weight and max landing weight—can be increased without having to add bulk to the basic airframe.

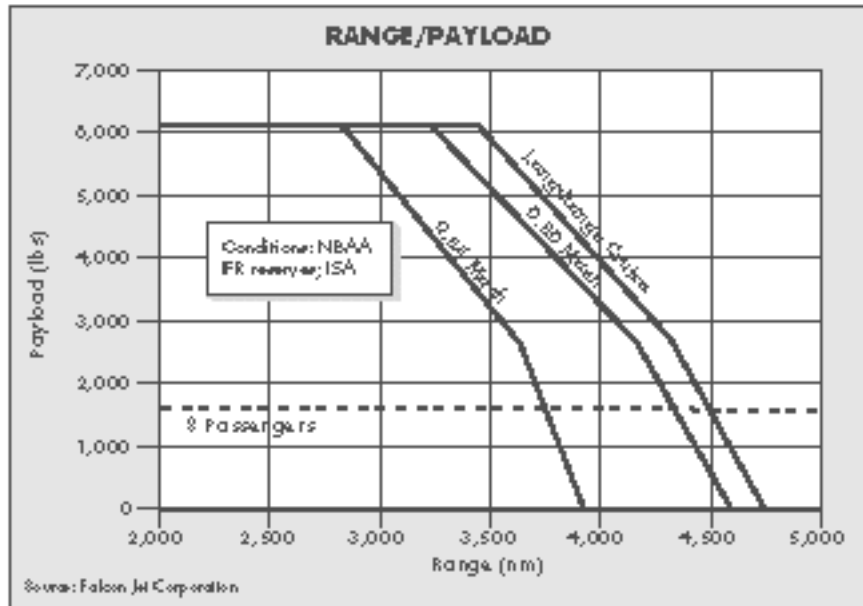
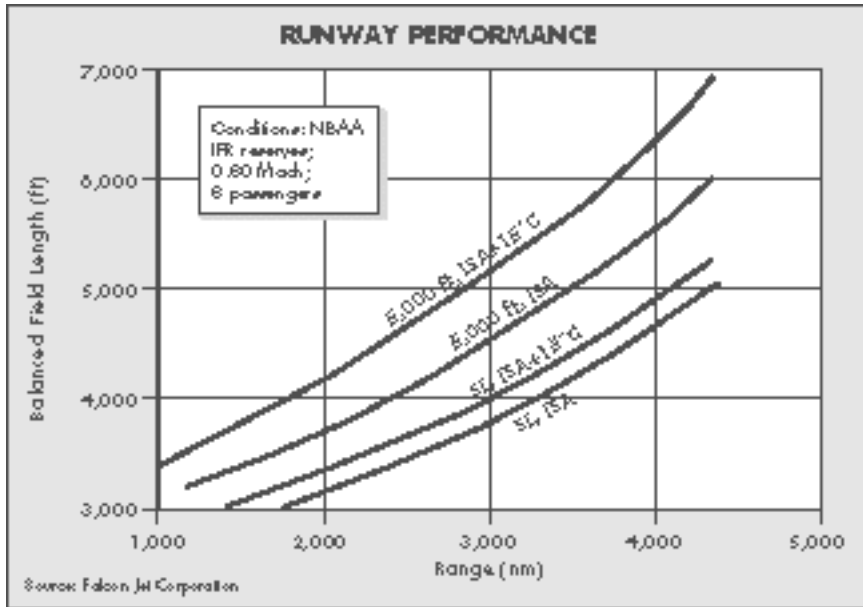
Dassault claims the Falcon 900EX will have a basic operating weight (BOW) of 24,700 pounds—only 40 pounds more than the Falcon 900B. Lightweight interior completion materials make possible the minimal weight gain even though the 900EX's airframe is heavier.

MORE RANGE, SPEED AND FLEXIBILITY

Two years ago, Dassault proposed building the 6,000-nm range Falcon 9000, a three-engine business aircraft that would have competed head-on with the emerging class of ultra-long-range business aircraft. After serious consideration of the size of the market it estimated for such aircraft, Dassault concluded there wasn't room for three ultra-long-range contenders, especially those priced at \$30-million to \$35-million.

Dassault, thus, bowed out of the competition and elected to develop an advanced version of the Falcon 900, a model that would be available sooner than the

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PRELIMINARY SPECIFICATIONS DASSAULT FALCON 900EX

B/C/A Equipped Price \$25,950,000

Characteristics

Seating 2+12/19
 Wing Loading 91.6
 Power Loading 3.22
 Noise (EPNdB) FAR Part 36, Stage 3

Dimensions

See Three-Views

Power

Engines 3 ASE
 TFE731-60-1C
 Thrust 5,000 lbs ea.
 TBO OC

Weights (lbs/kgs)

Max Ramp 48,500/21,999
 Max Takeoff 48,300/21,909
 Max Landing 42,000/19,051
 Zero Fuel 30,864/14,000
 BOW 24,700/11,204
 Max Payload 6,164/2,796
 Useful Load 23,800/10,796
 Executive Payload 2,400/1,089
 Max Fuel 20,825/9,446
 Payload—Max Fuel 2,975/1,349
 Fuel—Max Payload 17,636/8,000
 Fuel-Exec. Payload 20,825/9,446

Limits

Mmo 0.870
 FL/Vmo FL 250/370
 Vfe (app.) 180 KIAS
 PSI 9.3

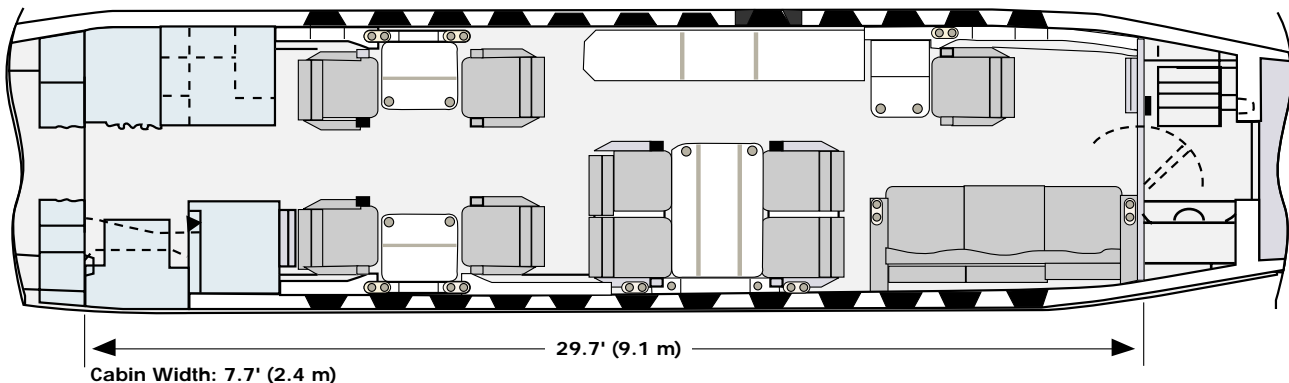
Airport Performance

TOFL (SL, ISA) (ft/m) 5,290/1,612
 TOFL (5,000 ft, ISA+20°C) NA
 Mission Weight (lbs/kgs) 47,125/21,376
 NBAA/IFR 4,500 nm
 V₂ NA
 VREF 109 KIAS

Ceilings (ft/m)

Certificated 51,000/15,545
 All-Engine Service NA
 Engine-Out Service NA
 Sea Level Cabin 25,300/7,712

Source: Falcon Jet Corporation



T FE731-60 Engines Will Power Falcon 900EX

Three 5,000-pounds-thrust AlliedSignal TFE731-60 engines, the most powerful versions of this veteran turbofan yet produced, will be fitted on Dassault's newest trijet. The -60 engine is based on the -5 series turbofans that power earlier Falcon 900s, but it incorporates several changes.

Up front, a new wide-chord, damperless fan, with 25 percent fewer blades and a one-inch larger diameter than the one in the -5, produces 16 percent more flow and is two percent more efficient than the fan on the -5. The higher flow rate helps to boost thrust, and it also increases the bypass ratio of the engine to 4.1:1, compared to 3.2:1 for the -5BR, thereby improving fuel economy.

The fan is driven by a redesigned fan gear box with helical cut gears for lower noise and less vibration, plus other improvements that reduce oil contamination from induced metal wear.

Most significant of the -60's changes, however, are farther downstream. An improved gas generator core incorporates three major changes: a more efficient, high-pressure centrifugal compressor; more effective seals in the hot section and boundary-layer effusion cooling of the combustion liner; and a high-pressure turbine with advanced aerodynamics. As a result, the gas generator has increased gas flow to power the larger-fan, 33-percent-higher cycle pressure for much improved specific-fuel consumption, a boost in high-altitude thrust output and lower wear characteristics.

The -60 engine produces 1,120 pounds of thrust at a specific fuel consumption (SFC) of 0.685 pounds of fuel consumed per hour per pound of thrust produced at 0.80 Mach, ISA, uninstalled. The -5B engine, that powers the Falcon 900B, produces 1,050 pounds of thrust at the same cruise design point and has an SFC of 0.745 lbs/hr/lb. Thus, the -60 engine yields 6.7 percent more push at altitude and squeezes eight percent more thrust out of a pound of fuel.

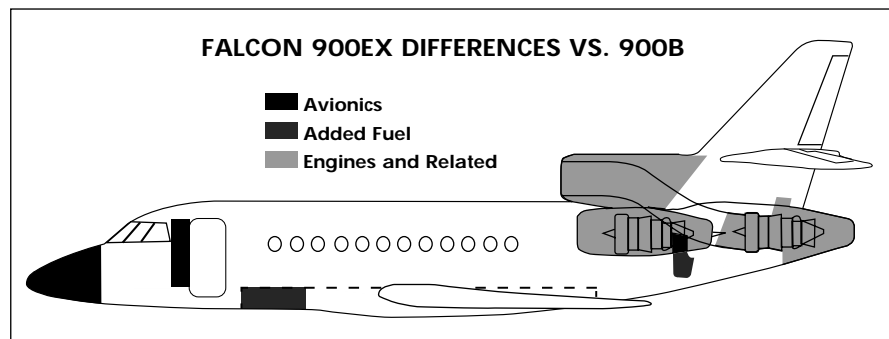
Another improvement on the -60 is the engine-mounted, N₁-rpm-referenced digital electronic engine control (DEEC). The DEEC, which is a single-channel design backed up by a conventional hydromechanical fuel control unit, will be capable of two-way communication with the Primus 2000 avionics package that includes full-authority autothrottle functions.

However, the -60's performance features are overshadowed by its 71 maintenance and durability advances. This engine was designed from day one to be easier to maintain. For example, conspicuously missing are virtually all the safety wire connections. They have been replaced by self-locking fasteners and connectors, thereby helping to reduce maintenance labor time by an estimated 35 percent.

The oil system has been improved with the addition of a more effective oil filter and a higher-capacity pump with better oil scavenging. A redesigned fuel pump eliminates the need for a fuel heater and the anti-ice valve. Fuel nozzles can be individually replaced.

Other durability improvements will allow the engine to enter service with a 2,100-hour major periodic inspection (MPI) interval and a 4,200-hour compressor zone inspection (CZI) interval. An aggressive testing program will push the MPI to 2,500 hours and the CZI to 5,000 hours within two years after aircraft certification, claims AlliedSignal. The fan, plus all compressor and turbine disks, has a 10,000-cycle design life.

The TFE731-60 promises to deliver significantly better fuel economy, substantially lower operating costs and less maintenance downtime than does the -5B. It's a prime reason why the Falcon 900EX should be less expensive to operate, as well as a stronger performer, than earlier versions of the Falcon 900.



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ultra-long-range business jets and one that would be priced several million dollars less.

The result is the Falcon 900EX—on the fast track for certification in 1996. According to Dassault, the newest Falcon 900 will have 4,500-nm range at an average 0.75 Mach, 4,330-nm range at 0.80 Mach and 3,745-nm range at 0.84 Mach. The manufacturer claims a larger market exists for a large-cabin business aircraft with such range and speed performance than for a 6,500-nm range aircraft.

Such range performance will allow the 900EX to fly nonstop from Sapporo, Japan to San Diego at 0.80 Mach, or from Fort Lauderdale, Florida to Budapest or Paris to St. Louis at 0.75 Mach. Just as impressively, the 900EX will be able to depart Aspen at 14°C and fly directly to Dublin.

The 900EX also will be able to dash from Paris to White Plains, New York at 0.84 Mach (482 KTAS) high-speed cruise—and use Washington National as an alternate. The high-speed efficiency of the 900EX will allow it to fly eight passengers at the same speed from White Plains to Vancouver, British Columbia, Canada with intermediate stops in Richmond, Virginia and Memphis—without refueling.

Assuming a 24,700-pound BOW, the Falcon 900EX also will have a greater than three-ton maximum payload. That is two-thirds more than that of the Falcon 900B, enabling the 900EX to fly 19 passengers and virtually all the luggage and all of the optional equipment that can be stuffed aboard. Carrying the maximum 6,164-pound payload, the 900EX will be able to fly 3,380 miles with NBAA IFR reserves.

PASSENGER CABIN

The newest Falcon 900's passenger cabin will be virtually identical to the Falcon 900B's. Most corporate buyers of Falcon 900 aircraft have favored a three-lounge cabin configuration, similar to the one shown in the accompanying illustration.

The standard interior, included in the purchase price of the aircraft, includes 12 seats with four swiveling chairs in the forward compartment, a four-seat club in the center and an aft section with a three-place divan and a single swivel chair. There is some question regarding certification of the side-facing divan, though, because of new regulatory requirements involving passenger restraints.

Dassault includes a forward galley equipped with oven, coffeemaker, hot and cold water, and china and stemware. Aft of the passenger cabin, a full-width lavatory was built, with an externally serviced toilet, plus a 127-cubic-foot pressurized baggage compartment. A second, forward-crew lavatory is available as an option.

Buyers of the Falcon 900EX will have the option of

outfitting the aircraft with Honeywell's new Communications Management Unit (CMU), a multi-mode box that helps transform the passenger cabin into an airborne office. The CMU makes it possible for several passengers to participate in conference calls, and they will have access to a seat-to-seat intercom, fax machine, a printer and a PC modem. By means of a link to the FMS, the CMU compares aircraft position to available communications facilities. Thus, the equipment can automatically route voice and data by the appropriate means—air-to-ground radiotelephone, ACARS VHF or HF datalink or satellite communications transceiver. Each of those communications systems, however, is a separate option.

The CMU makes it possible for all voice communications functions to be integrated into a single handset, eliminating the need for separate handsets for each communications system. Also, the CMU is capable of functions such as call forwarding, call waiting and call holding. It even may be fitted with an answering machine.

IMPROVED OPERATING COSTS

Dassault has made reduced direct operating costs (DOCs) a top priority for the Falcon 900EX, in line with its high-profile campaign to keep the Falcon 2000's DOCs as low as possible.

The 900EX will be five percent less expensive to operate than the 900B, according to company estimates. This projection is based on up to eight percent lower fuel consumption, reduced maintenance labor resulting from onboard, computerized system diagnostics and more extensive warranty coverage. For example, the manufacturer estimates that parts costs will be six percent lower during a 12-year period of ownership because of the improved warranty. In addition, AlliedSignal has reduced its hourly Maintenance Service Plan fee to \$114.70 per engine for the -60 turbofan compared to \$127.44 per hour per engine for the -5B turbofans fitted to the 900B.

PROVEN TECHNOLOGY, MINIMAL RISK

The Falcon 900EX, though it will incorporate many advanced systems, will use well-proven technology. Arguably the new aircraft's most critical components, the TFE731-60 turbofan engines, have been in flight test since June, and AlliedSignal says they will be certified by April 1995.

First introduced on the Dornier 328 and subsequently selected for use on several business aircraft, the Primus 2000 avionics suite will have accumulated thousands of hours in revenue passenger service prior to the first flight of the Falcon 900EX in May 1995. Such opera-

Honeywell Primus 2000 Avionics

There is a striking contrast between the Primus 2000 avionics suite of the Falcon 900EX and earlier versions of the Falcon 900 that use Honeywell's SPZ 8000. Most obviously, the Falcon 900EX's instrument panel will be fitted with large-format, eight-by-seven-inch integrated display tubes (including a center-mounted engine instrument display) that eliminate more than two dozen, single-function instruments while also offering more useful information to the flightcrew.

If one looks closely at the photograph on page 83, substantive improvements become apparent when compared to the Falcon 900B. Many controls that were formerly located in the instrument panel and in the center console have been moved to the glareshield, resulting in much less head-down time and better hand-eye coordination. In our opinion, the Falcon 900EX cockpit design places top priority on human engineering.

Collins Pro Line 4 comm/nav/ident (CNI) radios, well-known for superb reliability, will be controlled by integrated radio tuning units (RTUs) positioned on either side of the digital flight-guidance system control panel in the glareshield. The compact RTUs are positioned where both pilots easily can see them, and they eliminate the separate CNI control heads in the center console.

However, most of the significant changes were made behind the instrument panel. The SPZ 8000 offered dual redundancy of critical systems—but both systems were required for dispatch. The Primus 2000 provides triple redundancy for many systems, allowing dispatch with the failure of one system. For instance, the EFIS display processors are triplicated, as are the fault-warning computers. Dual Laseref III inertial reference systems will be standard, and a third system will be offered as an option, thereby allowing dispatch with one Laseref III inoperative.

Dual FMZ-2000 FMSes, with a third FMS offered as an option, will be fitted to the newest Falcon trijet. The FMS is a circuit board that plugs into the avionics computer box. The FMS will have virtually every function needed to guide the aircraft from after takeoff to shortly before touchdown, including predicted and actual wind corrections, learned performance data, what-if performance queries and full autothrottles—the latter function being a first for a Dassault business aircraft.

Forming the center of the Primus 2000's hub-and-spoke avionics architecture will be the Falcon 900EX's three integrated avionics computers (IACs). The IACs provide display processing, FMS functions, fault warning and system-warning.

The Primus 2000's integration of functions into the centralized avionics computers, coupled with lighter-weight components and reduced wire count (compared to the SPZ 8000) will yield a 10-percent weight savings—almost a fifth less bulk and a 10-percent reduction in the electrical power required.

Other standard equipment includes a Honeywell P870 Doppler turbulence-detection weather radar, dual AlliedSignal Bendix/King KHF-950 HF comm transceivers, an AlliedSignal GPS, a JET standby attitude indicator and Sextant standby air-data instruments, as well as cockpit voice recorders and flight data recorders and an ELT.

Options will include Honeywell's Communications Management Unit, three- or six-channel satellite communications systems, a multiple-channel, VHF air-to-ground radiotelephone and single or dual satellite navigation receivers.

tional experience will go a long way to exterminate any bugs in the system. Many other Falcon 900EX components and systems are seasoned fleet veterans, which already have proven their durability.

Dassault also has reduced its financial exposure by entering into an 80/20 joint venture with risk-sharing partners AlliedSignal (engines), Honeywell (avionics), SABCA (center engine intake), Hellenic Aircraft Industries (rear-fuselage fuel tank), Latécoère (aft-fuselage section and engine pylons) and Alenia (engine nacelles and center-engine thrust reverser).

If it measures up to Dassault's expectations, the Falcon 900EX will smoothly fit into the niche between

today's 4,000- to 4,200-mile, long-range heavy-iron business aircraft and future 6,300- to 6,500-nm range ultra-long-range business jets. Dassault's third-generation 900 will provide nonstop service between Europe and North America, even against statistically improbable fierce headwinds. Eastbound, it will allow business travelers to fly nonstop from many West Coast U.S. cities to Europe—a first for a Falcon Jet.

Such long legs, however, won't extract a penalty in short-field flexibility. Simply put, the 900EX will be able to operate out of more airports than any other competitive business aircraft. Its three-engine configuration and added thrust offer hot-and-high airport performance that

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The newest Falcon trijet will have the V-speeds and docile handling characteristics of a much smaller business aircraft, based on our experience flying the Falcon 900B. These attributes make flying out of smaller airports safe and comfortable.

is unmatched by others in this class.

Just as importantly, in our opinion, the newest Falcon trijet will have the V-speeds and docile handling characteristics of a much smaller business aircraft, based on our experience flying the Falcon 900B. These attributes make flying out of smaller airports safe and comfortable. The Falcon 900 series is well-known for its cabin comfort, handling ease and fuel efficiency. With the introduction of the 900EX, Dassault will gain a new title: speed and range champion in the under-\$30-million business aircraft class (\$25.950 million to be exact). **B/CA**

Falcon 900EX Warranties

Major airframe	10 yrs. or 10,000 hrs.
System components manufactured or specified by Dassault	5 yrs. or 5,000 hrs.
Standard avionics	5 yrs. or 5,000 hrs.
Engines	5 yrs. or 3,000 hrs.
APU	3 yrs. or 2,000 hrs.
Interior completion and exterior paint	1 yr. or 1,000 hrs.
Maintenance labor	6 mos. or 500 hrs.