



Bombardier Learjet 45

It's a fast, efficient passenger pleaser, but the first all-new Learjet in three decades gets checkered marks from those who rely on it most.

By Fred George

Ask Learjet 45 operators to name their five favorite characteristics about their aircraft and you'll find plenty of consistency. They say it's fast and economical, quiet and comfortable for passengers, especially according to operators who've upgraded from 20- and 30-series Learjets. The Model 45's fuel economy rivals or even surpasses that of the much smaller Learjet 35A, operators claim. It climbs directly to FL 410 or higher on all but the shortest trips. Just as importantly, its clean-sheet wing has excellent high-speed aerodynamic characteristics, resulting in a safe, stable ride, even in turbulence. And its low-speed handling characteristics are far superior to any previous Learjet.

"We wanted eight-passenger capacity in an extremely efficient airplane. The Learjet 45 is the only airplane that did it. It operates at half the cost of our Falcons," explained Scott Robertson, chief pilot for Werner Aire, an Omaha-based operator.

The first all-new Learjet in three decades embraces next-generation digital technology, operators say. "I admire Bombardier for venturing into the latest technology and bringing it to fruition," said David Vaughn, head of Hytrol Conveyor, a firm that took delivery of serial number 10, the first customer airplane, in July 1998.

The aircraft also has good range, enabling it to fly nonstop between most airports in North America, except those on the east and west coasts, according to operators. In large part, this is due to better-than-forecast, high-altitude

cruise performance of the Honeywell TFE731-20 engines.

Cabin comfort is one of its biggest assets. "The aircraft is a real people pleaser. Our passengers love it," commented Greg Kuta, aviation department manager for Eaton Corp. Eaton has been a Learjet operator for more than three decades.

"Our people just love flying in it," echoed George Spillane, Carpenter Technology's chief pilot. Operators also say passengers appreciate the 50-cubic-foot aft, external baggage compartment, which is twice as large as Learjet 60's luggage bay.

Pilots laud the aircraft's handling characteristics and stability, although it's somewhat heavier in roll control force than Learjets 31A and 60, they say. Many also say the wheel brake stopping power was head-and-shoulders above that of any previous Learjet.

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Bombardier set lofty goals for the Learjet 45 when the program was launched in September 1992. The aircraft would not only be a technology demonstrator, it also was intended to have the lowest direct operating costs of any eight-passenger light jet.

High technology, though, proved to be a double-edged sword, operators told B/CA. "Just because the technology is available doesn't mean it should be used," reflected Bill Sparks, flight department manager at Helmerich and Payne (serial number 82), who favors wringing out the bugs before introducing the technology to market.

As a result, more than two years after the aircraft's entry into service, operators give the Learjet 45 mixed marks. Quality control issues, especially ones associated with aircraft completion at Bombardier's Tucson facility, continue to affect the aircraft. In everyday operations, Learjet 45 aircraft, especially early serial numbers, have been plagued by dispatch reliability woes, according to some operators.

Many say the aircraft was rushed to market before the bugs were ironed out. "The airplane was two years late and one year early," said Kirby Woehst, managing director of corporate aviation for Federal Express, which operates five Model 45s, with two more on the way.

Woehst's comments were echoed by several others. "When everything works, it's great," said Jim Mackey, Carlisle Co.'s chief pilot, adding, "But when the tide turns, look out."

"There have been times when we wanted to wad up the airplane and throw it back at Wichita," Donald Henderson, Key Corp.'s director of aviation, told B/CA.

"We [the flight department] have lost a lot of credibility [with management] because of dispatch delays," Helmerich & Payne's Sparks commented.

"The days when this airplane comes in without a squawk, I just love it. But so far, it has eaten my lunch," said Bob Schultz, chief pilot for Houston-based Knollwood LLC.

The reliability, however, of late model serial numbers, especially after the first 100 units, has improved. And to its credit, Bombardier has embarked on several post-certification upgrades to the aircraft, including a Performance Enhancement Program (PEP) in 1999. PEP improved braking and runway performance, and boosted the tanks-full payload by 500 pounds. Certification of another 800 pound increase in MTOW is slated for second quarter 2002. This will improve range/payload capabilities, but takeoff



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The Learjet 45 routinely climbs directly to FL 430, or higher, and then cruises at 440+ KTAS while burning 1,000 to 1,200 pph, operators said.

field length will increase because no thrust increase is planned. "We really increased the flexibility of the aircraft, commented Claude Chidiac, Bombardier's general manager of business aircraft programs.

Bombardier engineers are working on other product improvements, although operators think they're slow in coming. Most issues raised by operators "aren't critical, aren't related to airworthiness," Chidiac commented. "It takes more engineering work [than with an older aircraft] because the Learjet 45 is an advanced, clean-sheet design. This [ultimately] results in a more elegant solution," Chidiac said.

Overall, does the Learjet 45 and

Bombardier's product support measure up to expectations? Here's what operators told us.

Operator/Operations Profiles

Many Learjet 45 aircraft are operated by small to medium-size companies with regional subsidiaries, affiliates and customers. Most small companies operate one or two aircraft. If they have fleets, they are small in size and mixed in composition. Since its introduction, a large number of Learjet 45 aircraft have been sold to customers that previously operated smaller light jets or turboprops.

Learjet 45 buyers also looked at the Cessna Citation Excel, Raytheon Beechjet

Honeywell Avionics and Related Components

The Primus 1000 avionics suite, the first four-tube configuration in a business aircraft to include EICAS, was one of the most advanced digital avionics systems when the Learjet 45 was introduced.

A series of product improvements has helped the avionics system mature. The most recent Phase III package, now available as a no-cost retrofit, includes EICAS upgrades to eliminate some "cry wolf" false alarms, autopilot vertical mode enhancements, simultaneous operation of yaw damper and rudder boost, extended TCAS range and remote FMS CDU tuning of the Primus II radios with 8.33-kHz channel spacing. Numerous systems compatibility issues were resolved.

Future plans include upgrades to the autopilot to eliminate high-altitude wing rock and various FMS upgrades, including takeoff V-speed and runway field length computations.

Operators say they want a PFD bearing and distance readout for raw data while in the FMS mode, but Bombardier hasn't announced plans for this feature. In addition, operators would like to see flat-panel displays replace the CRTs in future production serial numbers.



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Hefty-size wheel brakes provide superb stopping power, but it's not easy to modulate the brake-by-wire system smoothly.

400A, Gulfstream G100 (a.k.a. Astra SPX) and Raytheon Hawker 800XP, among other aircraft. The final selection came down to speed, range, payload and operating economics.

"It flies faster, farther and uses less fuel than [the competition]," said Lamar's Alan Bessonnet, echoing the comments of many other operators.

Utilization typically varies with company size. Some privately held firms fly their aircraft only 250 to 300 hours per year. Medium-size companies may use the Learjet 45 as a workhorse, typically logging 550 to 750 hours per year in the airplane.

The Learjet 45 also has been delivered in sizable numbers to larger firms that operate sizable fleets, such as Eaton Corp., FedEx, Southern Cos. and TAG Aviation, as well as Flexjet, Bombardier's fractional ownership wing. Most larger companies fly each Learjet 45 at least 600 hours per year, but TAG's utilization is closer to 350 to 400 hours per year on each of its aircraft.

Most operators have configured the cabins in a double-club layout. Few ordered the aircraft with four chairs in center-club, flanked by two aft-facing forward chairs and two forward-facing aft chairs. A belted potty seat is available as a ninth full-time passenger chair.

In everyday operations, most operators say their average passenger load is three to five people. Some operators, such as FedEx, say they average five to six passengers and routinely fill eight seats.

With such passenger loads, the Learjet 45 is capable of flying more than 1,800 nm, assuming NBAA IFR reserves. Operators typically fly 1.5- to 2.0-hour legs, spanning 600 to 800 miles. Most

operators, however, told B/CA their missions average 1.3 to 1.5 hours and 400 to 600 miles. Average total fuel burn is 1,300 to 1,400 pph on such short hops.

On typical missions, operators take full advantage of the Learjet 45's high-altitude climb and cruise performance by filing for FL 410 or higher. They cruise at 440 to 450 KTAS or faster. "We don't pull it back. We just let it cook," said Jerry Manning, Temple-Inland Forest Products' aviation department manager. "It likes to fly fast," Eaton's Kuta commented. "We have to come back from max cruise thrust to avoid overspeed," claimed T. Michie Hill, president of Richards Aviation.

On slightly longer missions, operators climb their aircraft into the mid-forties where the Learjet 45 cruises at 440 KTAS-plus on 1,000 to 1,200 pph. "FL 430, 450 and 470 seem to be its favorite altitudes," said Werner Aire's Robertson, whose missions average 700 miles, about 1.8 hours at high-speed cruise.

Most operators say they can fly the Learjet 45 as far as 1,800 nm, verifying the predictions of Bombardier's Mission Planning Guide. Departing at the 20,500-pound MTOW, operators told B/CA they can climb directly to FL 410 or FL 430 if the OAT is close to standard. Under warm day conditions, up to ISA+15°C, they report climbing directly to FL 390.

First hour fuel flow is 1,550 to 1,600 pph on longer missions. During the second hour, operators typically step climb to a higher flight level and total fuel flow drops to 1,150 to 1,200 pph. Third hour fuel flows drop to 1,100 pph, and subsequent hour fuel flows are as low as 1,000 pph, operators say. Virtually all operators told B/CA they cruise at 0.78 Mach or faster.

While operators are pleased with the Learjet 45's high-altitude speed and fuel efficiency, they're not nearly so satisfied with takeoff field performance. This is directly related to the Learjet 45's increases in MTOW, including next year's scheduled 800-pound MTOW increase to 21,500 pounds. This will make the Model 45 the first production Learjet to have a weight-to-thrust ratio in excess of three-to-one. Some operators complained that the aircraft is underpowered.

"They should have put -40 engines on it. They knew this up front. I was on the first customer advisory board," Kuta commented. Virtually none of the operators, however, complained about Model 45's climb and cruise performance.

Bombardier's Chidiac claims the 800-pound increase will give a typically equipped Learjet 45 an eight-passenger, full-fuel capability, assuming a 13,700-pound BOW. In truth, though, the average BOW is closer to 14,000 pounds,

Honeywell TFE731-20 Engines

Learjet 45 was originally delivered with -20R engines flat-rated at 3,500 lbf for takeoff up ISA+16°C, with 3,650 lbf thrust available for APR. After approximately 100 engines were delivered, Bombardier and Honeywell introduced the -20AR, an upgraded version with more-robust hot-section parts that improve durability.

Early -20R engines were prone to carbon seal failures, related to excessive heat buildup. High temperatures also caused coke buildup that flaked off into the oil, causing oil filter clogging. Honeywell redesigned carbon seals for improved cooling and elimination of coke buildup, according to Joan Sciacca, the firm's TFE731-20/40/60 product manager. Those changes are incorporated in -20AR engines.

Honeywell is now delivering -1007 software, the fifth production version, for the -20's Digital Electronic Engine Control. The latest change resolves an uncommanded acceleration issue and revises the N1 rpm cutback schedule during anti-ice system operation.

There are more than 280 -20 series engines in the field, and they've racked up nearly 250,000 hours in service as of November 1, 2001. The high-time engines are now reaching the 2,500-hour MPI interval, during which the hot sections are inspected. "We like what we see," Sciacca remarked.

The -20R and -20AR engines have a mean time between unscheduled engine removal of one in 48,000+ hours and an in-flight shut-down rate of one in 97,000 hours. Honeywell claims that it ships 100 percent of all AOG parts orders within 1:30 hours of notification.

The current basic MSP rate is \$118 per engine per hour. More than two-thirds of the operators are enrolled.



Paul Bowen Photography

according to operators contacted by B/CA. With the pending weight increase, a typically equipped Learjet 45 will be able to carry seven passengers, full-fuel and have margin for excess baggage.

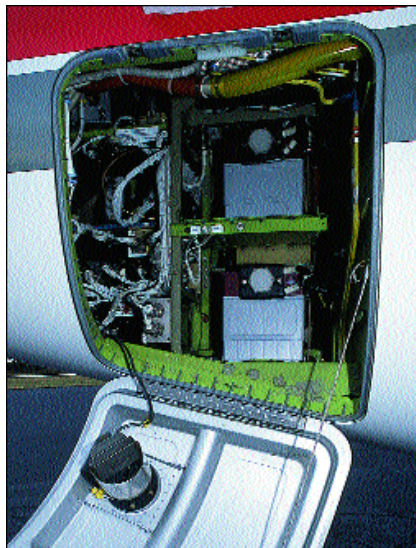
Most buyers order the optional APU. That's the main reason for the difference in Bombardier's spec weight and actual BOWs. The APU is almost a necessity, operators say, because the Model 45 is the first mass-produced Learjet to be fitted with an air-cycle machine (ACM) as the heart of its environmental control system package.

The ACM requires a source of high-pressure, high-volume pneumatic bleed air for operation, such as an APU, unless one or both propulsion engines are running. "You really have to have the APU," said Kuta. Most operators don't want to run one or both main engines longer than necessary on the ground.

Report Card and Quality Control Issues

The Learjet 45 generally got high marks for airframe, avionics and systems design. Operators noted that the engine's digital electronic engine controls (DEEC) are similar to FADECs, enabling them to set takeoff, climb and cruise thrust using detents in the throttle quadrant. Most operators say the engines were quite reliable, except for gripes associated with carbon seal failures in early production engines. (See Honeywell TFE731-20 engine sidebar.)

Operators are critical of the Learjet 45's design quirks. For example, while they generally are pleased with APU operation, they're not happy with the installation design. It's crammed into too small a



When the Learjet 45 is fitted with the optional Honeywell RE100 APU, 10 pounds of equipment get squeezed into the five-pound aft equipment compartment, operators told B/CA.

Paul Brou

AOG for Spares!

Few aspects of operating the Learjet 45 have caused more heartburn than lack of spare parts. Operators told B/CA they've been stranded for two to three days or longer while awaiting AOG spares.

Bombardier officials don't mince words in owning up to the problem. "A year ago, our same-day AOG fill rate was 45 percent," said Spare Parts Director Christian Bergeron.

Since then, Bombardier has made considerable changes. First, they focused on stocking more spares on the shelf. The firm has beefed up spares inventories of the aircraft's 22,000 part numbers, especially the 1,500 items most often needed by operators. Next, an upgraded computer tracking system provides better inventory accuracy and allows the firm to "gain visibility of all sites" where spares are housed. "We've also moved the parts closer to the geographic distribution of the fleet," Bergeron said. Bombardier also now has its Wichita AOG spares desk staffed 24/7.

Currently, the same-day AOG fill rate has improved to 90 percent, Bergeron claimed. The goal is to increase the AOG fill rate to 96 percent. A new computer system is shrinking handling times before shipping to four hours, with the goal of reducing it to one hour by year-end at Bombardier's Dallas, Newark, Singapore and London warehouses. By first quarter 2002, Wichita's response time also should drop to one hour.

compartment, making it difficult to check the APU fire bottle, oil level and operating hours meter, they say. Bombardier officials had no response.

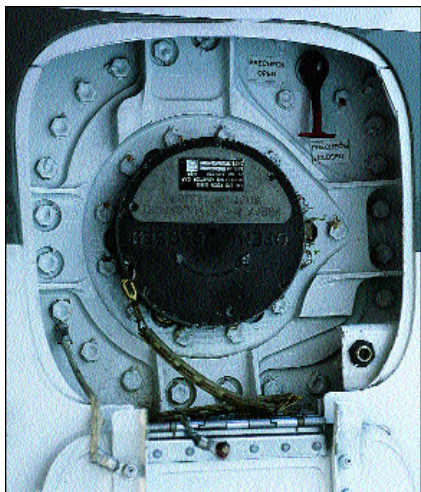
Operators say the Single Point Pressure Refueling (SPPR) port is in an awkward position. Its location above the right wing trailing edge makes the composite wing flap vulnerable to damage if line service personnel drop the refuel hose nozzle. Company insiders told B/CA the SPPR port's position was dictated by certification requirements.

Inaccurate fuel quantity indications also received criticism. Bombardier is developing a service bulletin to remedy the problem. Certification and availability is slated for 2002.

Some operators say the emergency oxygen bottle is much too small, and it's difficult to service without installation of an after-market refill access door. The system is also prone to leaks. Service Bulletin 45-12-1 solves the oxygen bottle servicing issue. Bombardier claims the standard oxygen system has enough capacity to meet regulatory requirements, but Scott Wight, Learjet product manager, says the firm is developing optional oxygen systems with two to three times the capacity of the standard system.

Operators also say the aft equipment compartment is prone to rain leaks, resulting in electrical shorts and remote avionics box failures. SB 45-55-3 provides for installation of rain gutters and improved door seals. A companion kit reseals the APU inlet and exhaust ducts.

During the initial design phase, prospective customers told Bombardier they wanted all access doors to hinge forward to prevent damage if they inad-



The SPPR port's location over the composite right wing flap makes it prone to damage if the refueling nozzle is dropped accidentally by line service personnel.

Paul Brou



Operators miss not having Learjet's traditional full seats/full tanks capability. But, even with partial fuel, the Learjet 45 can carry eight passengers 1,400 nm.

Paul Brou

vertently opened in flight. On production aircraft, though, not all doors have this feature.

Windshield failures have been a frequent problem for Learjet 45 operators. The chemically tempered glass face plies are subject to shattering. Sierracin/Sylmar, the windshield vendor, now has developed a replacement windshield with thermally tempered glass face ply that solves the problem, Bombardier officials say. The new windshields were scheduled to be available through Bombardier's spares pool by November 1.

Operators also don't like the rain-repellent coating on the glass face plies. It's not durable, and recoating the windshields with rain repellent is expensive and time consuming, they told B/CA.

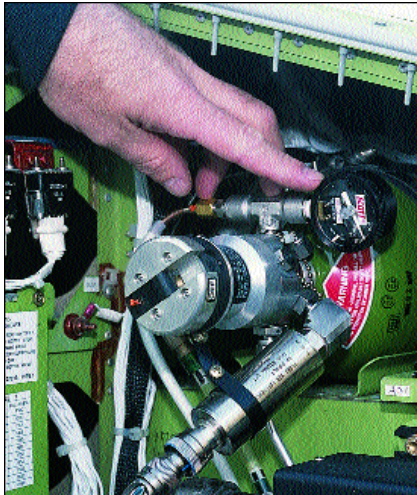
"I don't know how long the coating is supposed to last," Chidiac said. He didn't believe that recoating the Learjet 45's windshields was much more difficult or expensive than buying Rain-X brand rain repellent at a car-parts store and rubbing it onto an automobile windshield.

Electrically powered auxiliary hydraulic pumps don't last long, according to operators. As a remedy, Bombardier now offers a replacement pump with much-improved brushes.

Learjet 45 aircraft up to serial number 76 had a comparatively noisy cabin air flow distribution system, operators say. Bombardier developed SB 45-21-4, a muffler kit that substantially reduces noise levels.

Pressurization systems shortcomings also were often mentioned. Operators say the digital pressurization system has a software bug that at times causes the cabin altitude to climb. Bombardier has developed a software upgrade to solve the problem.

Pressurization bumps at the top of descent are another quirk. When the



The Learjet 45's oxygen bottle is way too small to support operations above FL 410 which require at least one crewmember to use oxygen continuously, operators said. The bottle must be refilled after every flight, they told B/CA.

Paul Brou

throttles are reduced to idle, the pressurization system switches from the low-pressure bleed air circuit to the high-pressure port.

Operators were very complimentary about the Learjet 45's wheel brake power. They were less satisfied with brake-by-wire system reliability and their pilots' difficulties in modulating braking action smoothly.

"This is the first brake-by-wire Learjet. For operators, this takes some getting used to. It has a lot to do with [pilots] making the transition from old brakes to a brake-by-wire system," Chidiac remarked. He believes brake modulation difficulties are related more to pilot training and experience than to BBW design shortcomings.

Completion issues often dog the Learjet 45. Some operators report exterior paint problems that require rework or total

repaint. Others say the quality of interior fittings and furnishings isn't up to traditional Learjet standards. Several say they had to bring quality control lapses to the attention of completion center management. Also, Bombardier, like other aircraft manufacturers, has changed to low VOC paint, which is more difficult to apply. Fine-tuning aircraft painting is an ongoing process.

As for completion center quality control issues, Chidiac said, "People taking delivery of their airplanes are very satisfied. We're going to look at one or two things we can improve. I don't think we have an issue." Regarding paint application, the company said progress is being made.

Overcoming Dispatch Reliability Woes

Learjet's Wight believes that, in light of the forgoing and other improvements, three-fourths of the Learjet 45's reliability problems have been solved. He estimates that within a year, the aircraft's reliability will have matured to Learjet 31A, Learjet 60 and Challenger 604 levels.

"Thanks largely to the strong, ongoing support and input from our customers, the aircraft is gaining a new maturity as it begins to demonstrate the reliability customers have come to expect from a Learjet," Wight commented.

"Bombardier's continued commitment, coupled with customers' ongoing feedback, will ensure a bright future for the Learjet 45 platform," he added.

Most operators also believe Learjet 45 is maturing and that within a year or so, its reliability will improve. Few operators would trade their aircraft.

Knollwood's Schultz wasn't shy about pointing out his airplane's — serial number 22 — shortcomings. But he's voting with his wallet on the product maturing. Knollwood has serial number 180 on order.

"The first six months, we had the typical new-airplane problems," said Walter Pratt, Clarco's chief pilot. "Overall, it's a great airplane."

John Skelton, head of Southern Co.'s flight department, says the aircraft has a bright future. "We have seven in service or on order. Yes, there's been a high learning curve, but as the serial numbers get higher there are fewer and fewer problems. Overall, I give the aircraft an excellent rating."

In the interim, the Learjet 45's five-year warranty is protecting operators during its growing pains. Some operators aren't optimistic about the outlook after five years.

"What's going to happen when the war-



Glass-faced windshields, a first for a Learjet, have been prone to cracking and optical distortion. A change in the tempering process is supposed to remedy the problem.

Paul Brou



Paul Brou

Most Learjet 45 aircraft are configured with double-club seating, even though they carry four passengers on average.

ranty runs out? It's going to be a tough deal, Bubba," remarked Temple-Inland's Manning.

Eaton Corp. took delivery of five early Model 45 aircraft. "It sure took a long time for the airplane to settle down. It's a good airplane, and I hope they'll keep making improvements. But I'll never buy another airplane below serial number 50," said Eaton's Kuta. Officials from Switzerland's TAG Aviation, another operator of early production aircraft, expressed similar comments. Compounding these problems, lack of spare parts in Europe has been an acute problem for TAG.

"Our chairman is not yet convinced we're going to keep our airplanes," cau-



Paul Bowen Photography

The full-width aft lavatory is popular with passengers. But the external waste water port requires a special adapter fitting, contrary to the promises made by Learjet marketers when the aircraft was first introduced.

tioned Ray Sauter of Kohler, a firm that operates serial numbers 61 and 65.

"We're so frustrated. We can't keep going this route," said Parker Hannifin's Al Maurer, who marked his Model 45 report card mostly with C and D grades. "It's wearing on everybody's patience," Maurer commented.

Key Corp. operates serial numbers 51 and 150. The early aircraft has caused heartburn. "There's always been a sacred trust between management and flight department. We've used up a tremendous amount of corporate good will. We're keenly watching the reliability of our aircraft. The jury's still out and we're not sure we're going to keep them," reflected Don Henderson, Key Corp.'s flight department chief.

"We sold our airplanes because we were disappointed in the reliability," said Dave Gardner, head of flight operations for Albertsons.

But not all operators of early serial number aircraft had such severe problems. "I've been flying Learjets for 20 years and this one is the best I've ever flown," said Mike Kroll of London Air Services regarding their aircraft, serial number 24.

And Maurer, one of the product's



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The refreshment center's ice-chest drain requires aircraft electrical power to drain off water accumulation. Operators say this quirk is an inconvenience during overnight layovers.

staunchest critics, is optimistic about later serial numbers. "There don't seem to be any problems after serial number 100," he noted.

FedEx's Woehst was downright bullish, in spite of operating several early production aircraft, including those acquired from Albertsons. "OK, we do get treated differently [by Bombardier] because of our size," Woehst conceded, "but the proof of the pudding is that their efforts are starting to show."

Most operators of late serial number aircraft were indeed pleased. "Bombardier did an excellent job. I love the low operating costs. That's the airplane's strongest selling point," commented Polar's Doug Gotterba, who operates serial number 142.

And many operators of early aircraft have later serial numbers on order. If Bombardier can capitalize on customer loyalty, continue its highly regarded technical support and make strides in spare parts availability, it may be able to buy enough time for the Learjet 45 to mature into a successful 10- to 20-year production run. B/CA

Kudos to Bombardier's Flight Operations and Product Support Team Members

More than a few operators laud Bombardier's Learjet personnel for "bending over backwards" to help them keep their aircraft flying. "They're a real good bunch of folks," said Kirby Woehst, Federal Express' managing director of corporate aviation.

Many folks were mentioned by name, including flight operations chief Robert Agostino and tech reps Trevor Andrews, Jim Edwards, Mike Kaelin, Tim Gronberg, Thomas Rutherford and Tim Verble, among others. Mike Lederer in aircraft sales and Terry Noss in sales engineering also were applauded for candor and integrity.