TURBINE PILOT

LEAR 60

The largest Learjet gets bigger and better.

BY MARK R. TWOMBLY

What a difference a dozen years make. The new-in-1993 Lear 60 is longer, is heavier, and has larger engines than the Lear it replaces, the Model 55, which went into service in 1981. Yet the 60 is 10 to 12 percent more fuel efficient, flies farther on a full tank of gas, is more comfortable for passengers, and is friendlier to pilots, too. ■ There is more to the "Lear 55 becomes Lear 60" story than performance improvements made possible by a decade's worth of aerodynamic and engine technology. You have to go back, way back—to the rest room in the back of the Lear 55's cabin. "Rest room" is a charitable description of what really is a closet-size enclosure on the left side

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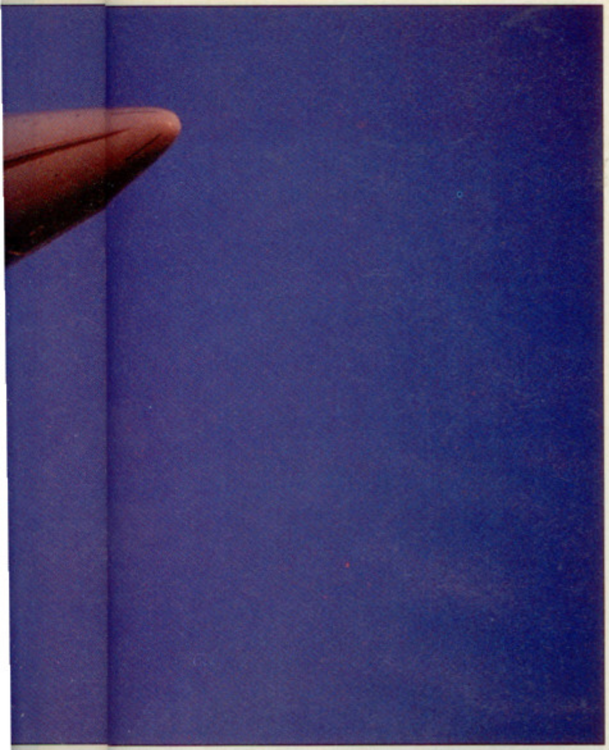
Learjet
N610TM
PARKING BRAKE
FLIGHT PLAN
FLIGHT PLAN



of the cabin facing a lonely passenger seat across the aisle. It would be a stretch to say that a $7- to $10-million mid-size corporate jet is bought—or not—solely on the basis of the size of the john, but it can be an important consideration for the people who ride back in the expensive seats and who may on occasion actually want to use the facilities.

The 55 was Lear's first large-cabin airplane. Though comfortably wide with 5-foot 8-inch headroom thanks to a full-length dropped aisle, the 55's cabin was the shortest among the field of mid-size business jets. Lear made changes in the 55 over the years, most significantly going to a Collins Pro Line electronic cockpit in the 55B and adding large stability-enhancing tailcone fins to the 55C, but there was no way around the fact that inside, the biggest Learjet still was a lot smaller than the competition.

The 60 is Lear's answer to the problem. The fuselage is 43 inches longer than the 55's; 28 inches was added to the passenger cabin and 15 inches to the tailcone baggage area. The added length makes all the difference. During a visit to Lear's plant at Wichita's Mid-Continent Airport, I had a chance to tour a pair of large Lears parked swept winglet to swept winglet on the ramp: a 55 that was in for service and Lear's 60 demonstrator, N610TM. From the outside, the 60 is proportionally balanced. The longer fuselage softens the somewhat rotund look of the 55. One clue to the 60's stretch is a sixth cabin window on the left side. Even though it has the classic Learjet shape that dates back 30 years to the original Model 23, the 60 looks more contemporary than some jets of recent design. Learjet lines will always be in style.

Inside the 60's cabin is where the change is most apparent, partly because the clamshell cabin entry door is 9 inches farther forward. The passenger seats in the company demonstrator included a rear club arrangement (the person calling the shots sits aft and right to take command of the master control panel for cabin lighting, temperature, audio, and VCR) and, ahead of that, a two-person divan across from a forward-facing seat on the left. Each individual chair has an articulating base that allows movement in any direction. Refreshments, microwave, and compact VCR and CD players are neatly stowed inside attractive cabinetry on both sides of the aisle just behind the cockpit.

And the rest room? It's still in the back, but in the 60, it stretches from one sidewall to the other—71 comfortable inches. The large emergency exit in the right sidewall of the bathroom doubles as an access door for loading baggage into a pressurized bay aft of the john. A second heated but unpressurized baggage area tucked in the tailcone is large enough to handle requisite golfing gear.

"Everyone expects good performance from a state-of-the-art aircraft," Pete Reynolds, Lear's chief test pilot, explained during his briefing on the 60 prior to our flight in 610TM. "The customers' focus is on passenger comfort and economy: how much it costs to buy and how much it costs to operate." Those were the broad objectives of the 60 design effort. More specifically, Learjet set out to correct the major shortcomings in the 55 by upgrading the cabin and improving field performance and range.

The Learjet 60 looks more contemporary than some jets of recent design.

Performance was addressed with a combination of new engines, more fuel capacity, and a drag reduction program. The 60 is powered by a pair of Pratt & Whitney 305A turbofans, each rated at 4,600 pounds thrust.

Though 24 percent more powerful than the 55's Garrett TFE731s, the 305As are more fuel efficient, thanks to higher operating temperatures and pressures and intelligent computer-controlled fuel metering.

The thrust levers are electrically linked to the Fadec (full authority digital electronic control) fuel controllers. Each engine's Fadec computer reads thrust lever position and adds that information to input from various engine sensors and the aircraft's air data computer to figure fuel flow and adjust compressor vanes. Detents in the full range of thrust lever movement correspond to approximate positions for engine cut-off, idle, maximum cruise, maximum continuous thrust, takeoff, and automatic performance reserve. The pilot selects the

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appropriate detent, and the Fadec computers set the exact power.

The system protects against engine overspeed at high power settings, automatically synchronizes the engines, increases power on one engine when it detects a loss of power in the other, and reduces reverse thrust as the airplane slows on the landing rollout. The payoff is maximum efficiency under normal circumstances, safety in abnormal situations, and a lot less work for the pilots.

The drag reduction program centered on controlling airflow in critical areas. The 55 and 60 share the same mildly swept wing planform except at the wing root. Fairings on the inboard leading and trailing edges of the 60 wing smooth airflow and add to the chord in the wing root area, which has the effect of widening the margin between low- and high-speed buffet. Induced drag off the wing/winglet juncture was reduced by extending the trailing edge of the juncture. The P&W engines have a larger diameter fan, so the nacelles on the 60 are larger. That meant the nacelles had to be moved higher and farther out to maintain optimum separation from the wing and fuselage.

Designing airplanes sometimes takes on the character of a child's game of knocking down dominoes. Stretching the fuselage of the 55 addressed the major problem of cabin size but created some new ones, including changing the drag characteristics. The wing root fairings helped fix that but led to another problem because the trailing edge fairing resulted in a slight decrease in flap area. That was solved by adding a small extension to the trailing edge of the flaps, which finally stopped the dominoes from toppling.

The two large fins on the underside of the tailcone (delta fins in Learspeak, so named because of their highly swept delta-wing shape) were first used on the 55C and later on the Lear 31A. The fins are aligned with the slipstream and contribute to yaw stability in cruise. At high angles of attack, they reduce the potential for deep stall by generating lift to counteract a loss of down-force from the T-tail. Evidence of the delta fins' effectiveness is the fact that finless, early production 55s had dual yaw dampers and stickshaker and stick-pusher. The 60 has but a single yaw damper—and it is not even a no-go item—and a stickshaker but no -pusher.

The night before meeting with Reynolds, I went to FlightSafety International's Learjet Learning Center at Mid-Continent and logged some time in a Lear 55 simulator. It is configured like an early Model 55 cockpit with electromechanical instruments and stick-pusher. I had no previous experience in Lears, so the sim ride was a good warmup to the upcoming flight


EXIT

LONNA TUCKER

in the 60. I especially appreciated the eye-opening demonstration of evils, such as aileron snatch, which lurk on the far side of M_{MO}.

The back-to-back sessions in the 55 simulator and 60 demonstrator made a point about the vast evolutionary changes that have occurred in turbine aircraft in a little over a decade, particularly in the cockpit. Each of the colorful 6 × 7-inch Collins Pro Line 4 displays on the 60's panel is a window on a world of information. The left and right (pilot's and copilot's) primary flight displays (PFDs) and multifunction displays (MFDs) depict airplane altitude, airspeed/Mach, vertical speed, air temperature, attitude, navigation information, flight director commands, mode annunciators, weather radar, check lists, warnings, and diagnostic messages. They have lots of neat features, like trend symbology for airspeed. The trend information makes for smoother, more precise power and control inputs. The MFDs also back up the PFDs in the event one fails.

Communications, navigation, and transponder radio frequency management is handled by a pair of digital-display radio tuning units. They flank a sensor display unit in the middle of the panel that serves as a backup heading and navigation display. The Collins panel, a single FMS-850 flight management system, and WXR-840 weather radar are included in the $9.095 million base price.

Control surfaces are mechanically linked to the flight controls, so the 60 has a natural and pleasing control feel.

Complex systems including fuel and pressurization are easily managed. The new digitally controlled pressurization system requires the crew to set only the landing field elevation; the rest is automatic. The fuel control panel has a schematic with annunciators that show exactly what's happening in the system.

Starting the engines is a simple matter of pushing a pair of buttons and monitoring the gauges; the electronic fuel controllers have the responsibility for avoiding hot starts. The dual digital nosewheel steering system matches rudder pedal travel with tire speed. At 90 knots, the rudder is fully effective and the nosewheel is disengaged from the steering system.

The taxiway leading to Lear's ramp was being widened when Reynolds and I trundled out to the runway in N610TM, but I had no trouble negotiating the remaining narrow lane bounded by heavy equipment.

With only the two of us aboard and about 3,400 pounds of fuel in the tanks (maximum capacity is 1,449 pounds in each of the wing tanks and 5,012 pounds in the fuselage tank, for a total of 7,910 pounds), the 60 weighed in at 18,000 pounds for our flight, some 5,350 pounds below maximum ramp weight. Reynolds computed the safety numbers for a 20-degree-flaps takeoff: a balanced field length (BFL) of 3,480 feet; V_1, 113 KIAS; V_R, 125 KIAS; and V_2, 132 KIAS. At max gross takeoff weight in standard conditions, the 60's BFL is 5,360 feet, with V_R and V_2 of 139 and 146 KIAS, respectively.

The higher gross weight of the 60 exacts a toll on its takeoff performance relative to the 55, at least in standard conditions. In warmer weather or at higher field elevations, the 60 easily outperforms its predecessor. The Pratt & Whitney engines are flat-rated from their certified maximum of 5,225 pounds of thrust, so plenty of reserve is available.

We were cleared to an initial altitude of 5,000 feet and told to expect a clearance to our requested block altitude of 41,000 to 45,000 feet. When I shoved the thrust levers forward to the third detent for takeoff power, the engines spooled up, and the airplane began to slowly build up speed. Then the afterburners kicked in, or so it felt. The airplane rocketed down the runway. Per Reynolds' instructions, I concentrated on directional control in the initial ground run, then stole a glance at the N_1 gauges to ensure that the Fadecs were doing their job by holding the needles to within 1 percent of the bug value.

Reynolds made the calls as the airplane blasted through takeoff and initial climb V speeds. When the gear and flaps were stowed, I retarded the thrust levers one detent to set maximum continuous power. Thank goodness for the Fadecs and the select-a-detent method of power management because I was spending too much time marveling at the airspeed and rate-of-climb indications. We were given an unrestricted climb clearance before reaching 5,000 feet, and three minutes after takeoff, the Lear was climbing through 18,000 feet at 250 KIAS and 4,500 feet per minute. Kansas City Center asked us to stop at Flight Level 230 for a minute, then gave us the green light. The autopilot was tasked with maintaining a 250-KIAS/0.7-Mach climb, and 15 minutes after liftoff, we leveled at FL430. I neglected to record fuel burn to altitude, but according to Reynolds, it typically takes about 650 pounds to climb to FL410.

The 60 can take off at its maximum 23,100 pounds and, in standard conditions, climb directly to FL430. At lighter weights, it can go to FL450 without hesitating. It is certified to FL510, but that's not really a useful altitude; the airplane has to be very light and the pilots very patient to reach it.

The power was set for normal cruise speed of 0.76 Mach, which yielded 428 KTAS on 1,030 pounds per hour. Our takeoff weight was typical for a two-hour passenger-carrying flight. According to Lear's mission planning guide, the 60 is capable of a 2,400-nautical-mile IFR flight (in standard conditions with no wind) at FL450 and 0.76 Mach with full fuel and four passengers.

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High-altitude, slow-speed maneuvering showed the 60 to be docile and forgiving. Control surfaces are mechanically linked to the flight controls, so the 60 has a natural and pleasing control feel. A slight nose-up trim adjustment and a dash of power kept speed and altitude on track during steep turns. Pulling on the yoke set up mild but noticeable airframe buffeting, a clear warning of an impending stall. With the wings level, I let the speed degrade past the onset of buffeting until the stickshaker started its wake-up call. Stall recovery is a simple matter of applying power and maintaining pitch attitude.

Spoilers can be deployed at intermediate or maximum settings to hasten a descent from altitude. With the power at flight idle and the airspeed at 0.76 Mach, we departed FL430 at 2,500 fpm. Use of the spoilers increased the rate to 4,500 fpm. At lower altitudes where indicated airspeed and drag is higher, use of spoilers can and did peg the vertical speed indicator at a descent rate in excess of 10,000 fpm.

At FL350, Reynolds pulled a thrust lever back to idle to simulate the loss of one of the 305As. Even at that altitude, the airplane was able to climb on one engine. Reynolds guided me through various speed and configuration changes, and I could see that confidence comes quickly in the 60.

Wichita Approach vectored us to an intercept with the final approach course for the ILS 1L at Mid-Continent. By then, I was fairly comfortable reading all the data on my PFD and was able to use the trend features to capture and fly the ILS with acceptable airspeed and glidepath control. Flap speed is higher on the 60: 250 knots for 8 degrees and 165 knots for the full 40 degrees.

We did a touch and go on the first approach. Reynolds asked the tower for a standard pattern to a second touch-and-go landing. Despite having performed two takeoffs, it was apparent I had not fully tamed the 60's power because I blew right through the pattern altitude. On the next circuit, I felt I had the measure of the airplane. Reynolds pulled an engine, and we ended the morning with a single-engine approach to a landing.

Learjet has staged an impressive rebound since it was acquired by Montreal-based Bombardier, Incorporated, in 1990 from Integrated Resources Corporation, which was operating under bankruptcy protection. In three years, employment at Learjet has doubled to 3,800. 1992 production totaled 28 airplanes; the figure for 1993 will be 40 including the first 18 Lear 60s. Revenue will be double last year's. The product line has been rebuilt with the 31A, the 60, and the Model 45, a new eight-seat design sized between the 31A and 60. First flight is scheduled for March 1995.

Learjet had two new aircraft on its wish list when Bombardier arrived. One was the Model 45. The other was a larger aircraft than the 55, one that would put Learjet right in the thick of its mid-size competitors in terms of cabin size. That airplane would have taken a long time and a lot of money to develop. The decision was made to do something more quickly, while the Model 45 comes together, to make the 55 a contender again. That something was to spend $100 million to stretch the fuselage, attend to performance concerns, and update the panel and systems.

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The package is a nice one. Although the Model 60's cabin still is the shortest among mid-size jets, Lear has addressed the shortcomings inherent in the 55. The 60 competes well in almost all performance areas and has the edge in fuel efficiency. Pilots will appreciate its flying qualities and contemporary cockpit technology. It's the difference of a dozen years. □

Learjet 60
Base price: $9.095 million

Specifications

Powerplants	Two P&WC 305A @ 4,600 lbst ea
Recommended TBO	2,500 hr
Length	58 ft 8 in
Height	14 ft 8 in
Wingspan	43 ft 9 in
Wing area	264.5 sq ft
Wing loading	87 lb/sq ft
Power loading	2.63 lb/lbst
Seats	2 plus 6–10
Cabin length	17 ft 8 in
Cabin width	5 ft 11 in
Cabin height	5 ft 8 in
Basic empty weight	13,840 lb
Equipped operating weight (with crew)	14,240 lb
Max ramp weight	23,350 lb
Useful load	9,110 lb
Payload w/full fuel	1,200 lb
Max takeoff weight	23,100 lb
Max landing weight	19,500 lb
Zero fuel weight	16,500 lb
Fuel capacity, std	1,181 gal usable 7,910 lb usable
Baggage capacity	58.7 cu ft
Performance	
Accelerate-stop distance	5,360 ft
Rate of climb, sea level	4,500 fpm
Single-engine ROC, sea level	1,340 fpm
Max level speed, 30,000 ft	479 kt
Cruise speed/endurance w/IFR reserves (fuel consumption, both engines)	
High-speed cruise 41,000 ft	453 kt/5 hr (191 gph/1,282 pph)
0.76-M cruise 41,000 ft	435 kt/5 hr 45 min (167 gph/1,117 pph)
Long-range cruise 41,000 ft	411 kt/6 hr (151 gph/1,011 pph)
Max operating altitude	51,000 ft
Single-engine service ceiling	25,000 ft
Landing distance	3,710 ft
Limiting and Recommended Airspeeds	
V_{MC} (min control w/one engine inoperative)	110 KIAS
V_{FE} (max flap extended)	165 KIAS
V_{LE} (max gear extended)	260 KIAS
V_{LO} (max gear operating)	200 KIAS
V_{MO}/M_{MO} (max operating limit speeds)	340 KIAS to 20,000 ft 0.81 M to 37,000 ft
V_R (rotation)	139 KIAS
V_{S1} (stall, clean)	128 KIAS
V_{SO} (stall, in landing configuration)	106 KIAS

For more information, contact Learjet Corporation, Post Office Box 7707, Wichita, Kansas 67277; telephone 316/946-2000; fax 316/946-2204.

All specifications are based on manufacturer's calculations. All performance figures are based on standard day, standard atmosphere, sea level, gross weight conditions unless otherwise noted.