LEARJET 31A

A more civilized Learjet

BY RICHARD L. COLLINS

While the autopilot and the electronic flight instrument system might be considered the "newest" features of the Learjet 31A, attention to detail in other areas makes the airplane even more friendly to fly. The check list may not be any simpler or shorter on this airplane than its predecessor, the 31, but it flows better. The circuit breakers, switches, and gauges may not be any fewer, but they are more logically ar-

PHOTOGRAPHY BY MIKE FIZER

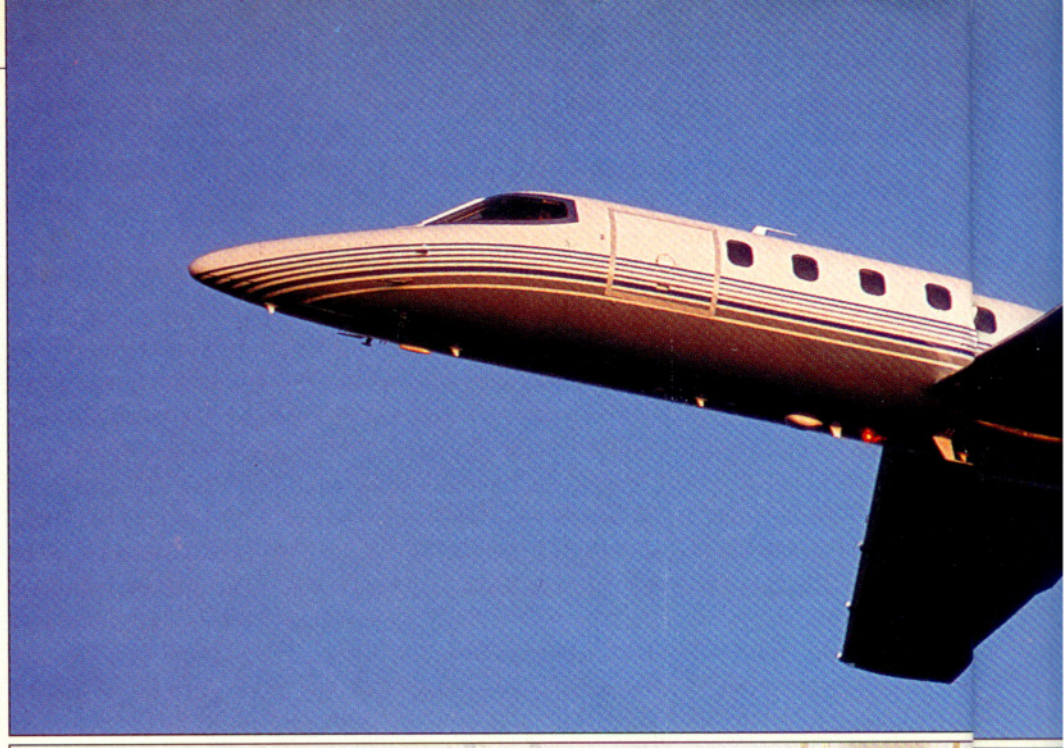
ranged. Learjet, in developing the airplane, had a "cockpit committee" that put human factors out front in the design of the pointed end of the airplane, and it did an excellent job.

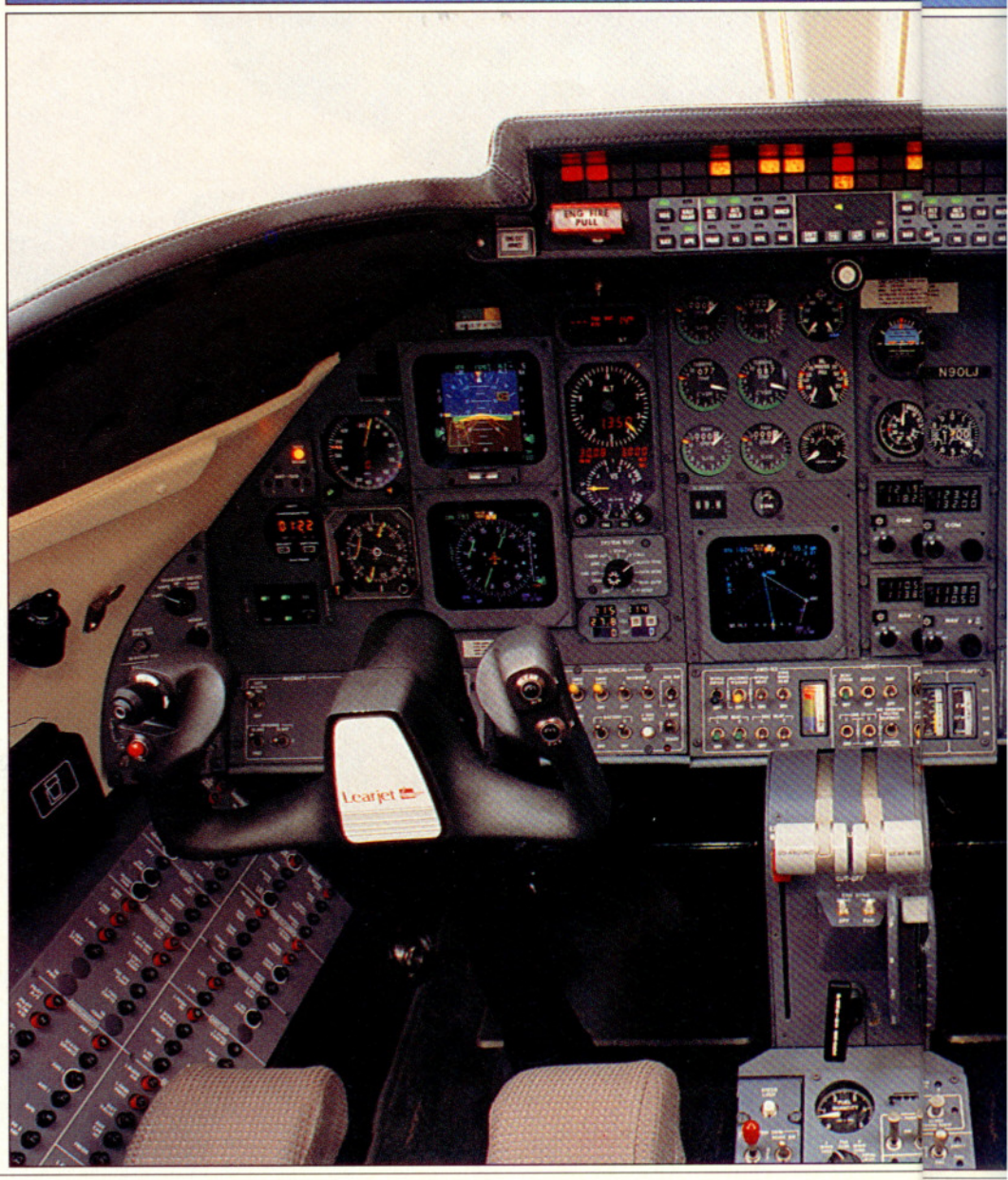
The 31A has a Bendix/King KFC 3100 flight control system integrated into the airplane's air data system, the attitude and heading reference system (AHRS, pronounced "ayehars"), and the Bendix/King EFS 50. All are dual systems, and there are three symbol generators for the EFIS. A Universal Navigation UNS-1B is also included. This can accept up to five long-range-navigation sensors, and the worldwide database includes all the SIDs, STARs, airways, and instrument approaches. The full flight can be programmed before takeoff—all the pilot or autopilot has to do is follow the commands unless a change is made along the way. The system also provides vertical navigation. All this is standard equipment; the option list is quite short.

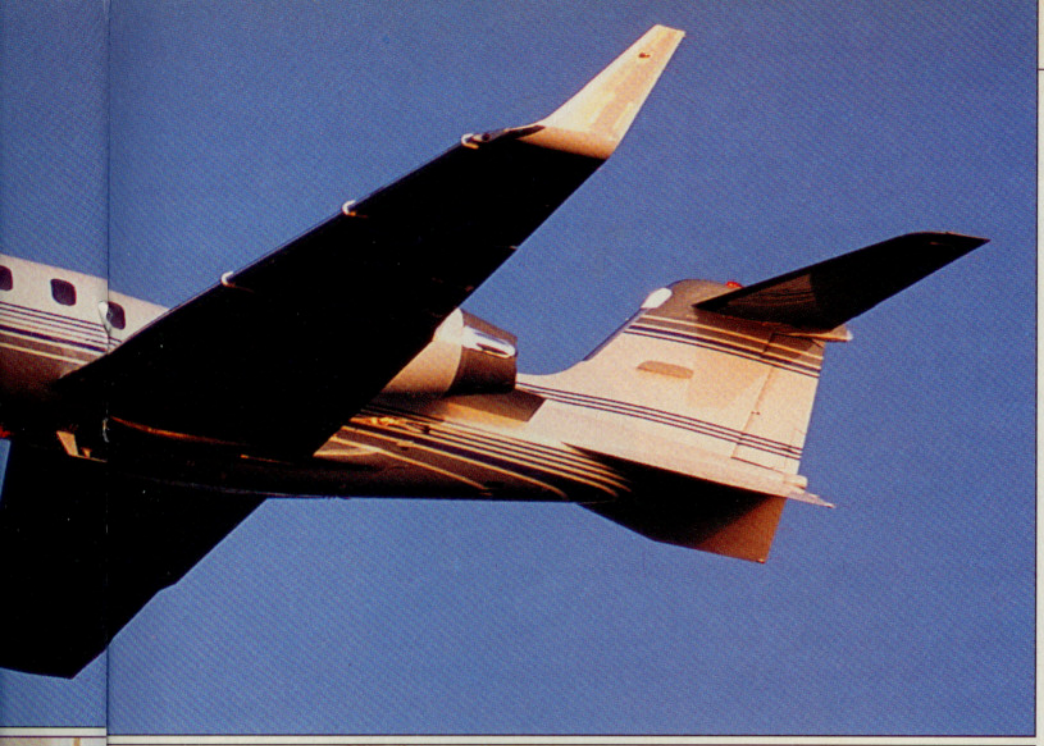
The most notable change with the 31A is the flight control system. The goal was to make it as velvet smooth as possible, and Learjet was quite successful in this. A fringe benefit is that, if the pilot opts to hand-fly using the flight director, he will also be velvet smooth as long as he follows the commands. All this is in recognition of the fact that the person paying the bills is usually in the back and likes to enjoy a gentle ride.

The flight control system panel is on the glareshield and is straightforward. What you punch is what you get, and a light illuminates right above the button to make sure you know what is selected. Because the Learjet is a two-pilot airplane and has two separate flight guidance systems, the mode selector is repeated to the left and right side of the autopilot/yaw damper engage buttons and status annunciation.

For our flight, we would head out to the Boot Heel Two flight-test area west of Wichita and would beg for an unrestricted climb to sample the Learjet's excellent direct climb capability. The calculated takeoff weight was 13,775 pounds (against a maximum takeoff weight of 16,500 pounds), and we had just over 2,500 pounds of fuel (against a maximum of 4,653 pounds). The departure was calculated using 20 degrees of flaps; the speeds were 100, 109, and 112 knots for V_1, V_R, and V_2. The temperature was 40 degrees







Fahrenheit and the balanced field length 2,630 feet. I always love to think through what balanced field length means because it is so revealing of the level of performance at hand: In half a mile, accelerate to 100 knots and then stop, or have one engine fail at that point and fly away in that distance. It takes a lot of power and good brakes, both of which the Learjet has.

Another new feature of the 31A is in the windshield. It is electrically heated to eliminate any fogging at altitude, as well as for deicing. It is also bird-proof without heat and is a key to the airplane's increased V_{MO} of 325 knots.

Always look to the right when entering, to size up the cabin. This one has seven seats or, if you sit three across on the aft couch, eight. The seat opposite the cabin entrance can be either forward or rearward facing in an instant. There are plenty of cabin windows for a nice light appearance, and the Learjet offers the passengers a fine, as well as a quiet, ride.

Up front, Learjet has done a remarkable job of de-cluttering what is not a very large instrument panel. The new design clusters items by function and includes information where you need it. The limit speeds on the flaps are at the appropriate positions on the selector, likewise for the landing gear. The little gadget in which you set the target N_1 value for takeoff is right below the N_1 gauges. It was 95.2 percent for our flight. The circuit breaker panels are new, and all the items on the emergency bus have a little red collar around them. When selected, the emergency bus uses power from the aircraft batteries to run essential systems. It is required that this last for 30 minutes; on the 31A, it is said to provide adequate power for an hour.

In an extreme electrical emergency that would completely disable the ship's normal power source, there are two additional batteries in the nose that are constantly trickle charged to provide power for the mechanical standby attitude indicator and other essential instruments, as well as the attitude and heading reference system.

The electrical system has had its share of simplification, too, with a power monitor that keeps tabs on the left and right AC bus voltage and generator load, plus the DC charging bus voltage. The parameters monitored have normal, caution, and warning ranges, and any anomaly is shown on

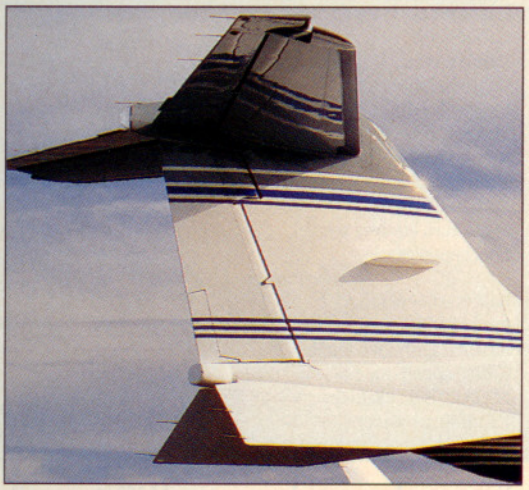
the monitor as well as on the annunciator panel.

The control wheel has some important buttons on it. There's pitch and roll trim, as well as a microphone and transponder ident button. A control wheel steering switch allows the pilot to fly the airplane to a new condition and then release the button to synchronize the flight director. A flight director clear switch stows the command bars, and a master switch disengages the autopilot. The latter is also depressed for nosewheel steering on takeoff until the airspeed comes alive and is used to cancel the yaw damper for landing, if desired. It will also cancel a rudder boost system that will kick in automatically and help the pilot manage an engine-out at any time the pilot applies 35 pounds of rudder force.

The nosewheel steering on Learjets has always been sensitive, requiring a fine touch. The 31A flown had this system, but Learjet has a new one coming on line that is said to be as smooth as the autopilot on the airplane. It is computerized and does not have to be turned on and off because it makes all the necessary adjustments for speed internally. The brakes, too, are not for cowboys on the ground. Remember, the airplane will accelerate to 100 knots and stop in a half-mile, so those brakes have to be quite powerful.

In a two-crew airplane, the takeoff calls for the pilot flying to advance the thrust toward the computed N_1. The other pilot taps the throttle hand as the thrust approaches the desired value, indicating that he will fine-tune the power. When the airspeed is called as alive, the pilot flying releases the steering button on the wheel. Then it is a matter of tracking the centerline until the V_1 call and then the rotate call, at which time the nose is brought to 9 degrees nose up. The acceleration is rapid and fun, and you blow right through those speeds. The visibility is excellent over the nose, and even at 9 degrees nose up, there is a feeling that the earth is just falling away from the airplane.

Because of low-altitude speed restrictions, the power has to come much further back than optimum to avoid busting the 200-knot speed limit in the airport traffic area. Once clear of that, the normal climb speed corresponds with the under-10,000-foot speed limit of 250 knots, which is maintained in the climb until Mach



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0.70 is reached, and that becomes the best-climb speed. The initial climb rate is nothing short of spectacular, and climbing is one of the 31A's strong suits. After a maximum-weight takeoff, the airplane will climb directly to Flight Level 450 in just under 24 minutes, using 655 pounds of fuel and covering 147 miles in the process. With the weight 1,000 pounds under maximum, it will go to FL470 in under 30 minutes, and at a total weight of 14,000 pounds, it will climb to FL490 in under 30 minutes. It will climb directly to FL510 at 12,000 pounds in less than 25 minutes.

At a cruise weight of 14,000 pounds, the normal cruise (Mach 0.76, 433 knots) at FL470 requires a fuel burn of just under 900 pounds per hour total. Go on up to FL490 and long-range cruise, Mach 0.744 (424 knots), and the fuel flow drops to 800 pph. The high-speed cruise down at FL410 is 463 knots on 1,212 pph.

The day we flew, the temperature was above standard, and the airplane wouldn't climb to FL510 at the weight we were flying. A couple of years ago on a cooler day, I flew a 31 to that lofty height, and in fact, of the FL510-certified airplanes I have flown, only the Lear 31 and 28 have made it all the way up there.

The high-altitude handling qualities of the Learjet 31A are excellent. There is plenty of speed margin, and a Mach trim system kicks in at Mach 0.70 anytime the autopilot is not engaged. This enhances longitudinal stability by compensating for movement of the center of lift as speed changes. It trims nose up as speed goes higher and nose down as it decreases.

The airplane is usually flown as high as possible to keep the true airspeed as high as possible on the least fuel. There is a fringe benefit. Because the indicated airspeed is relatively low—between 180 and 200 knots—and because there is not a lot of power being developed, the airplane is extremely quiet inside. Only looking at the power instruments tells you that there is still a lot going on back there.

After taking off with full tanks, the airplane will usually reach cruise altitude with 4,000 pounds of fuel or a little less, so it does have good endurance. It can hold at 5,000 feet on less than 900 pounds an hour, so if you subtract 700 pounds for holding, 500 for an alternate, and 500 for gener-

al principles, on a scuzzy weather day, you can run it up high almost three hours at normal cruise without sweating fuel. If the destination were VFR, that could increase to almost four hours at cruise altitude with a reserve.

Not only is the autopilot smooth and user-friendly, it is smart. You can adjust the vertical modes of the autopilot with the trim switch on the control wheel. Without pushing the arm button on the switch, moving the trim switch fore or aft changes the reference altitude if in the altitude-hold mode. In the other modes, it can be used to change the Mach number being maintained, the vertical speed, or the indicated airspeed, and you can toggle between normal and high-speed descent profiles.

When it came time to start our descent from FL490, I let the autopilot fly and gave it a little workout. The spoilers are effective for a descent, though they cause a bit of a rumble, and when hand flying, it is always a challenge to get the spoilers out and in without more pitch reaction than you'd like. The autopilot handles this well, though at a flight idle descent, it might not hold the Mach or airspeed selected because there is a 10-degree nose-down limitation on the autopilot's authority.

I watched the autopilot fly the first approach, and it did an absolutely perfect job. All I had to do was adjust the power to keep the airspeed at V_{REF} plus 10 in the early stages of the approach and then at V_{REF} (112 knots) in later stages of the approach. Sixty-percent N_1 about does the trick; though this day, some wind shear dictated a slight power adjustment at about 700 feet for just a moment.

We did a "touch, touch, touch, and go" after that coupled approach, and I resolved to do a better job of minding my landing manners on the next one.

Hand-flying the approach, using the flight director, was almost as easy as sitting and watching the autopilot do the work. Because I had been in the loop all the way down, I did a better job of landing this time and, with only moderate braking, had the airplane stopped in about 3,000 feet. While thrust reversers are available, they were not on this airplane. Whether or not to have them is a trade-off on the cost ($197,000) and weight (279 pounds) of the reversers versus higher brake maintenance. The use of reversers is not considered in calculating balanced field lengths, so they have no operational effect on the utility of the aircraft.

The 31A is a neat airplane, and as has always been true, Learjets do interesting as well as good work. A recent use of the 31 has been with Singapore Airlines. Because the airline flies such long legs, not many landings are available in normal operations. So it bought two Learjet 31s, modified to have avionics and instrumentation as much like their line aircraft as possible, and put them in service as training as well as proficiency maintenance aircraft. In three months, each airplane had accumulated 700 hours and had averaged three landings per hour. That is almost two years' worth of use in the average corporate or entrepreneurial use of the airplane.

Finally, it is almost (but not quite) as much fun to admire a Learjet as it is to fly one. The basic design might have started out 30 years ago, but nothing on the ramp today looks any sleeker or more timely than a Learjet 31A. □

Learjet 31A
Base price: $4.275 million

Specifications

Powerplants	Garrett TFE731-2-3B turbofans, 3,500 lbst ea
Length	48.67 ft
Height	12.25 ft
Wingspan	43.83 ft
Wing area	264.41 sq ft
Wing loading	62.40 lb/sq ft
Power loading	2.36 lb/lbst
Cabin seats	10 max
Cabin length	20.58 ft
Cabin width	4.92 ft
Cabin height	4.33 ft
Empty weight	10,698 lb
Max ramp weight	16,750 lb
Max takeoff weight	16,500 lb
Useful load	6,052 lb
Zero fuel weight	13,000 lb
Maximum landing weight	15,300 lb
Fuel capacity	4,653 lb

Performance

Balanced field length	3,280 ft
Rate of climb, engine out	1,530 fpm
Rate of climb, two engines	5,100 fpm
Cruise speed, max	481 kt
Max certified altitude	51,000 ft
Landing distance	2,767 ft

Airspeeds

V_R	118 kt
V_2	122 kt
V_{LO} (extend and retract)	200 kt
V_{LE}	260 kt
V_{FE} (8 degrees)	250 kt
V_{FE} (20 degrees)	200 kt
V_{FE} (40 degrees)	150 kt
V_{MO} (SL to 27,500 ft)	325 kt
M_{MO} (27,500 to 43,000 ft)	M 0.81
M_{MO} (43,000 to 47,000 ft)	M 0.81–0.79
M_{MO} (above 47,000 ft)	M 0.79

For more information, contact Learjet, Incorporated, Post Office Box 7707, Wichita, Kansas 67277; telephone 316/946-2450.

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. The numbers reflect the "ER" option, which adds $118,000 to the price and 1,000 pounds to the maximum weight, and which is included on virtually all the 31A aircraft built.