CAFE FOUNDATION
AIRCRAFT PERFORMANCE REPORT
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Lancair IVP

BY BRIEN SEELEY, C.J. STEPHENS AND THE CAFE BOARD

Photo: Larry Ford

The the Lancair IV-P is perhaps the most sophisticated homebuilt aircraft available today. Incorporating pressurization and twin turbos with intercoolers, it is a complex and expensive machine with capabilities that rival jumbo jets.

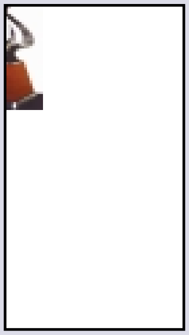
Lance Neibauer and Mick Williams designed the sleek Lancair IV-P, which first flew in 1992, successfully filling a niche in the homebuilt marketplace. Today there are more than 130 examples of them flying in the United States and abroad.

The Lancair IV and IV-P vary only in the ply schedule (additional plys were added for pressurization) and modifications to the door latch system. Thicker windows are now standard on all Lancairs. Listed as an option on the IV, but essential for the IV-P, are winglets which increase the stability at high altitudes by increasing wing area and lift.

Carsten Sundin, an aeronautical engineer for Lancair has designed new molds and jigging which makes it easier for the factory to provide fast build kits to builders. Recently a firewall forward *Fastbuild* kit has been added to the others along with an engine kit enabling the builder to slice off dramatically the time required for that portion of the project.

The Builder's Assist Program, offered to purchasers of the new fast-build complete kit, could be a reason why these high-end homebuilts are so plentiful. The builder comes to the factory for a one week course which includes one on one composite training. At the end of the week the builders are more confident in their composite techniques, have closed out their wings and horizontal stabilizers under factory supervision and have crated up their kits for the journey home.

Derek Hine's N114L is a special example of the Lancair IV-P. It uses the Lycoming engine



TRIAVIATHON TROPHY

CHALLENGE TROPHY

installation developed by Brent Regan and described here in the pages of *Sport Aviation* in December 1996.

Basically, Brent modified the Lycoming TIO-540, which is a rear mount engine, to comply with the bed mount design that Lancair incorporated for the standard Continental TSIO-550-B. Although comparable in power, the Lycoming has a larger diameter crankshaft which is beneficial for running at high power. The engine compression ratio is also increased to 8.5:1, permitting less boost pressure for the same or better performance.

All of these changes required that Brent design and build a custom engine oil sump that puts the engine mounts and propeller thrust line in the same place. The entire aluminum induction and stainless steel exhaust systems were redesigned and handcrafted by Brent to include Garret turbochargers, intercoolers and associated plumbing. He also designed a snazzy carbon fiber plenum chamber which reduces engine operating temps while minimizing cooling drag. In addition, the entire electrical and ignition systems were also redesigned. Brent contributed many other modifications to both his own and Derek's planes.

SUBJECTIVE EVALUATION

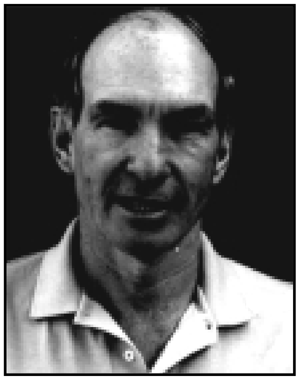
Lancair IV-P, N114L

BY C.J. Stephens

First Impression

The Lancair IV-P stands tall on its tubular, low drag landing gear. Noticeably absent are the landing gear doors that are normally attached to the landing gear legs. This gives the airplane an almost spindly appearance. The sleek, and sturdy steel legs, with the gear doors flush to the fuselage (except during the retraction/extension cycle) adds to the flowing clean lines of the airplane. I found the operation of the main gear doors to be both innovative and simple. The doors are held firmly shut with springs and a tension strap. The doors are held closed with springs and a tension strap that the gear leg engages when the gear is up. On extension, the gear leg opens the door by pushing against a wear strip in the door and a small elliptical hole in the front of the door allows the doors to close again with the gear down and locked. On retraction it all works in reverse.

The next impression of the airplane comes from the smooth flowing, high rise, contour of the fuselage. All of the external surfaces blend with each other and are finished perfectly smooth. The paint is blemish free and regardless of the amount of searching there is not a single imperfection noted in the construction or finish. This Lancair is larger than most other homebuilt aircraft, but then, this is no ordinary homebuilt.



Overall

Located on each side of the front cockpit is a side-stick for control of the ailerons and elevators. Both sticks are canted inboard to match a natural grasp of the pilot's hand. It pivots at the base and has light and equal motion of about three inches in all directions.

As reported in the CAFE's Cozy article (April 1999 issue of *Sport Aviation,*) there are many advantages of the side stick flight control. Wrist motion controls operation rather than upper arm movement as in most stick controlled aircraft. This allows precise but small motion to be exerted on the controls. It may not be at all fair to measure and compare the stick forces of this type of control with those in conventional center stick (arm movement) since they involve such different leverages. We have, however, measured and reported the stick forces later in this report for general information and comparison.

An electric motor and pump provides hydraulic pressure to operate the landing gear and flaps. No parking brake is installed on the self-contained hydraulic toe brakes. Ninety-four gallons of fuel is contained in the wing and selectable by a left/right/off valve on the lower center console. All 94 gallons of fuel are usable.

Ground Handling

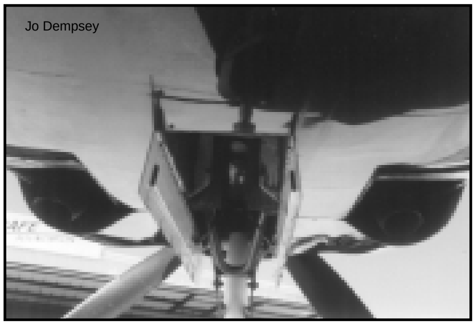
Even with the hefty empty weight of 2212.5 lbs it is possible for one person to push or pull the airplane, although it requires a pretty good shove and a smooth level surface to do so. Getting into the cockpit requires either a knee to get up on the wing, or to sit on the leading edge and then stand up. There is no anti-skid "wing walk" which added to the good looking smooth surface, however it also necessitates the placement of a protective pad on the wing to keep from scratching the paint. Once on the wing it is easy to step directly onto the floor of the cabin without stepping on the upholstery of the seat. The erect seats put all occupants in a conventional upright sitting position. All four seats are comfortably padded with Temperfoam which is most appreciated on long high altitude flights.

The ignition system on N114L is a conventional dual magneto set up. There would be little advantage to be gained with the installation of electronic ignitions since sea level manifold pressures are nearly always attainable, negating some of the advantages of ignition advance. The injected TIO-540 Regan/Lycoming engine has a purge valve installed to purge any air out of the injector lines prior to start. This was very effective during those difficult hot starts. To operate the purge system, one only needs to turn on the low boost pump for about 20 seconds with the purge knob pulled out. This circulates cool fuel through the injector lines, purging the air and vapor out. The fast spinning starter also aids in the quick start of a hot engine.

Taxi operation is very easy with toe

Larry Ford

Larry Ford



Jo Dempsey

Larry Ford

brakes located on the rudder pedals for steering and stopping control. The plane moves easily, and comfortably holds normal taxi speed with about 1,000 rpm. An excellent laminated checklist is provided by Derek which is easy to follow. Prior to take off an important item is to lock the one entry door located on the left side of the fuselage. The door is held in place with two hinges and eight sturdy latches and is operated by two lever type handles that snapped over center with a positive locking motion. The outward forces on the door are tremendous once the 5.2 psi cabin pressure is reached at flight altitude. All of the mechanisms holding the door in place during flight appeared to be built strong enough to do the job without fail. A flat door seal, to help maintain cabin pressure, is mounted in the channel that mates with the door and is inflated pneumatically prior to takeoff. This plane was pressure-tested on the ground at 7.5 psi to verify a good safety margin.

A light on the enunciator panel notifies the pilot if the baggage door is not properly locked. This seems like a good idea since it is not visible from the cabin and could be overlooked until after everyone is strapped in for flight. The baggage compartment is eye level and spacious but un-pressurized.

Lancair IVP N114L, Sample c.g.

	Weight, lb	Arm	Moment
Main gear, empty	1606.5	107.63	172894
Nosewheel, empty	606.0	34.25	20757
Pilot, front seat	170.0	98.00	16660
Passenger, front seat	170.0	98.00	16660
Passenger(s), rear seats	80.2	129.00	10346
Fuel, wing tanks full	564.3	94.80	53496
Oil, included 6.5 qt.	0.0	0.00	0
Baggage, aft limit 140 lb	0.0	140.00	0
TOTALS	3200.0		290813
Datum = a pt. fwd of firewall			
c.g., inches	90.88		
c.g., % aft of fwd limit	55%		
Gross weight, lb	3200.0		
Gross weight, landing, lb	2900.0		
Empty weight, lb	2215.5		
Useful load, lb	984.5		
Payload, lb, full fuel	420.2		
Fuel capacity, gallons*	94.05		
Empty weight c.g., inches	87.53		
c.g. range, inches	86.5-94.5		
*as determined by CAFE			

Take off and climb

A flap setting of 10 degrees, as noted by a paint stripe on the flap hinge or by the flap indicator, is used for take off. The boost pump needs to be on at the low setting until reaching 1,000 feet of altitude. Full throttle holds 35 inches of manifold pressure, 2700 rpm, and a fuel flow of 40 gallons per hour. The airplane tracks straight down the center of the runway with only light rudder pressure required to maintain directional control. Moderate rotation produces a nice liftoff which quickly turns into a substantial climb rate.

After becoming safely airborne the landing gear and flaps are raised, followed by a power reduction to 32”/2500 rpm which reduces the fuel flow to 25 gph. A waste gate holds manifold pressure constant during the climb; a nice feature that keeps the pilot workload to a minimum. Since the manifold pressure holds constant during the climb, it eliminates the requirement of constantly adding throttle or leaning the mixture. The next necessary adjustment of the throttle or mixture is at level-off.

Cabin Pressurization System

The Lancair received an extra measure of design engineering in order to make it a safe pressurized airplane for flights at higher altitudes. By using air pressure from the turbo-charger, a pressurization dump valve (regulated to 5.2 psi maximum), installing sturdy latches to hold the cabin entry door against the outward pressure, and an inflatable rubber door seal to minimize leaks, this airplane is able to produce a comfortable environment for the occupants. It eliminates the requirement of wearing oxygen masks during flights at high altitude provided the system operates normally. Emergency descent oxygen and masks are available should a situation occur that caused cabin pressure loss. The added material required for pressurization and the lack of air noise from the air-sealed cabin contributed to a noticeably lower noise level than would be expected.

A flapper valve located above the rear seat automatically activates during the transition between pressurized and non-

ABOUT THE BUILDER

Derek Hine is the talented owner/builder of the Lancair IV-P featured in this article. Derek began his career in aviation at the early age of 16 as an aeronautical engineer apprentice at Armstrong Whitworth Aircraft, Ltd. in Coventry, England. He attended college at the same time earning the equivalent of a bachelor’s degree in Aeronautical Engineering and his master’s in Mechanical Engineering. He has worked for over thirty years in mechanical engineering and management involving aerospace, vehicles, lasers and semiconductors. Included in his accomplishments is the design and construction of NASA’s Mobility Test Article details, a vehicle designed to simulate the moon’s gravity and give astronauts “driver’s training”.

Derek has logged about 3000 hours of single and multi-engine flying. He chose the Lancair IV-P to build based on the aircraft’s performance. Getting places fast is high on his list! He also needed a four-place cabin and the pressurization option capped off his decision process. He is delighted with the results which earned him an award for outstanding workmanship at Oshkosh ‘98.

His advice to builders is that the plane will go together the way the manual suggests it will. And, that a builder can finish the project in the time suggested by the factory, if you’ve built a plane before; but if it’s a hobby, then you’re likely to put in extra time anyway.

Photo: Larry Ford

pressurized flight and causes muffled banging sounds during flight which was somewhat distracting.

Trim System

Electric trim is installed in all three axes. The hat switch at the top of the control side stick operates the elevator and rudder trim tabs. A spring loaded three position rocker switch on the right instrument panel operates the aileron trim tab. Considerable rudder trimming is required as power and airspeed change since the trim actuator operates quite slowly. An electronic device was installed that doubles the rate of travel of the elevator trim during times when the landing gear is extended. This helped, but the rudder still seems to require a lot of trimming during the many maneuvers performed on the flight tests.

Static Longitudinal Stability

The static longitudinal stability, speed stability, was evaluated by fully trimming to 170 KIAS then changing the airspeed in 10 knot increments throughout the entire attainable envelope, without retrimming, and measuring the amount of stick force required to hold level flight. The resultant curve indicates the airplane's tendency to return to its trimmed airspeed. The greater the tendency to return, the greater the static stability. Figure _____ shows the elevator stick forces recorded during this evalualtion. As the airplane's center of gravity shifts to the aft, the static stability is reduced resulting in less stick forces or lower a stability margin. There was a very slight reversal of stick force gradient at the slowest airspeed measured during the exploration of the forward center of gravity; however, it was minimal and not considered to be a problem.

During the aft center of gravity measurements there was a considerable reduction of the stick force required to maintain level flight, even though only at 84% aft within the allowable limits. Upon reaching 90 knots airspeed, with only 50% of the high stick force (1.5 lbs at 90 knots) remaining (3.1 lbs at 110 knots), I terminated the test and decided not to attempt a stall series. Tests of this nature (aft CG stalls) are beyond the time and scope and equipment of the CAFE Foundation evaluation and should always be approached with respect and caution.

Turbo-Charger Operation

I don't recall ever seeing a nicer installation of a turbo-charging system as far as uncluttered equipment inside the cowl goes. The exhaust plumbing seems tight and about as simple as the system could be designed. There is one compact turbo nicely installed on each side of the engine at the aft end of the header that exhausts the three cylinders on that same side. It eliminates all of the crossover plumbing that is usually associated with single turbo installations.

Flying with a turbo-charged engine is somewhat different from the pilot's point of view. A large amount of heat is built up within the turbo system and must be dealt with to prevent mechanical problems. A conscious effort must be made to cool the engine and turbo as power is reduced from cruise settings to descent, landing and shut down. Turbo-charged engines also tend to cause greater difficulty during hot starts for many pilots. The purge valve mentioned earlier seems to eliminate the starting difficulty problem.

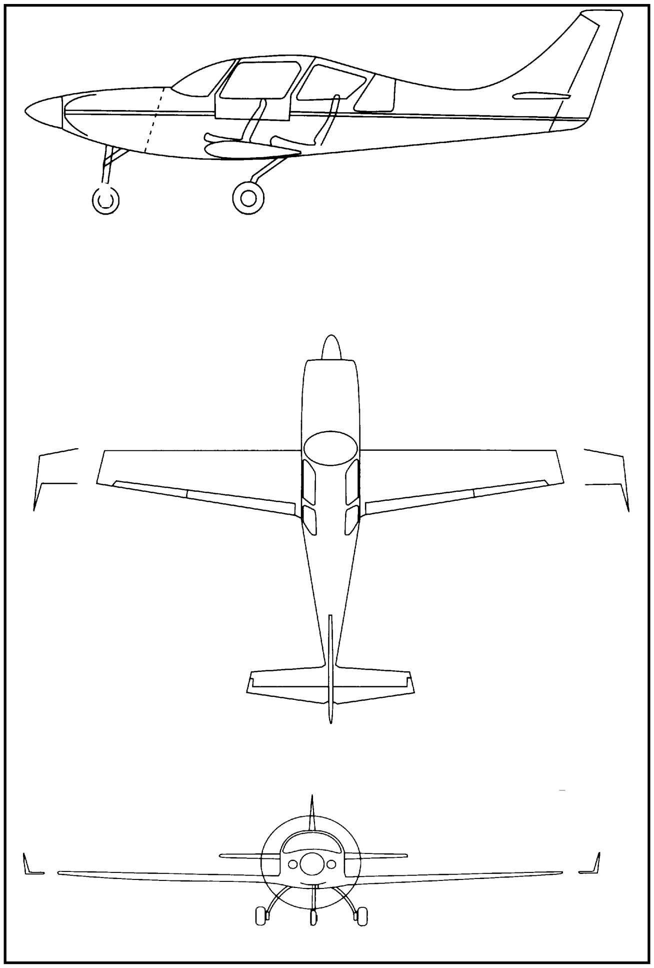
On the good side though, besides the obvious ability to get greater power from a given engine size and maintain greater power to higher altitudes, the throttle remains right at the set manifold pressure during climb. If 32" of manifold pressure is set for climb, that number remains constant all of the way to the top of the climb without having to readjust throttle; even if your level off is up in the flight levels. Also, since the power, manifold pressure, and rpm remain constant, there is no need to adjust the mixture until the throttle is re-set.

Maneuvering stability

An examination was made of the elevator forces on the control stick as the aircraft is turned at an increasing G force to measure the tendency of the airplane to return to level flight after displacement. Measurements were made in clean configuration at 170 KIAS, and with landing configuration at 100 KIAS, during flights at a forward CG and at an aft CG. The graph_____ shows that the Lancair has a strong dynamic stability in each of the modes sampled.

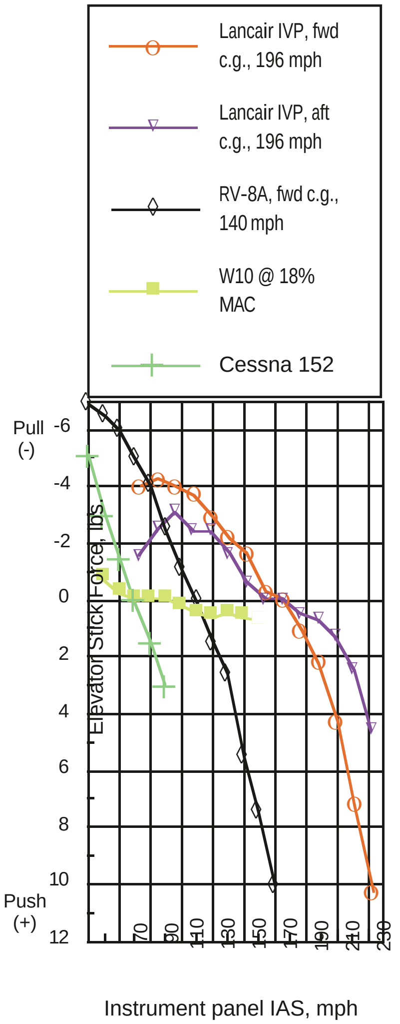
Spiral stability

To measure the airplane's natural tedency roll out of a bank or to over bank, known as spiral stability, the airplane was fully trimmed and set into a 15 degree



CAFE MEASURED PERFORMANCE, N114L

Propeller max, static RPM	2575 RPM
Vmax,TAS, 29.8” MP, 2607 RPM,25.1 gph, 2980 lb	321 MPH
T.O. dist., 3183 lb,8 mph headwind	1420 ft
Liftoff speed, by	96.6 mph CAS
Touchdown speed, Barograph,2872 lb	84.8 mph CAS
Minimum sink rate, 4.2” MP, 1445 RPM, 1.1 gph, clean	820 fpm @ 123 mph CAS
Glide ratio, 3.6” MP, 1500 RPM, 1.2 gph, 2948 lb	13.85
Noise levels, full power climb/cruise	95.0/95.0
Peak CHT in climb,OAT 23° F, 200° F CXT	466 ° F
Cowl exit air temp, 7” MP, 2567 RPM,118 mph CAS	215° F



Static longitudinal stability

Trimmed to zero pounds with stick- free and flaps up at Va.

bank. By releasing the controls and observing the airplane’s tendency to either increase in bank or level out roll stability can be judged. The Lancair IV-P showed complete neutrality. It neither increased, nor decreased, and after 30 seconds of constant bank the test was concluded.

Adverse Yaw

With the airplane trimmed for level flight at several airspeeds from 170 KIAS down to 120 KIAS, moderate aileron input was induced without any coordinating rudder input to evaluate the amount of adverse yaw present. I noted a low amount of adverse yaw prior the airplane initiating the turn. In the samples taken, as the airspeed decreased the amount of adverse yaw only increased slightly.

Roll rates

Using a stop watch, and averaging several attempts, roll rates were measured in both directions of roll. Full deflection aileron was used and the time was measured from the start of the input until passing 120 degrees of bank change. The resulting measured roll rate is, therefore, less than full sustained roll rate attainable. The airplane showed good crisp roll response with precise control throughout.

Stalls

Stalls were performed in clean and landing configurations only with a forward center of gravity location. The data below indicates the exact airspeeds that the stall occurred. The airplane exhibited no adverse character or unpredictable tendency. All of the recoveries were prompt with the repositioning of the elevator (forward stick movement). Wings level could be maintained during the maneuver with judicious use of the rudder, and the resulting pitch change was very manageable and mild. As shown on the stick force graph the stick force did not increase appreciably during the latter portion of the approach to the stall; however, they were sufficient for control and feel. The nose had a pronounced natural tendency to pitch down as the stall occurred. The effectiveness of the Fowler flap becomes obvious with the significant stall speed differences between the flaps up and flaps down.

Less aerodynamic buffet was exhibited during the landing configuration stalls and the right wing dropped mildly at the stall. No stalls were performed during the aft CG flights.

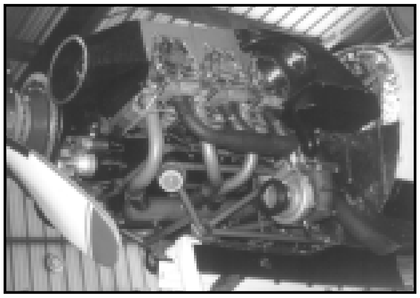
Flight at High Altitude

Flights to higher altitudes will become more commonplace with the increasing use of turbo-chargers on modern airplanes. More and more people will find themselves operating in atmosphere that is less hospitable than which we have become used to. Turbo-charging in not for everyone, it has a special use. The Lancair IV-P has found an excellent balance of taking advantage of the higher thin air and pressurizing the airplane to put the most comfort and safety into this type of airplane.

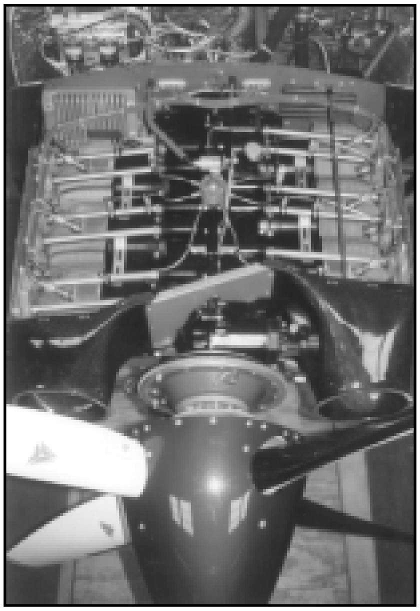
A turbo-charger gives more power at high altitude but it has its disadvantages as well. It is not well suited for the weekend flyer who does most of his flying on short trips within the local area. Turbo-chargers cost more to install, require more maintenance and attention to operate however, they do have the ability of getting the airplane up into the thin air where it can go faster than at lower altitudes. A big disadvantage is that it puts the pilot and passengers in an environment that needs some supplements for survival. Most turbo-charged airplanes simply provide oxygen for the passengers aboard which can be a big inconvenience. Pressurizing the cockpit eliminates the need for inflight oxygen, however it must be available for immediate use should the

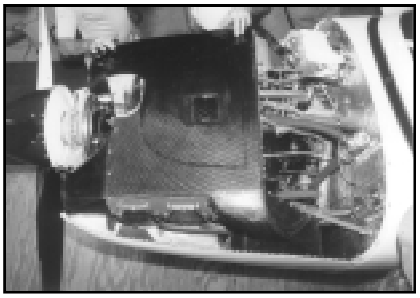

Photo: Larry Ford

Stall speeds-- Lancair IVP	Flight/Clock	Mode	MP/RPM	Weight, lb	CAS, kt/mph
fwd c.g. at various	#1--5/15/99	clean	13.4/2304	3112	78.0/89.9
M.P. and RPM's	#1--5/15/99	dirty	13.6/2106	3111	66.2/76.3**
Wing Baro #3					
**panel read 66 kts					



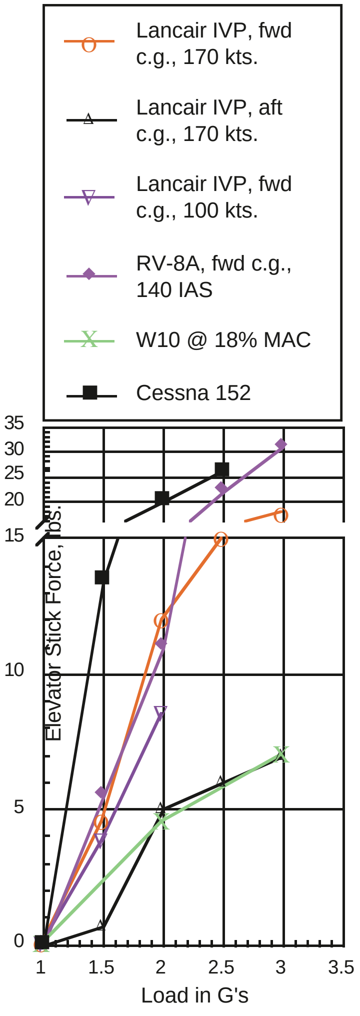
Larry Ford photos





cabin pressurization system fail.

It is my opinion that even pressurized flights above 25,000 feet should only be attempted by the most experienced and prepared pilots. If a cabin pressure leak or an engine failure occurs, the results can be disastrous without the immediate implementation of the proper breathing equipment. The oxygen equipment available in most general aviation airplanes is less than adequate for unpressurized flight above 25,000 feet. The survival problem is further compounded in that the time to descend to a safe altitude becomes excessive should a pressurization failure occur at altitudes above 25,000 feet.



Maneuvering stability

Lancair N114L climbed smartly to 24,000' maintaining 32"/2400 rpm all of the way. While level at that altitude I advanced the power and easily attained 35"/2700 rpm. Although I did not attempt to climb higher, it seemed to me that the plane could reach on the order of 35,000 feet with little difficulty. The 5.2 psi pressure difference between the inside and the outside pressure provided a comfortable 8,000' cabin while operating at 24,000 feet.

This is where you fully realize that 'this is a significant airplane'. Here is a homebuilt airplane flying at four nautical miles of altitude, at 310 KTAS with cruise power of 30/2500. It was indicating 185 KIAS and handled quite nicely. This speed calculated to .53 MACH.

N114L develops a very mild divergent movement in pitch and roll in level flight with smooth air starting at altitudes above 12,000'. The intensity increases steadily as the altitude increases. It is quite mild and might not even be noticed below 20,000' if the airplane was flying in any turbulence or was on autopilot. The only times that I observed this event was while flying at 185 KIAS and at high altitude. The motion was an exaggeration of any input in pitch or roll. By that I mean, if I made a normal small control input it seemed to be more than was needed. It was as if the plane became more sensitive to the controls.

I had the opportunity to discuss this oversensitivity with Dave Morss, who has considerable experience in Lancair IVP. He indicated that this trait was commonly known by those who fly the IVP and that the installations of winglets eliminates this phenomenon.

Descents

Turbo-chargers operate at a high temperature and need special attention to cool them properly as the power is reduced just prior to and during descent. The generally accepted method is to reduce the power in several small steps so as not to rapidly shock the system or cause carbon build up. This becomes a planning item, especially when you figure that you may be at 24,000 feet altitude requiring about 100 nautical miles of descent. The speed brakes work well to expedite the descent but it causes some aerodynamic rumbling within the airframe while extended at high speed.

Drag Producing Devices

At given airspeeds drag producing devices were extended and measurements were made of the increase in rate of descent that was produced by that device while keeping all else constant. All tests were commenced from level flight and constant power. The amount of drag is expressed in terms of rate of descent after the descent stabilized. (See the tabular data.)

During the fully-instrumented flights at the CAFE test facility the laptop computer in the cockpit shows a continual readout of the glide ratio. It is interesting to note the dramatic increase in the glide ratio in a power off glide with the only difference

being that propeller control is pulled full back. Should the pilot ever be faced with needing to stretch the glide it would certainly be an advantage to remember the big improvement with the propeller full coarse.

Traffic pattern/ landing

The beautiful Fowler flap design adds to the total wing area when extended and is very effective in reducing the approach and landing speed as reflected on the graph of stalls. Extension of the flap is quite slow causing no associated pitch change with their operation. A paint mark on the flap leading edge, visible from the cockpit, indicates 10 degrees flap deployment. This amount of flap can be used as high as 174 knots. As the flaps extend to the full down position the drag increases to a comfortable lift and drag combination. This is reflected by the nominal power required on final approach with gear and full flaps down. Flap retraction, however, is very quick and in flight causes a noticeable drop which must be allowed for during a go around situation. Early flap retraction is not recommended.

The work load in the pattern is no more that in any other complex airplane. The visibility is excellent and with the 10 degree flap setting available as high as 174 KIAS there is never the feeling that the plane is behind the power curve on downwind leg. The low drag of the landing gear requires very little additional power to compensate, once extended. The flap extension, base turn, and turn to final approach all fall well within the normal range and feel solid and straight forward.

The handling seemed to be best at 100 KIAS on final, arriving at the flare at 85 KIAS and reducing the power to idle. Flare out and touch down seemed easy to manage once I got used to the length of the main landing gear. My initial tendency was to touch when I thought I was still 2 feet in the air, however by the third landing the whole process was producing predictably smooth landings.

During the landing roll out, the weight of the airplane became evident with a little more than normal braking required to stop the airplane. After landing a full four minutes of engine run at idle power was recommended to dissipate the engine/turbo heat prior to shut down.

Conclusions

The Lancair IV-P is a beautiful four passenger airplane that is for the serious homebuilder. It is intended to make long trips at a fantastic speed. It is capable of carrying all of the equipment necessary to do whatever level of flying might be intended. It is not within everyone's budget to build and fly such an airplane, but if you do get the chance to, you will truly enjoy the experience. The installation of cabin pressurization allows flight above much of the turbulence and a lot of the unpleasant weather, adding greatly to passenger comfort.

My special thanks to Derek Hine for allowing the CAFE Foundation to test his gorgeous airplane. It is perfectly built, beautiful to look at and a joy to fly. THANK-YOU, Derek.

Lancair IVP	Panel IAS, kts	Cabin Baro, mph	CAS in mph, Wing Baro	Config.
N114L ASI calibration	66	na	76.3	dirty stall
	82	na	89.9	clean stall
Cabin Baro #1 has	85	99.0	94.6	
same pitot/static	90	103.8	100.2	
as panel ASI	100	116.2	111.9	
	110	127.6	122.6	
Wing Baro #3 uses	120	138.5	133.7	
a calibrated, certified	130	151.0	145.8	
gimbaled pitot/static	140	162.4	157.8	
	150	174.6	170.2	
	160	185.5	180.3	
	170	195.8	191.2	
	180	205.1	201.2	
	190	220.7	216.2	
	200	234.1	229.8	
	210	248.0	243.8	
	220	260.6	255.9	

ROLL RATE, deg./second, includes input time

	Va	1.3 Vso
Lancair IVP N114L	79 Rt./ 90 Lt.	70 Rt./ 56 Lt.
RV-8A N58VA	109 Rt./102 Lt.	78 Rt./80 Lt.**
Cessna 152	47	34
RANS S-7C	61 Rt./63 Lt.	50 Rt./53 Lt.
GlaStar	52 Rt./50 Lt.	47 Rt./43 Lt.
**full flaps, 80 IAS		

LANCAIR IVP, N114L, SPECIFICATIONS

Empty weight/gross weight	2215.5 lb/3200 lb
Payload, full fuel	420.2 lb
Useful load	984.5 lb
ENGINE:	
Engine make, model	Regan Lycoming TIO-540 with 8.5 :1 c/r pistons
Engine horsepower	360 BHP by dyno
Engine TBO	na
Engine RPM, maximum	2700 RPM
Man. Pressure, maximum, 2 min.	35 " Hg.
Turbine inlet, max/cruise/climb	1650 °F/1550 °F/1450 °F
Turbocharger	Garrett 466642-9005
Wastegate	Garrett 481064-9002
Starter	B&C BCS206-149-24V
Alternator	B&C L-60 28 Volt, 60 Amp
Cyl head temp., maximum	475° F
Oil pressure range	30 - 60 psi
Oil temp., maximum	245° F
Fuel pressure range, pump inlet	na
Weight of prop/spinner/crank	na
Induction system	Bendix RSA-10 AD1 fuel injection
Induction inlet area	11.5 sq in
Exhaust system	3 into 1 into turbo, each side, auto wastegates
Oil capacity, type, cooler	10 qts/Shell 15/50
Ignition system	Bendix 1200 series
Cooling system	Downdraft air, hot accesssory section
Cooling inlet area	77 sq in
Cooling outlet area	88 sq in, inc. 2 3 in ext. pipes
PROPELLER:	
Make	MT 4 blade, 195-30A blade (experimental)
Material	composite
Diameter/Pitch	78 in
Prop extension, length	na
Prop ground clearance, full fuel	12 in
Spinner diameter	16 in
Fuel system	2 wing tanks (L, R shutoff), FlowScan gph
Fuel pump	2 Duke 5134 elect. pumps, hi/lo press
Fuel type	100 LL
Fuel capacity, by CAFE scales	94.05 gal
Fuel unusable	8 oz
Flight control system	pushrods for aileron/elevator and cable for rudder
Braking System	Cleveland disc, single caliper dual puck
Tire size, mains/nose	6:00 x 6 x 15/500 x 5
Seats	4
Cabin entry	gull wing door, pilot's side
Width at hips, front/rear	37 in
Width at shoulders, front/rear	46 in
Height, seat to headliner	37 in
Baggage capacity	13.5 cu ft and 150 lb
Baggage door size	23w x 19h
Baggage lift over height	47 in
Step-up height to wing step/T.E.	19 in

FLIGHT TEST DETAILS

One performance flight was made during May, 1999, in day VFR conditions. A Flowscan 201A fuel flow transducer was used for the gph determinations and was calibrated by measuring the weight of fuel burned on each flight. A PropTach digital tachometer was mounted on the top of the instrument panel. The performance data flight was conducted with pilot and flight engineer aboard and flying qualities were evaluated with other solo flights using an analog G meter and Brooklyn Tool & Machine Co., Inc. NJ hand-held stick force gauge.

Cruise flight data was obtained with the wingtip CAFE Barograph (#3) mounted on a wing cuff with a dummy barograph and cuff mounted on the opposite wing. These were correlated with the panel airpseed indicator to produce the airspeed correction table shown here. Our data suggest that Vy is 135 mph CAS and Vx is 105 mph CAS.

Cowl exit temp (C.X.T.) is a function of the OAT & CHT and is a measure of the efficiency with which the cooling system removes heat from the hot engine. This can be expressed as the temp rise relative to the hottest CHT observed during climb:

CAFE HONORARY ALUMNI

Steve Barnard--RV-6A
Jim Clement--Wittman Tailwind
Jim Lewis--Mustang II
Ken Brock--Thorp T-18
Larry Black--Falco F.8L
Chuck Hautamaki--Glasair III
Jeff Ackland--Legend
Jerry Sjostrand--Express
Randy Schlitter--RANS S-7C
Stoddard Hamilton Aircraft, Inc. GlaStar
Fred Baron--Lancair 320
Mark Beduhn--Cozy Mark IV
Dick VanGrunsven--RV-8A
Derek Hine Lancair IV-P

COMPARATIVE AIRCRAFT
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The CAFE Foundation:
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IMPORTANT NOTICE

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KIT SUPPLIER

Neico aviation, Inc.
2244 Airport Way
Redmond OR 97756
541-923-2244 www.lancair.com

OWNER/BUILDER N114L

Derek Hine
5 Hawk View
Portola Valley CA 94028
derekhine@aol.com 650-858-8456 hangar

DESIGNER’S INFORMATION

Cost of airframe materials, no engine or inst.	**$104,500, incl wing mating and Fast-Build**
Kit starts sold to date	**450**
Number completed	**130**
Est. hours to build	**5000-6000**
Prototype first flew	**1992**
Normal empty wt. per Owner’s Manual	**2200 lb**
Design gross weight, lb, Takeoff/Landing	**3200/2900 lb**
Recommended engine(s)	**Teledyne/Cont. TSIO-550**

CAFE FOUNDATION DATA, N114L

Wingspan	**30 ft 1.25 in**
Wing chord @ root/tip	**47.25 in/ 30.125 at tip joint**
Wing area	**98 sq ft**
Wing loading	**32.6 lb/sq ft**
Power loading	**9.1 lb/hp**
Span loading	**30 ft 3 in/3200 ln**
Airfoil, wing	**Laminar Flow**
Airfoil, design lift coefficient	**max 2d lift design coef. 2.5**
Airfoil, thickness to chord ratio	**17% at root**
Aspect ratio	**9:1**
Wing incidence	**1.6 °**
Thrust line incidence, crankshaft	**1.5 ° to right**
Wing dihedral	**3 °**
Wing taper ratio, tip/root,	**50.26 in/ 29.95 in**
Wing twist or washout	**at least 2 °**
Wing sweep	**-1.6 °**
Steering	**Diff. braking, int. nose shimmy damper**
Landing gear	**Retractable electro-hydraulically**
Horizontal stab: span	**130.625 in**
Horizontal stab chord, root/tip	**27.125/ 16.25 in**
Elevator: total span	**132.875 in**
Elevator chord: root/tip	**12 in/ 6.75 in**
Vertical stab: span	**~56 in**
Vertical stab chord: average	**21.5 in**
Rudder: average span	**14.5 in**
Rudder chord, bottom/top	**~19.25/~8.375 in**
Ailerons: span/average chord, each	**67.25/5.375 in**
Flaps: span/chord, each	**78.5/8.5/11 in**
Total length	**24 ft 9.25 in**
Height, static with full fuel	**8 ft 5.5 in**
Minimum turning circle	**na**
Main gear track	**6 ft 10 in**
Wheelbase, nosewheel to main gear	**74 in**
Acceleration Limits per factory:	**+4.4 G/-2.3 G**

AIRSPEEDS PER OWNER’S MANUAL

Never exceed, V_{ne}	**274 kts CAS**
Maneuvering, V_a	**170 kts CAS**
Best angle of climb, V_x	**126 mph**
Best rate of climb, V_y	**155 mph**
Stall, clean, V_s	**69 mph**
Stall, dirty, V_{so}	**84 mph**
Flap Speed V_{fe}	**10° @ 174 kts CAS, 40° @ 132 kts CAS** **150 kts/ 165 kts CAS**

Cruise data, mph	Config./flight #	DAD Clock	CAS, Baro	CAS, no cuffs	Densalt., ft.	Dens. ratio	New TAS	M.P., in. Hg.	RPM	GPH	MPG	Weight, lb.	Range, miles	**CAFE score	Endur., hrs.	Comment
Lancair N114L	#1, with cuffs, Baro #3	02:22:09	238.9	247.0	6100	0.833	**270.6**	31.6	2505	23.3	11.6	3132	1034	17	3.9	Vmax 6000'
94.05 gallons fuel cap.	#1, with cuffs, Baro #3	02:55:51	231.9	239.6	8387	0.777	**271.8**	30.2	2500	22.6	12.0	3063	1071	18	4.0	Max cruise 8500'
for computing range	#1, with cuffs, Baro #3	03:00:16	230.8	238.4	12015	0.693	**286.4**	30.0	2495	21.7	13.2	3052	1175	21	4.2	Max cruise 12000'
5 gallons VFR reserve	#1, with cuffs, Baro #3	03:09:10	224.5	231.7	17565	0.578	**304.6**	29.8	2536	23.0	13.2	3030	1179	22	4.0	Max cruise 17500'
Wing cuff	#1, with cuffs, Baro #3	03:24:59	206.5	212.6	25000	0.448	**317.5**	29.8	2549	22.3	14.2	2991	1268	25	4.1	max cont. cruise
drag penalty = 6.4 mph	#1, with cuffs, Baro #3	03:25:56	214.1	220.6	25000	0.448	**329.5**	34.4	2730	32.9	10.0	2988	892	19	2.8	2 minute limit
at 212 mph CAS	#1, with cuffs, Baro #3	03:29:22	208.7	214.9	25000	0.448	**321.0**	29.8	2607	25.1	12.8	2980	1139	23	3.6	2600 RPM cruise
**TAS^1.3 x MPG/1000	#1, with cuffs, Baro #3	03:31:18	206.9	213.0	25000	0.448	**318.1**	30.2	2420	25.9	12.3	2975	1094	22	3.5	2400 RPM cruise

Lancair IVP N114L	Flight/Date	Start time	Presalt., ft.	Densalt range	Weight, lb	CAS, mph	TAS, mph	fpm	comment
	Climbs							Rate of climb,	
31.6" MP, 2510 RPM, 25 gph, C.X.T. 205°F	#1--5/15/99	14:26:44	6647	7508-9006	3121	152	174	1431.0	
32.0" MP, 2510 RPM, 26 gph, C.X.T. 184°F	#1--5/15/99	14:37:38	6606	7513-9002	3100	163	185	1314.0	
31.6" MP, 2504 RPM, 25 gph, C.X.T. 184°F	#1--5/15/99	14:45:17	6588	7509-9024	3085	174	198	1357.0	
31.6" MP, 2507 RPM, 26 gph, C.X.T. 196°F	#1--5/15/99	14:51:04	6676	7510-9001	3072	140	159	1491.0	Best rate
C.X.T. = cowl exit air temp.									
	Descents							Rate of sink,	
Deploy dive brake, Va, level flt.	#1--5/15/99	15:44:00	16637	18031-17153	2955	190	251	-903.0	brake effect @ Va
2.2" MP, 2400 RPM, 1.8 gph, C.X.T. 145°F	#1--5/15/99	15:50:23	12467	13616-12977	2948	135	165	-1918.0	flat pitch, clean
3.6" MP, 1500 RPM, 1.2 gph, C.X.T. 133°F	#1--5/15/99	15:51:03	11349	12555-11862	2948	135	164	-1039.0	steep pitch, clean
4.2" MP, 1445 RPM, 1.1 gph, C.X.T. 115°F	#1--5/15/99	15:53:57	8905	9820-9547	2946	123	144	-820.0	min sink, clean