Lancair Owners & Builders Organziation

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## in this issue



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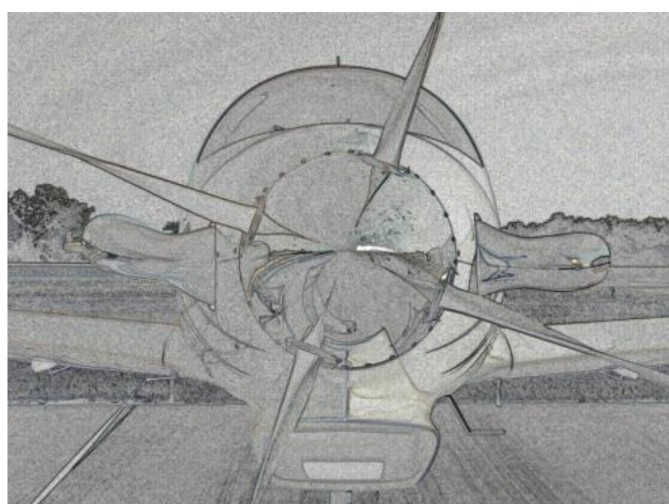
# FROM THE PRESIDENT

*jeff edwards*

Happy New Year as LOBO moves into its fifth year of operations! A new year is a good time for self-evaluation, for both individuals and organizations. This past year has seen many successes and some setbacks.

On the positive side, LOBO events continue to excel. Our annual fly-in held this year at Sedona, Arizona was very well attended by members and guests. Bob Jeffrey and Ernie Sutter's training event was packed with Lancair pilots and builders. Thank you also to Art Jensen for his presentation on engine operation and Don Gunn for sharing his experience in successfully handling an inflight engine failure (read his story later in this newsletter if you missed his presentation). A tip of the hat also to Claudette, Lisa, Jennifer, Jim Hergert and all of our volunteers who helped to make this a great gathering. Finally, a very special thank you goes to past EAA President Mr. Rod Hightower for a great keynote add-ress. All in all, our annual association event was a tre-mendous success, which we hope to better this year a bit to the east in Greenville, South Carolina. Don't miss it!



The LOBO board continues to meet with FAA leadership in our continuing quest to improve Lancair safety and reduce the accident rate. We are discussing several initiatives, including mandatory transition training for new Lancair pilots; bifurcating Phase I into a Phase IA and Phase IB. IA would be aimed at establishing the flight safety of the aircraft and IB would permit flight training of the new pilot. We are also discussing the pros and cons of a second qualified pilot onboard during Phase I under certain circumstances. The FAA is seriously considering all of these options.

### Accident Review

On a more somber note we remember Lancair pilots who flew west this year. Longtime friend, mentor, fellow builder/owner and LOBO member Mr. Harry League along with Mr. Pat Franzen were lost on April 30, 2012 when N66HL broke up in flight near Sisters, Oregon during a local training flight. The NTSB has yet to identify a definitive cause for this accident.


Also, Mr. Steve Appleton, CEO of Micron, perished in his newly purchased IVPT on February 3, 2012 following a loss of engine power on takeoff at Boise, Idaho. Mr. Appleton attempted a takeoff only to reject it after the engine "rolled back" shortly after liftoff. He set the aircraft down on the remaining runway. He then taxied back and attempted a second takeoff during which the engine again rolled back, this time after liftoff. Tragically, he stalled the aircraft while attempting to turn back to the runway. LOBO assisted the NTSB and FAA with these two investigations.

Mr. Donald E. Klein, Jr., died Saturday, April 14, 2012 when his Lancair 235 N235MW went down near Hudson, Kentucky. A post-crash examination of the wreckage revealed evidence of battery outgassing, and chemical/soot staining inside the battery box. The NTSB reported the battery was recharged prior to the accident flight.

On June 26, 2012, Mr. Thomas Plodzien of Monee, Illinois crashed near Monroe Center, Illinois following a report of smoke in the cockpit. Mr. Scott Kreuger assisted the NTSB and FAA in their investigation of this accident.

On September 6, 2012, a kit-built Lancair IV, N1126V, was destroyed when it impacted terrain during a go-around at the Winnsboro Municipal Airport (KF89), Winnsboro, Louisiana. Mr. Fairley Gooch, a retired Delta captain and former Army aviator (pilot) was fatally injured.

The aircraft was on a Phase I test flight. Discussion with the FAA inspector assigned indicated the pilot overshot the landing zone of the 3,000 ft runway and attempted a go around. The pilot had been advised by two LOBO members to use at least a 5000 ft runway for Phase I testing. He had also been advised to obtain model-specific training, but he declined.

Witnesses at the airport reported an increase in engine noise consistent with a go around. They observed the landing gear of the accident airplane retracting followed by what sounded like a loss of engine power. They further observed the nose of the airplane go up, then down. The airplane impacted grass approximately 800 feet from the departure end of runway 18.

Prior to the mishap flight the pilot had asserted to an insurance broker he had received Lancair flight training—he had not. LOBO assisted authorities in this crash investigation.

On December 30, 2012 a IVPT crashed killing owner William Stern, his wife and daughter, and on July 3, 2012 a IVP crashed near Concepcion, Argentina with two fatalities.

This brings 2012 totals to seven serious accidents, with eleven fatalities.

I urge you to examine your skills, practices and mindset this New Year, and make a pledge to help reduce the Lancair accident rate. A good starting point is the LOBO website, which contains great information on flight safety and aviation risk management.

In summary:

1. Fly responsibly. Make certain you and your Lancair are ready to fly. The FAA's IMSAFE checklist is a good place to start.
2. Ensure you are current and proficient for the flight operations planned. Annual recurrent training is strongly recommended. If you have an instrument rating an Instrument Proficiency Check (IPC) is in order.
3. Address any aircraft airworthiness issues prior to flight.

## To Stall or Not

*jeff edwards*

There has been much buzz recently regarding the "to stall or not to stall" debate within the Lancair community. Let me address those thoughts here. Some argue strongly pilots should be encouraged to practice stalls as a matter of routine in Lancair aircraft. Some, including myself and LOBO's cadre of instructors, urge a more cautious approach because:

- Some Lancairs may not recover from a spin even under the control of an experienced test pilot
- The stall itself can be disorienting, with rolls of 90 degrees or more
- Just because your friend's Lancair stalls straight ahead with the ball centered does not mean yours does—even minor differences between the left and right wings can cause one to stall before the other

Those advocating stall practice were not Lancair model specific, nor did they offer any reason beyond the "machismo" argument—the one that says a "real pilot" should be able to recover from any stall. This, despite the fact that the primary purpose of stall awareness training is to learn to avoid stalling in the first place!

### No Old, Bold Pilots

One individual advocating stall practice in Lancairs is relatively new to the aircraft, with two years' experience in a Legacy FG (this is the only background data I have about this person). Another individual preferred not to discuss his aeronautical experience, including the extent (if any) of his Lancair experience.

Among those opposed to stall practice in Lancair aircraft are several former military pilots (thank a veteran!) including former Director of the U.S. Navy Test Pilot School, Col. Pete Field, USMC (ret.); Jon Addison, one of Pete's classmates; Skip Slater (ex-naval aviator); and Lynn Farnsworth (USAF).

I've found it's important when judging the value of advice to consider the source. On the "do it" side of the stall practice debate are two complete unknowns, while the "don't do it" side has decades of the best aviation training and experience in the world. Which side do you value more?

### What the Data Says

I am privileged to have spent the last two years serving on the General Aviation Joint Steering Committee working group investigating and researching loss of control accidents. I am representing a couple of organizations, including LOBO, as a subject matter expert (SME). So far it's been a terrific experience!

A sub-group I participated with

> *Those advocating stall practice [didn't] offer a reason beyond the "machismo" argument—the one that says a "real pilot" should be able to recover from any stall.*

examined experimental amateur-built (EA-B) accidents over the last ten years—the data is not encouraging.

We read hundreds of accident reports. A typical report involving loss of control reads like this:

- Mishap pilot recently finished building
- Mishap pilot was practicing stalls
- Witnesses saw the aircraft rotating prior to ground impact

You get the picture.

Our committee made several recommendations to government and industry to mitigate the risks of a loss of control and this article addresses most of those recommendations.

As a matter of course, I would encourage all pilots (not just Lancair pilots) to obtain upset and recovery training, including stall/spin recovery, from a qualified professional (although for a variety of reasons I do not recommend receiving such training in a Lancair). Here's why:

From my experience as a flight instructor and FAA designated pilot examiner, the average private pilot applicant has accomplished less than 40 stalls before attempting the practical test. While most private pilot applicants can pass the rudimentary two stall requirement of the Practical Test Standards (PTS) in a benign training aircraft like a Cessna 172, some cannot.

As for those who successfully completed the PTS, many pilots who passed a check ride years ago have not practiced stalls—in any aircraft, much less a Lancair—in a long time. This (lack of) experience hardly qualifies someone to practice or test stalls in a Lancair.

As for spins, a majority of pilots have no spin training—and believe me when I say you better get it if you intend to practice stalls in a Lancair. Very few pilots have ever been upside down in an aircraft. The average GA pilot lacks stall experience, and (s)he has even less spin experience. Many GA pilots, in fact, have never performed a spin.

Spin training is only necessary for the CFI certificate, which requires the candidate to demonstrate only two spins; one right and one left. Most CFI's are not spin experts. If asked, most pilots could not tell you what is required to spin an aircraft (think aerodynamics). If you think I'm blowing smoke up your tailpipe read Dr. Patrick Veillette's research posted below.

Here a few more facts to ponder:

1. Loss of Control is the leading cause of general aviation airplane accidents (almost 50%). It beats all other causes combined. (Source GA JSC Pareto CY2001-2011) LOBO is participating in this research aimed at decreasing the loss of control hazards.
2. 90 out of 190 serious Lancair accidents have been because of loss of control of one form or another. (Source www.ntsb.gov)
3. Read this very good Australian report on a IVPT Loss of Control accident. The pilot (fatal) was a military test pilot.
4. Most of the Lancair pilots are not former military test pilots—not even close. (Source LOBO membership data)

There have been too many Lancairs lost with "qualified" instructors and pilots aboard "practicing" stalls. This is one of the primary reasons I do not recommend stall practice in a Lancair: The risk versus reward equation doesn't add up.

With that in mind, LOBO does not recommend practicing stalls in Lancair aircraft. If you feel the need to practice stalls you are best served by taking upset and recovery training from P. J. Ransbury or from Rich Stowell. Tell them I sent you!

What about aerobatic training? Aerobatics is about flying precise maneuvers, sometimes for competition purposes and usually within a specified "box" of airspace. Upset training is about learning to recognize and recover from a bad situation—in other words, aviation survival skills. I recommend you learn the survival skills first.

Bottom line-- if you want to practice a stall get an aircraft you can do it in safely with an instructor who knows what he or she is doing.

## Certified vs. Experimental

Certified aircraft are tested by the manufacturer (and the FAA) to ensure they meet established stall and spin certification requirements. Your Lancair is not required to meet these design criteria.

Does this make your Lancair a "bad design?" No—it just means certification design regulations do not apply. It doesn't mean, however, we shouldn't apply common sense.

You might find it enlightening to review the documents outlining current FAA stall/ spin requirements. That way, when you transition from your C172 to the Lancair, you'll have a better understanding why they do not behave the same. Should you be afraid? No. But you should have plenty of respect for the machine. The old pilot knows his limitations and the aircraft's limitations and stays within the envelope.

## Aircraft Modifications

LOBO does recommend the installation of calibrated AOA systems. LOBO also recommends flight testing by a qualified test pilot to include stall testing, installation of stall strips and other leading edge devices to improve stall characteristics (as necessary).

## LOBO Designed Training

LOBO does not perform stalls as part of flight training. LOBO instructors demonstrate slow flight and high angle of attack flying with the emphasis on stall recognition and proper recovery techniques.

Many pilots have a very weak understanding of basic aerodynamics. I recommend a thorough reading of *Aerodynamics for Naval Aviators* by H. H. Hurt to brush up. I also recommend Rich Stowell's book *Stall/ Spin Awareness*, which is a great treatise on the subject and a good read on the history of stall spin safety.

Finally, the definitions of "full stall" and "approach to stall" have been used rather loosely in the aforementioned discussion. A better term is "exceed the critical angle of attack".

As to IVP specifics, I am not personally aware of any pilot I trained intentionally performing a "full stall" landing in a IVP. The IVP lands best when flown onto the ground above stall speed. Otherwise you invite a nasty surprise.

Below is a list of suggested reading on stall/ spin or loss of control issues for those so inclined.

Recommended reading and pertinent FAA regulations are below. Be safe.

## Recommended Reading


- DiCarlo, D. J. , Stough H. P., Glover, K. E., Brown, P. W. and Patton, J. M. (1986). *Development of Spin Resistance Criteria for Light General Aviation Airplane*, SFTE 3rd Flight Testing Conference April 2-4, 1986/Las Vegas, Nevada, (NASA Langley Research Center AIM-86-981 2), Hampton, VA
- Ellis, D., (1977) *A Study of Lightplane Stall Avoidance and Suppression*, Washington, D.C., FAA-RD-77-25
- FAA. (2000) AC 61-67, *Stall and Spin Awareness Training*,
- Gluck S. (2003) *Spin Awareness Survey*,
- Hoffman, W. C. and Hollister, W. M., (1976) *General Aviation Pilot Stall Awareness Training Study*, Washington, D.C., FAA-RD-77-26
- Manuel, G.S., DiCarlo D. J., Stough, H. P. III, Brown P.W. and Stuever, R.A. (1989) *Investigations of Modifications to Improve the Spin Resistance of a High-Wing, Single Engine, Light Airplane*, NASA Langley Research Center Hampton, Virginia, General Aviation Aircraft Meeting & Exposition, Wichita, KS April 11-13, 1989, in SAE, 891039
- NTSB Bureau of Aviation Safety. (1976) *Special Study U.S. General Aviation Takeoff Accidents—The Role of Preflight Preparation*, Washington, D.C., NTSB AAS-76-2
- NTSB Bureau of Technology. (1979) *Special Study Light Twin-Engine Aircraft Accidents Following Engine Failures, 1972-1976*, Washington, D.C., NTSB AAS-79-2
- NTSB. (1972) *Special Study-General Aviation Stall/Spin Accidents 1967-1969*, Washington, D.C., NTSB AAS-72-8
- Silver, B. (1976), *Statistical Analysis of General Aviation Stall Spin Accidents*, SAE
- Stephens, C. (2011), *GA JSC SAT and Working Group Processes*, Washington, D.C.
- Stough, H. P. III, DiCarlo D. J., and Patton, J. M. Jr. (1987). *Evaluation of Airplane Spin Resistance Using Proposed Criteria For Light General Aviation Airplanes*, NASA Langley Research Center Hampton, Virginia, 23665, 1987, AIAA
- Stowell, R. *Innovations in Stall/Spin Awareness Training*, Second Annual Instructor Conference, April 9-10, 1999, Embry-Riddle Aeronautical University, Daytona Beach, FL
- Stowell, R. (2007), *The Light Airplane Pilot's Guide to Stall/Spin Awareness*
- Veillette P. R. (1992), *Re-Examination of Stall/ Spin Prevention Training*, University of Utah, National Research Council Transportation Research Board, 1993 (Conference Proceedings, 1992)
- Veillette P. R. (1993) *Rudder and Elevator Effects on the Incipient Spin Characteristics of a Typical General Aviation Training Aircraft*, University of Utah, Salt Lake City, 31st Aerospace Sciences Meeting & Exhibit January 11-14, 1993, Reno, NV, AIAA 93-0016

## *FAA Design Regulations*

This section contains pertinent excerpts from FAA regulations concerning aircraft design as related to stall characteristics.

### *§ 23.201 Wings level stall.*

(a) It must be possible to produce and to correct roll by unreversed use of the rolling control and to produce and to correct yaw by unreversed use of the directional control, up to the time the airplane stalls.

(b) The wings level stall characteristics must be demonstrated in flight as follows. Starting from a speed at least 10 knots above the stall speed, the elevator control must be pulled back so that the rate of speed reduction will not exceed one knot per second until a stall is produced, as shown by either:

(1) An uncontrollable downward pitching motion of the airplane;

(2) A downward pitching motion of the airplane that results from the activation of a stall avoidance device (for example, stick pusher); or

(3) The control reaching the stop.

(c) Normal use of elevator control for recovery is allowed after the downward pitching motion of paragraphs (b)(1) or (b)(2) of this section has unmistakably been produced, or after the control has been held against the stop for not less than the longer of two seconds or the time employed in the minimum steady slight speed determination of § 23.49.

(d) During the entry into and the recovery from the maneuver, it must be possible to prevent more than 15 degrees of roll or yaw by the normal use of controls except as provided for in paragraph (e) of this section.

(e) For airplanes approved with a maximum operating altitude at or above 25,000 feet during the entry into and the recovery from stalls performed at or above 25,000 feet, it must be possible to prevent more than 25 degrees of roll or yaw by the normal use of controls.

(f) Compliance with the requirements of this section must be shown under the following conditions:

(1) Wing flaps: Retracted, fully extended, and each intermediate normal operating position, as appropriate for the phase of flight.

(2) Landing gear: Retracted and extended as appropriate for the altitude.

(3) Cowl flaps: Appropriate to configuration.

(4) Spoilers/speedbrakes: Retracted and extended unless they have no measureable effect at low speeds.

(5) Power:

(i) Power/Thrust off; and

(ii) For reciprocating engine powered airplanes: 75 percent of maximum continuous power. However, if the power-to-weight ratio at 75 percent of maximum continuous power results in nose-high attitudes exceeding 30 degrees, the test may be carried out with the power required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 VSO , except that the power may not be less than 50 percent of maximum continuous power; or

(iii) For turbine engine powered airplanes: The maximum engine thrust, except that it need not exceed the thrust necessary to maintain level flight at 1.5 VS1 (where VS1 corresponds to the stalling speed with flaps in the approach position, the landing gear retracted, and maximum landing weight).

(6) Trim: At 1.5 VS1 or the minimum trim speed, whichever is higher.

(7) Propeller: Full increase r.p.m. position for the power off condition

### *§ 23.203 Turning flight and accelerated turning stalls.*

Turning flight and accelerated turning stalls must be demonstrated in tests as follows:

(a) Establish and maintain a coordinated turn in a 30 degree bank. Reduce speed by steadily and progressively tightening the turn with the elevator until the airplane is stalled, as defined in § 23.201(b). The rate of speed reduction must be constant, and—

(1) For a turning flight stall, may not exceed one knot per second; and

(2) For an accelerated turning stall, be 3 to 5 knots per second with steadily increasing normal acceleration.

(b) After the airplane has stalled, as defined in § 23.201(b), it must be possible to regain wings level flight by normal use of the flight controls, but without increasing power and without—

(1) Excessive loss of altitude;

(2) Undue pitchup;

(3) Uncontrollable tendency to spin;

(4) Exceeding a bank angle of 60 degrees in the original direction of the turn or 30 degrees in the opposite direction in the case of turning flight stalls;

(5) Exceeding a bank angle of 90 degrees in the original direction of the turn or 60 degrees in the opposite direction in the case of accelerated turning stalls; and

(6) Exceeding the maximum permissible speed or allowable limit load factor.

(c) Compliance with the requirements of this section must be shown under the following conditions:

(1) Wings flaps: Retracted, fully extended, and each intermediate normal operating position as appropriate for the phase of flight.

(2) Landing gear: Retracted and extended as appropriate for the altitude.

(3) Cowl flaps: Appropriate to configuration.

(4) Spoilers/speedbrakes: Retracted and extended unless they have no measureable effect at low speeds.

(5) Power:

(i) Power/Thrust off; and

(ii) For reciprocating engine powered airplanes: 75 percent of maximum continuous power. However, if the power-to-weight ratio at 75 percent of maximum continuous power results in nose-high attitudes exceeding 30 degrees, the test may be carried out with the power required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 $V_{SO}$ , except that the power may not be less than 50 percent of maximum continuous power; or

(iii) For turbine engine powered airplanes: The maximum engine thrust, except that it need not exceed the thrust necessary to maintain level flight at 1.5 VS1 (where VS1 corresponds to the stalling speed with flaps in the approach position, the landing gear retracted, and maximum landing weight).

(6) Trim: The airplane trimmed at 1.5 VS1.

(7) Propeller: Full increase rpm position for the power off condition.

### *§ 23.221 Spinning.*

(a) Normal category airplanes. A single-engine, normal category airplane must be able to recover from a one-turn spin or a three-second spin, whichever takes longer, in not more than one additional turn after initiation of the first control action for recovery, or demonstrate compliance with the optional spin resistant requirements of this section.

(1) The following apply to one turn or three second spins:

(i) For both the flaps-retracted and flaps-extended conditions, the applicable airspeed limit and positive limit maneuvering load factor must not be exceeded;

(ii) No control forces or characteristic encountered during the spin or recovery may adversely affect prompt recovery;

(iii) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin; and

(iv) For the flaps-extended condition, the flaps may be retracted during the recovery but not before rotation has ceased.

(2) At the applicant's option, the airplane may be demonstrated to be spin resistant by the following:

(i) During the stall maneuver contained in § 23.201, the pitch control must be pulled back and held against the stop. Then, using ailerons and rudders in the proper direction, it must be possible to maintain wings-level flight within 15 degrees of bank and to roll the airplane from a 30 degree bank in one direction to a 30 degree bank in the other direction;

(ii) Reduce the airplane speed using pitch control at a rate of approximately one knot per second until the pitch control reaches the stop; then, with the pitch control pulled back and held against the stop, apply full rudder control in a manner to promote spin entry for a period of seven seconds or through a 360 degree heading change, whichever occurs first. If the 360 degree heading change is reached first, it must have taken no fewer than four seconds. This maneuver must be performed first with the ailerons in the neutral position, and then with the ailerons deflected opposite the direction of turn in the most adverse manner. Power and airplane configuration must be set in accordance with § 23.201(e) without change during the maneuver. At the end of seven seconds or a 360 degree heading change, the airplane must respond immediately and normally to primary flight controls applied to regain coordinated, unstalled flight without reversal of control effect and without exceeding the temporary control forces specified by § 23.143(c);

and

(iii) Compliance with §§ 23.201 and 23.203 must be demonstrated with the airplane in uncoordinated flight, corresponding to one ball width displacement on a slip-skid indicator, unless one ball width displacement cannot be obtained with full rudder, in which case the demonstration must be with full rudder applied.

(b) Utility category airplanes. A utility category airplane must meet the requirements of paragraph (a) of this section. In addition, the requirements of paragraph (c) of this section and § 23.807(b)(7) must be met if approval for spinning is requested.

(c) Acrobatic category airplanes. An acrobatic category airplane must meet the spin requirements of paragraph (a) of this section and § 23.807(b)(6). In addition, the following requirements must be met in each configuration for which approval for spinning is requested:

(1) The airplane must recover from any point in a spin up to and including six turns, or any greater number of turns for which certification is requested, in not more than one and one-half additional turns after initiation of the first control action for recovery. However, beyond three turns, the spin may be discontinued if spiral characteristics appear.

(2) The applicable airspeed limits and limit maneuvering load factors must not be exceeded. For flaps-extended configurations for which approval is

requested, the flaps must not be retracted during the recovery.

(3) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin.

(4) There must be no characteristics during the spin (such as excessive rates of rotation or extreme oscillatory motion) that might prevent a successful recovery due to disorientation or incapacitation of the pilot.

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# HOW SLICK IS IT?

*fred moreno*

When it comes to bragging rights about who has the "slickest" airplane, we can settle the bet with some careful measurements and then calculate a number to decide who wins the bet. The number we want is called the "simplified" flat plate drag area (FPDA). This number represents the frontal area times the air flow impact pressure and yields the total drag of the airplane.

This gives us an easy comparison of various aircraft drag figures for the high speed cruise portion of the flight envelope. Table 1 list figures for a few different aircraft, most of which I dug up from Bruce Carmichael's book *Personal Aircraft Drag Reduction* (1995).

Flat plate drag area lumps ALL the drag—parasitic (friction), cooling, and induced—into one number. To make a reasonable comparison one has to compare performance at the same operating regime, most usually maximum speed or a high cruise speed. Small errors in TAS measurement and power assumptions make large errors in flat plate drag area so the resulting number you calculate is always subject to a sizable error band. Making an accurate calculation requires calibrating instruments, very carefully controlled flight (autopilot on for precision altitude control) in smooth air as we shall discuss below.

| AIRCRAFT | SIMPLIFIED FPDA ($FT^2$) |
|---|---|
| 1950's era jet fighter | 4 - 5 |
| Cessna 172/C182 (varies by model/series) | ~6 |
| C-210/Beech Bonanza class (varies by model/series) | ~4 |
| Columbia/Cirrus Lancair ES | ~3 |
| Voyager (remember, it flew very slowly) | 5.4 |
| A.J. Smith's AJ-2 (1980) 200 HP, 280 MPH top speed | 1.14 |
| Bellanca Skyrocket 1983 | 2.83 |
| Lancair 200 (0-200 engine, calculated by Carmichael) | 1.61 |
| Mike Arnold's tiny AR 5 (213 mph on 65 HP) | .88 |
| Nemesis (formula 1) | 0.6 - 0.72 |
| Lancair ES | ~3 |
| Lancair IV prototype (turbo, calculated by M. Hollman) | 2.12 |
| VH-YFM, F. Moreno's modified Lancair IV, non-turbo | 1.85 – 1.95 |

TABLE 1

NASA aerodynamicist and drag reduction expert Bruce Carmichael provides a Horsepower x Prop Efficiency chart (H x PE, next page) that allows you to estimate flat plate drag area. It assumes you make a speed run at sea level, standard day, that you know the horsepower, and that you know the propeller efficiency.

## How to Calculate FPDA Accurately

If you can do a low pass over the ocean (or at sea level in Death Valley) on a 59F day with barometric pressure of 29.92 inches of mercury, do the following:

1. Make a full-throttle, two-way blast and average GPS readings of ground speed (three or four ways is better). Allow airspeed to equilibrate, which may take several minutes. If the barometric pressure is higher than standard, set standard in the altimeter window, climb until the altimeter shows sea level, and test there. If the barometric pressure is less than standard, do not descend below sea level! If you cannot get standard conditions you will have to correct for pressure and temperature (calculate density altitude).
2. Check manifold pressure and make sure it is adjusted to the engine manufacturer's manifold pressure for full power. If you are getting ram pressure benefit from your speed, correct power for the higher manifold pressure, or pull the throttle until you get the right manifold pressure for 100% power. Don't just assume you are getting 100%. You may be getting more.
3. Record data: GPS TAS, manifold

FRED'S IV (VH-YFM)

pressure, temperature, density altitude if your EFIS displays it. For non-turbo engines, each extra inch of manifold pressure adds about 3% power. If you are skimming the waves, have a friend record the data while you keep your eyes outside of the cockpit!

4. Average your air speed readings and convert to MPH (MPH equals knots times 1.15).
5. Determine your horsepower times prop efficiency (HPE) number by multiplying your actual horsepower (full power or corrected for differences in manifold pressure) by 0.85 (we are assuming 85% prop efficiency).
6. In the H x PE chart (**Figure 1**), find the diagonal HPE line corresponding to the number determined in Step 5. Find the point on that line where it intersects the vertical line for your TAS determined in Step 4 (remember: chart is in MPH).
7. At that intersection, move horizontally left or right and read off the flat plate drag area on the vertical axis.

### *The Simple Way (Less Accurate)*

Most folks are far from the ocean, making a sea level, standard-day full-power blast difficult without tunneling equipment. In that case you may have to test at altitude (avoiding rising

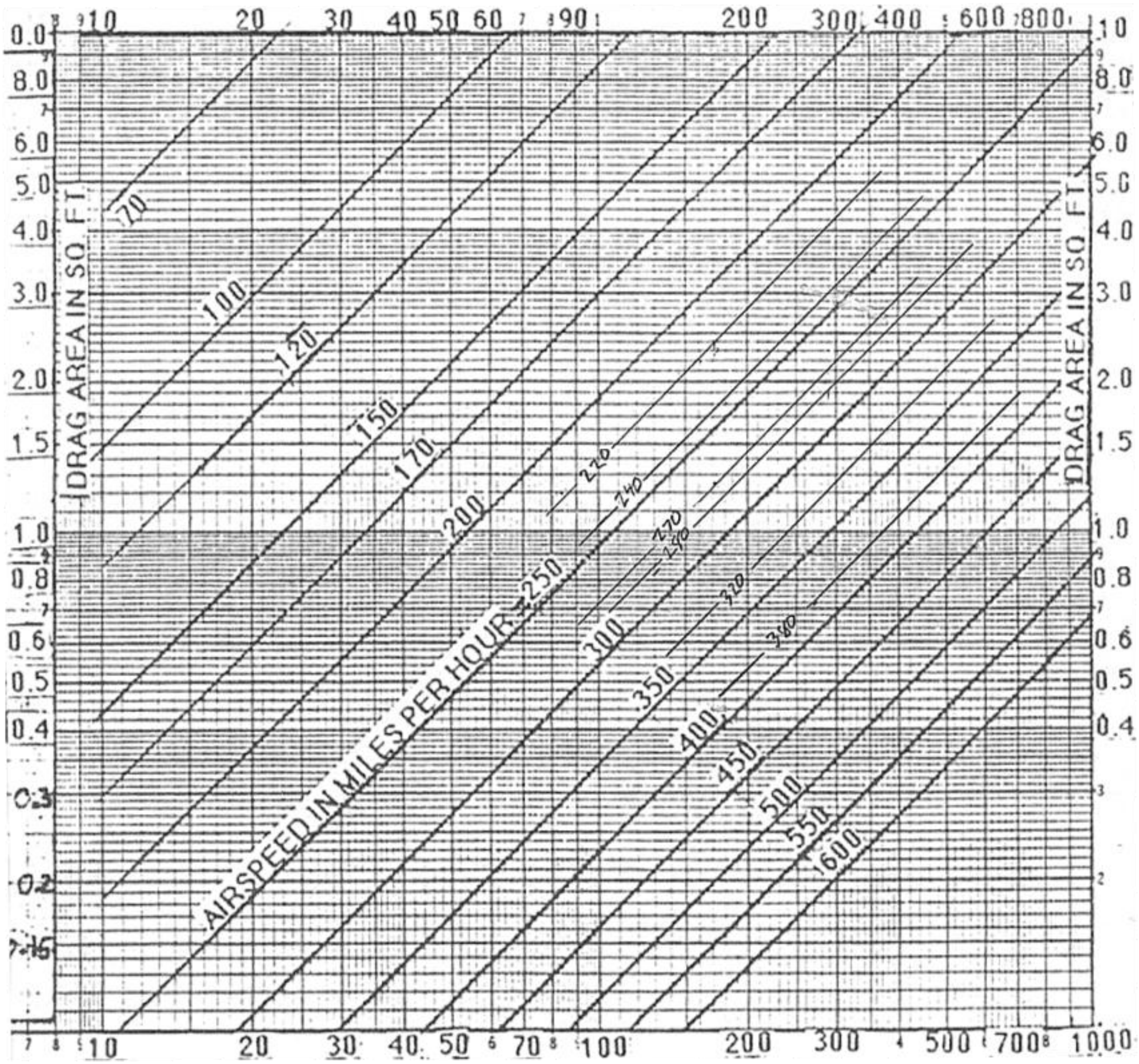



FIGURE 1 – HORSEPOWER VS PROP EFFICIENCY

| Density Altitude, feet | Density Ratio | Air Density lbs/cu ft | Cube root of density ratio |
|---:|---:|---:|---:|
| 0 | 1.0000 | 0.0765 | 1 |
| 1000 | 0.9711 | 0.0743 | 0.9903 |
| 2000 | 0.9428 | 0.0721 | 0.9806 |
| 3000 | 0.9151 | 0.0700 | 0.9709 |
| 4000 | 0.8881 | 0.0679 | 0.9613 |
| 5000 | 0.8617 | 0.0659 | 0.9516 |
| 6000 | 0.8359 | 0.0639 | 0.9421 |
| 7000 | 0.8106 | 0.0620 | 0.9325 |
| 8000 | 0.7860 | 0.0601 | 0.9229 |
| 9000 | 0.7620 | 0.0583 | 0.9135 |
| 10,000 | 0.7385 | 0.0565 | 0.9040 |
| 15,000 | 0.6292 | 0.0481 | 0.8570 |
| 20,000 | 0.5328 | 0.0408 | 0.8109 |
| 25,000 | 0.4481 | 0.0343 | 0.7654 |

TABLE 2

and/or sinking air), and correct the data sample for altitude, temperature and aerodynamic heating. There are a couple of ways to do this; this one is the simplest, but least accurate.

For constant power, speed increases roughly 1% per thousand feet for the first 10,000 feet or so. So your procedure is as follows:

1. Pick a smooth air day and fly a four way box recording GPS speeds. With the autopilot on, allow airspeed to equilibrate, then record your data. Make autopilot commanded gentle turns to the new direction, and allow two minutes (preferably more) after wings level to establish equilibrium. Remember, we are going for super accuracy.
2. Record your engine data so you will be able to make a horsepower estimate (more below).
3. Record density altitude if your instrumentation permits, or record OAT and then calculate density altitude later on. You will also correct for aerodynamic heating (more below). NOTE: Some instruments like the Chelton EFIS do this automatically.
4. Average all airspeed readings and convert to MPH.
5. Correct for altitude by reducing your average TAS by 1% per thousand feet of density altitude. This provides an estimate of the speed you would have gotten at sea level on a standard day.
6. Enter the chart (**Figure 1**) on the diagonal line for your HP times prop efficiency. Where it intersects the vertical line for your corrected sea level TAS in miles per hour (MPH = knots times 1.15) go horizontal to left or right and read off the flat plate drag area on the vertical axis.

## *The Simple Way (More Accurate)*

There is a way to make this estimate slightly more accurate. Don't use the 1% rule above. Instead, use the data in **Table 2** for the standard atmosphere, also from Carmichael's book.

Use the following procedure:

1. Complete steps 1-3 as above.
2. Find your recorded density altitude in the Density Altitude column of Table 2.
3. Move to the right on that row to find the cube root of the density ratio (interpolate as necessary).
4. Multiply this number by your recorded GPS TAS average to get your equivalent speed at sea level.
5. On the H x PE chart, slide down the diagonal line for your HP times prop efficiency until it intersects the vertical line for your TAS in miles per hour. Remember: MPH = knots times 1.15.
6. At that intersection, go horizontal to left or right and read off the flat plate drag area on the vertical axis.

## *Using a Calculator*

If you don't like the H x PE chart, you can record data and use your calculator. The formula is as follows:

$$DA = \frac{5231 * HP}{air\ density * velocity^2}$$

Where:

- DA = Drag Area, square feet
- Air Density is the air density at your density altitude, pounds per cubic feet, from **Table 2**
- Velocity is TAS at altitude in knots
- 5231 is a constant that takes into account conversion of HP to ft-lbs per second, the gravitational constant 32.2 ft-lb mass/lb force seconds squared and ½. (Math explained later).

## *Some Cautions*

Because there are a lot of estimates in power and prop efficiency as well as potential errors in air speed measurement and temperature, it is hard to get flat plat area accuracy to better than 10%. Multiple flight tests are needed to confirm data and do some statistics, more than most of us are willing to do. If you are a fanatic, do

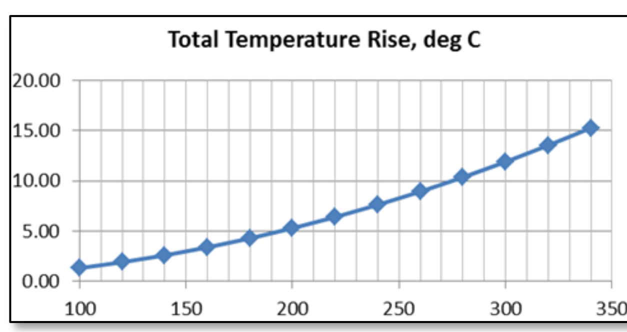



FIGURE 2

three test flights, same conditions (or as close as you can), and average your results. The differences in TAS numbers from three sets of tests will give you a feel for the accuracy (or conversely, the size of the errors) in your measurements.

Be wary of single point test data. It is easy to get a data point that looks really good. But you will only be fooling yourself.

## The Tricky Part—Corrections & Estimates

This section describes procedures to correct instrument errors and/or make accurate estimates when you're unable to collect all the required data.

### Outside Air Temperature (OAT)

If cruise speeds are high enough, there are aerodynamic heating effects that increase indicated OAT above ambient. As noted some EFIS systems (notably the Chelton) correct for these effects and present a "corrected" TAS number in that little box on the top left of the second screen. I don't know about other systems.

Temperature errors arise from both frictional/compression effects (about two-thirds of the error from an uncorrected instrument) and compressibility effects (about 1/3 of the total error). **Figure 2** (previous page) graphically depicts a simple formula showing the total rise in indicated OAT based on TAS.

If you are using a simple OAT instrument, which is usual for most of our airplanes, you need to correct your indicated OAT using the chart. For example, if your TAS is 200 knots and your indicated OAT is 15C, then the corrected OAT is 15C minus the expected 5.0C increase, which yields a corrected OAT of 10C. To get the most accurate results, use the corrected OAT to calculate the density altitude when making your TAS corrections back to sea level.

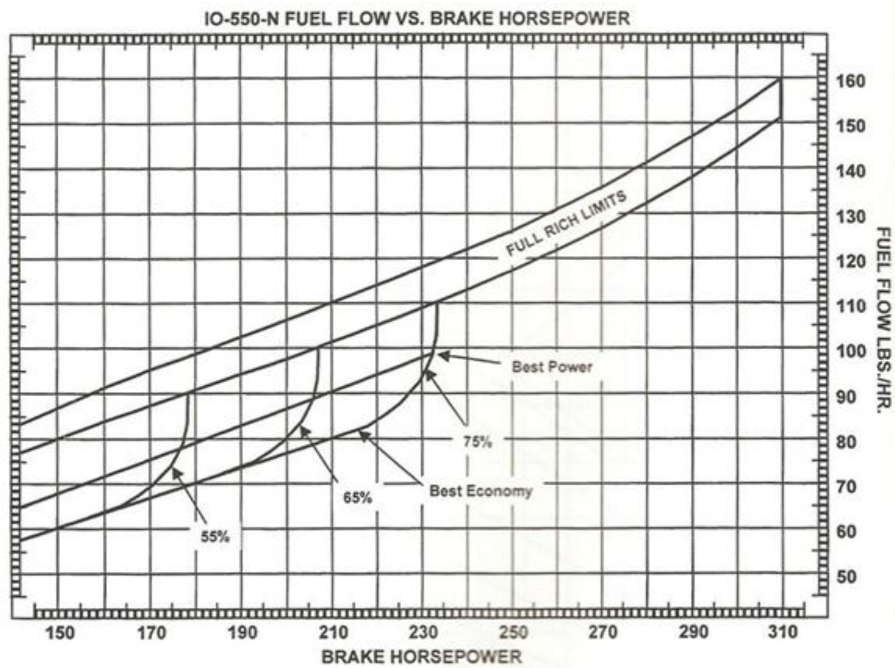



FIGURE 3

### Horsepower

Engines vary in their power output. For the Continental 550 series engines from the factory, the guarantee error band is that the power output is minus 0% and plus 5%. Other manufacturers use different error bands. ALL manufacturers base maximum HP on sea level ambient pressure (29.92 inches of Hg), 59F, and DRY AIR (no moisture). Real HP will be a trifle less with real world moisture, and of course higher temperatures will sap horsepower more. On a very hot 100% humid day, water vapor could be 4% of atmospheric density, and power suffers accordingly.

The only way I know to be reasonably sure about HP is to have a comprehensive engine power table for all altitudes and temperatures. For the IO-550 series, one can use the power tables for the Columbia/Cessna 350 or Cirrus R22. But even these require some interpolation.

For the IO-550 (stock) the chart in **Figure 3** is useful. The "best economy" line is for 50F lean of peak. To convert fuel flow in gallons per hour to pounds per hour in the graph multiply GPH by 5.85.

For the TSIO 550 refer to **Figure 4** (next page). The numbers down the right side beside the % HP numbers are the fuel flow in gallons per hour for 50F rich of peak and 50F lean of peak. I am not sure of the origin of this chart, but I believe it's from the folks at GAMI or those who offer the engine operating courses (Walter Atkinson et al).

The other way to estimate engine HP with reasonable accuracy is to operate 50F lean of peak, measure fuel flow accurately, and then convert to horsepower knowing the compression ratio. Lean of peak ALL the fuel is being burned, so this method works. RICH of peak, all bets are off because some portion of the fuel is not being burned, but dumped out the exhaust in the form of lots of carbon monoxide and unburned hydrocarbons.

To calculate horsepower based on compression ratio, you need to know compression ratio which can give you a conversion factor for your engine.

- For the IO-550 engine operating 50F lean of peak, stock 8.5

compression, the fuel burn at 65% (201.5 HP) is about 14.9 horsepower per gallon per hour, a specific fuel consumption of 0.391 lbs/hr/hp

- Raise the compression ratio to 10 and the figure becomes 15.6 hp/gal/hr, with a specific fuel consumption of about 0.37 pounds per horsepower hour, a net 5% improvement
- For carbureted engines that cannot operate smoothly at these lean conditions, an estimate can be made using a specific fuel consumption of 0.42 pound per horsepower hour
- For a 180 HP Lycoming at 65% (117 HP) you would expect to burn about 49 pounds per hour or about 8.4 gallons per hour to make this much horsepower.

So in your testing, if you are measuring fuel flow, you should be able to get a pretty good fix on the horsepower generated by the engine during your test flight. Multiply by 0.85 for the assumed prop efficiency (another source of possible error), and you get the net horsepower delivered to make thrust. Use this number to enter the chart and find your flat plate drag area.

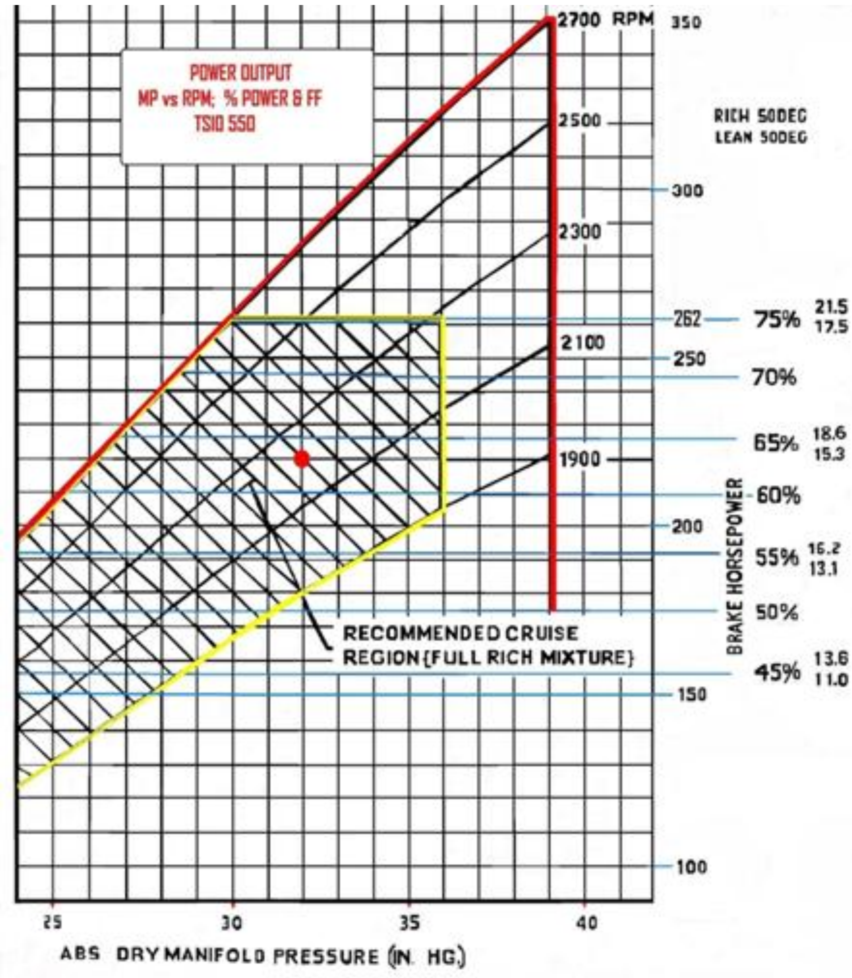



FIGURE 4

## *Some Examples*

In the following examples I've summarized three sets of estimates for drag area with my plane, a non-Turbo Lancair IV with IO-550 engine and innumerable little mods to reduce drag.

### *Example 1 – Brand new with High Compression Pistons (10:1), best power*

When new with engine barely broken in, nary a bug, nick, or speck of dust on the airplane, light weight, every seal in place—perfection—I recorded a maximum speed of 257 knots at 9900 feet density altitude. My power charts showed the engine was putting out about 84% power, or about 273 HP for my high compression IO-550. Assuming a prop efficiency of 0.85 yields a thrust power of 232 HP. At sea level, a rough estimate of sea level speed would be about 90% of the speed at 10,000 feet (a 10% adjustment for altitude change), or 231 knots or 267 MPH. Using the chart, the flat plate drag area would be roughly 1.8 square feet which probably turned out to be a bit optimistic due to errors and simplifications. Keep in mind that this includes all drag: induced and parasitic including cooling drag.

### *Example 2 – Full Power Sea Level Blast*

During this event, the engine had been returned to stock 8.5:1 compression ratio, we had nearly full tanks and 420 pounds of pork in the front seats. We skimmed the ocean on a calm day across King George Sound. The airplane had about 150 hours on it and so was not pristine with some bugs, nicks, and the prop spinner seal gone. I forgot to record the altimeter setting, but the GPS and Chelton corrected TAS were in general agreement within a couple of knots. Manifold pressure was 32 inches due to ram pressure, and the engine monitor showed 106% power. Seeing that and recognizing that my maximum fuel flow was not rich enough for that power setting, I terminated as we were showing about 240 knots. Put that all together and you get about 1.9 square feet for flat plate drag area.

### *Example 3 – Typical Cross Country Cruise*

In September a friend and I completed a 4500 NM trip weaving across Australia and back. The airplane had 250 hours on it, was somewhat buggy, dusty, and a bit worn with some seals missing, in other words, a typical cross country trip condition after a few years of thrashing around. Average cruise conditions were 65% power, 50F lean of peak, about 8000 feet density altitude, and we were usually heavy. Use the calculator approach and it yields 1.92 square feet. Clean and bug free would make a modest improvement. I know that lots of bugs cost about 10 knots compared to squeaky clean, a big effect on drag area because of premature boundary layer transition from laminar to turbulent on the front half of the wing area.

My conclusion: in the clean condition, every seal perfectly in place, all nicks off the leading edges and prop, the airplane drag area is probably around 1.85-1.90 square feet.

### *The Math and Physics*

Remember that Drag = Thrust at equilibrium, level flight.

- **Net Power** = thrust * velocity = drag = ½ * drag coefficient * area * air density * velocity squared
- But *Net Power* delivered to the air is engine power times prop efficiency (PE—estimated at 0.85)
- **Ram pressure** = ½ * air density * velocity squared (sensed at pitot)
- **Flat Plate Drag Area (DA)** = Drag coefficient * area

With this we can solve for DA. To get the units to work out we need some conversion factors:

- 1 HP = 550 ft-lb per second
- 1 knot = 1.6877 ft per second
- Gravitational Constant = 32.2 ft-lb force / lbs mass per second squared

Thus:

$$DA = \frac{(HP)(550)(PE)(32.2)}{(\frac{1}{2})(air\ density)(velocity^2)}$$

Or:

$$DA = \frac{5321 * HP}{(air\ density)(velocity^2)}$$

*for questions contact fred at frederickmoreno@bigpond.com*

## EMERGENCY!

***How to Deadstick a IVP with aplomb.***

*by don gunn*

It was a beautiful day for flying in early March of 2012. My wife, dog and I were cruising along at 15,500 feet en route from Denver, CO to Quincy, IL, a trip we had made in my IV-P at least a dozen times in the previous 12 months.

I'd had an uncomfortable feeling the day before the trip while checking the weather forecast, which was odd, as the weather looked to be ideal the next morning—clear skies, unlimited visibility, and a small tailwind at altitude—all the way from Colorado to Illinois. No likelihood of any turbulence either; my wife gets concerned when the air has even a ripple in it. So why was I feeling uneasy? The morning of the trip showed the forecast to be correct, not a cloud between takeoff and landing, but I still had the "funny" feeling that something was not quite right.

We loaded up the plane, took off with plenty of fuel to make the 650 nm trip and leveled off for cruise at 15,500 feet before we reached the Colorado/ Kansas border. My wife was reading a book, my dog was asleep in the back seat and the air was smooth as silk. As I looked down at the Kansas farm fields below, I noticed smoked rising virtually straight up into the sky as it diffused, indicating calm winds from the surface to two or three thousand feet AGL. I remember thinking if I had to make a forced landing, at least I didn't have to worry about what direction to land.

We were one hour from our destination when we heard and felt a rather loud "bang" which seemed to come from below us. Most likely an engine misfire, I thought. My wife looked at me, I looked at the engine gauges and everything seemed normal. I said "We have less than one hour until landing, so we'll continue and have the engine checked out in Illinois."

Based on subsequent events, that was not the most prudent decision I have ever made…

### *Eight Exciting Minutes*

Maybe 10 minutes later I noticed an airport below me and just to the left which I did not remember seeing on earlier trips. I looked it up on the Chelton and found it to be Brennen Field, adjacent to Falls City, NE, elevation 4,000 feet.

Five minutes after that all hell broke loose. There was another bang, followed immediately by a loss of

DON'S IVP

pressurization, multiple warning enunciators and the propeller spinning at a very high rate of speed. I handed the Chelton Operation Manual I was reviewing to my wife, put the nose down and started a 180 degree turn back to Brennen Field.

As I jockeyed the throttle, mixture and propeller controls it became apparent the engine was developing little to no power. I set an attitude to establish 120 knots, cycled the mags and racked my brain to trying to remember the distress frequency to call a Mayday. I hadn't reached total panic mode, but the stress was very high. I'd heard some chatter on the 123.0 a few minutes earlier, and decided that was good enough. I set the transponder to 7700, made sure I was properly set up for a glide to the runway before diverting any more attention to the radio, and took a moment to reassure my wife since the runway was right below us. She made no comment.

I had received my IV-P training from Rudy Haug and I really felt that he was now watching me from the right seat (my wife was totally silent staring straight ahead), and I heard him say "cross over the field at 3,000 feet AGL. At 7,000 (4,000 plus 3,000) I looked down at the runway and thought to myself "gee I seem way too high", and quickly checked the Airport info on the Chelton again. 4,000 feet turned out to be the runway length, the field was at 1,000 MSL. Well, I thought, much better to be 3,000 feet high than 3,000 low. On the other hand, a 4,000 foot runway leaves little room for error—I better not blow this!

Now should I do a 360 to bleed off the extra 3,000 feet or just make s-turns? S-turns seemed like a better choice so I used the "free time" to do those and make my Mayday call. (How do I you call Mayday without causing any more alarm to a frightened passenger?) I made a call using as normal a tone of voice that I could muster while starting my turn to base, still rather high. I noticed the end of the runway sat above a small bluff, so landing short was not an option. I decided to stay high until the last moment.

As I turned final I remembered I had just renewed my insurance, deciding I needed liability coverage only—all the more reason (as if more was needed!) to nail this landing. Plus I didn't want to disappoint Rudy...

On final now, sure to make the runway, speed brakes deployed and gear down. As the speed bled off to 90 knots on short final I checked gear down, retracted the speed brakes and floated over the fence. As the wheels made contact I redeployed the speed brakes, got on the brakes hard, stick full back and watched the corn stalks at the end of the runway, hoping I would leave them as they were.

We came to a stop with 50-100 feet of runway remaining—and my heart rate and breathing finally started coming down. I looked at my wife, who had not said a word, staring straight ahead for the entire eight minutes between engine failure and landing.

"Are you OK?" I asked.

She turned to look at me and announced "I am never getting back into this plane". Oh well, I thought. I couldn't blame her, but I sure would have liked an "attaboy" though...

The local Sheriff and a deputy arrived at the FBO as I made arrangements for a rental car. After a short phone call with the FAA controller who saw my 7700 squawk we hopped in the rental and drove the rest of the way to Illinois.

### *Aftermath*

The camshaft in my IO-550 had snapped in two, leaving only cylinders 1 and 2 producing power—somewhat. We got it repaired, and N777PC flies again! Oh, and my wife does ride along with me, although it took a few months for that to happen.

The biggest lesson for me is that Rudy Haug's training was essential; it saved both my wife's and my life. As I did what was necessary to make that plane ride end happily Rudy was in my mind, talking me through the procedures. As a matter of fact, I still hear his voice every time I fly—and I still don't want to disappoint Rudy!

My advice to everyone who reads this is to find a good instructor, listen and learn and practice, stay ahead of the airplane, stay proficient, stay current and enjoy flying your incredible Lancair aircraft!

*for questions contact don at* *don.gunn@att.net*

**WE'VE MOVED**

**3127 Creve Coeur Mill Road, Hangar N5**
**Saint Louis, MO 63146**
**(314) 682-0461**
**info@lancairowners.com**

## FROM THE SECRETARY

*jennifer ashley*

LOBO HQ has a new home! Please take a moment and update your address books. Also note: You can still contact LOBO at the same email address.

### *DUES!*

It's that time of year...DUES RENEWAL TIME!! If you have not already done so, please renew your

LOBO dues to avoid a lapse in your membership.

Dues are $40. Click here to pay via PayPal on LOBO's website. If you prefer to pay by check please be sure to use our new address!

*for questions contact jenn at info@lancairowners.com*

## Social Occasions

*claudette colwell*

Flying season is just around the corner, along with March winds. So brush up on those crosswind landing skills. This used to be a very challenging event for Steve and me while flying our RV-6, which happened to have its nose wheel on the tail. Thankfully, the nose wheel on N15SC is where it's supposed to be, so crosswinds offer a good deal less excitement, although they still require careful attention and skill maintenance.

### 2013 LOBO/Lancair Landing


2013 promises another wonderful schedule of events for our Lancair builders/flyers/wannabees. Our site selection team is another stellar cast including Larry Eversmeyer, Jim Scales and Don Gunn. **For the 2013 LOBO/Lancair Landing they chose Greenville, South Carolina, with the event to be held October 4-6.**

The Greenville Downtown Airport (KGMU) is looking forward to our arrival with designated parking and fuel discounts. We'll be holding our daytime activities at the Greenville Hilton. The airport itself does not have air conditioned or sound quality accommodations for forums, but the Hilton is a mere 2.4 miles from the airport. The Hilton has given us a great rate of $105.00 per night from three days prior to three days after our event. Even better, that includes complimentary WiFi, hotel parking and shuttle service within an eight mile radius.

Greenville, SC is anchored by what Forbes Magazine calls one of America's Best Downtowns, featuring a one-of-a-kind "floating" suspension bridge. Set against the scenic Blue Ridge Mountains, Greenville boasts a thriving arts scene, hundreds of restaurants, shops and boutiques, popular annual festivals, numerous historic sites and museums housing significant art collections. The tree lined downtown leads to Falls Park on the Reedy River, with beautiful waterfalls at the west end of Main Street.

We'll again have special events for the ladies, including a daylong trip to nearby Asheville, NC for a tour of the historic Biltmore, the palatial former home of the Vanderbilts. In addition, another style show exclusively for our ladies is in the planning.

**ATTENTION GUYS!!!** We know you're not interested in a style show, but we learned many of our LOBO ladies were unaware of the style show held at the Branson Chicos (the height of the weekend according to those who attended) before arriving.

*****We need your wife's or girlfriend's email address*****

We tried to get this important contact information at Sedona last year, but we were unsuccessful. Please send their email addresses to Lisa and/or me. Some of the activities we're planning require advance notice of attendance. You don't want to be responsible for your significant other missing out on the special and exclusive activities we're planning just for them!

### → LOBO Ground School ←

LOBO will conduct a one-day ground school the day prior to the 2013 LOBO/Lancair Landing, Thursday, 3 October, at the Hilton. Training starts at 9:00a and ends at 4:30p. Your paid admission includes lunch. This year's agenda will be split track. Track one is for those already flying and includes topics like traditional systems, pilot and environmental factors. Track two is for builders preparing their aircraft for first flight. We haven't finalized all the details yet, but we expect a portion of the day will combine tracks for review of pilot-specific considerations. Please indicate your interest in attending the regular ground school or the first flight preparation track when you register. As always, we welcome your building/flying partners to join either ground school track, or to consider a new "Partner in Command" course to be held the same day. Our own Sue Harrelson, retired airline captain, kit builder and Lancair pilot, will spend a half day with your non-pilot significant other teaching basic emergency procedures. Keep an eye on LOBO's website for all the details!

### Have Some Fun!

This year, why not plan to spend some extra time in Greenville? Here's something you might consider doing: BMW's Zentrum Museum is in nearby Greer, SC – a mere 23 miles from the hotel. Tours of the BMW factory there in Greer are offered (only M-F) to museum visitors. Steve and I took the tour with friends last year, and it was a marvelous experience. Visit the Zentrum Museum website for details.

You may want to also experience your "need for speed" on the ground instead of the air with the Ultimate BMW Experience and spend an afternoon on their driving track. Visit BMW's USA Factory website for more information.

If your tastes trend more toward entertainment of the live variety, the Flat Rock Playhouse, the State Theater of North Carolina, is in nearby Flat Rock, NC, and it's a highly-rated venue for theater productions.

Finally, Greenville is the east door to the Blue Ridge Parkway and the fabled Smokey Mountains. Trust me when I say you've never seen spectacular fall foliage until you've seen the Smokeys in autumn!

### Watch This Space!

Lisa and I will be releasing more specific information very soon. In the meantime, mark your calendar and plan to spend a few extra days in the Greenville area. We will announce a graduated fee schedule with LOBO member and non-member rates soon.

It's extremely helpful for Lisa and me to have committed responses from all y'all as soon as possible. It does make our planning a little easier. Information about the LOBO Ground School is included in the sidebar on the previous page. We plan to have a limited number of forums this year to allow plenty of time for short jaunts back to the airport for some all-important ramp time and hangar flying.

I hope to see you all in Greenville!!!

*for questions about the fly-in contact lisa williams (lisaw@lancair.com) or claudette colwell (c.colwell@lancairowners.com)*

## CONTINENTAL FACTORY TRAINING

*colyn case*

Ever wonder why engines don't always make it to TBO, or why they sometimes quit, seemingly with no provocation?

Continental Motors Inc. has some definite ideas about those very questions, and it wants to tell you about them. Continental says sharing maintenance and operational tips with you and the shops that work on your engine can go far toward improving engine reliability and longevity. To that end, it offers the *Advanced Factory Training Course*, conducted at company headquarters based at Mobile Downtown Airport (KBFM) in Mobile, AL.

Those who made it to Sedona last year might remember that Continental's Mike Council donated a couple training certificates to use as door prizes at the banquet. Bob Pastusek and I purchased the certificates from the lucky winners and attended the January course together.

My primary motivation for attending was to learn about the internal workings of my engine to better understand any issues that might come up. I was not disappointed. And as often happens I also learned other important things I wasn't expecting. Three stand out in particular:

### Design tradeoffs

In general, there is no more to the engine than needed, and what is there is more simply designed than I expected. The implication is improper assembly or maintenance will likely place more stress on parts than they were designed to handle. Every detail must work.

### Manufacturing processes

Like everything else about the engines, the manufacturing processes used have evolved to their present state because operational experience has shown them to be necessary. Construction techniques range from automatic milling machines to hand crafting. Careful measurement is ubiquitous throughout the process.

### Maintenance procedures

There's usually more to doing it "right" than might be obvious from inspection. Not just a matter of mechanical skill, there are specifics about each engine and sub-assembly that must be done in order to be reliable. You need to know that there is applicable detail for the part in front of you and you need to find all the relevant manual pages and SB pages to get it right.

The overriding theme is that what you are buying in a factory-built engine is

CYLINDER REMOVAL/REPLACEMENT

decades of learning from experience and failures in the field. The maintenance part of that is largely contained in Continental publications. The manufacturing (and rebuild) part is embodied in the factory processes, some of which exist only in the knowledge and skill of the craftsmen who work there.

## Course Content

Upon arrival, you will be given a 1" loose-leaf binder of course notes. I found the notes to be excellent; very detailed, with lots of pictures and a test at the end of each chapter. At the back is a CD which includes electronic copies of everything in the binder and a few other helpful publications.

The best way to understand the course content is to review the cover page from each chapter in the course manual. Click here to view a PDF containing each chapter's cover page.

Below is a brief summary of the topics:

### Monday

- **Chapter 1:** *Overview of different engine designs*
- **Chapter 2:** *Crankcases*

### Tuesday

- **Chapter 3:** *Internal Engine Drive Train Components*
- **Chapter 4:** *Lubrication Systems*
- **Chapter 5:** *Cylinder designs*
- **Practical:** *Remove and replace a cylinder*

### Wednesday

- **Chapter 6:** *Continuous Flow Fuel Injection*
- **Chapter 7:** *Induction Systems*
- **Chapter 8:** *Turbo-charging Systems*
- **Practical:** *Set up fuel system on an IO-550*

### Thursday

- **Chapter 9:** *Ignition systems*
- **Practical:** *R&R impulse coupling: Time a mag*

### Friday

- **Factory tour**
- **Fuels**
- **FADEC**
- **Operational recommendations**

## Factory Tour

Although it wasn't until the end of the course, the factory tour was a highlight of the week. Continental occupies many airline hangar-sized buildings at the north end of KBFM. While the raw forgings come from outside vendors, virtually every other fabrication operation is performed in house. Some key areas of the tour were the following:

**Chemical processing.** We didn't go inside due to the strong chemicals, but we learned some of the operations that go on there, including etching, bronzing and hardening.

**Ignitions: Point fabrication, wire harness/magneto assembly.** Each of the workstations here had a computer display that showed the parts and steps required to build each assembly. Remember, there are many versions of the same thing. Assemblies are built on demand for the most part, and workers rotate among work-stations so they don't get bored.

**Reclamation: Engine teardown, cleaning, culling, sorting.** Use-able parts are saved for rebuilding. Used or new, all parts receive the same level of scrutiny to ensure they meet specified tolerances. From this stage forward, the only differentiation between new and rebuilt engines is that rebuilt engines may include used parts. Both new and rebuilt engines are assembled to the new tolerances.

**Machining.** Work here includes crankshaft journal final dimensioning and polish, torsional damper tuning, camshaft machining/polish, cylinder milling, barrel assembly, valve guide and seat insertion, and much more.

**Subassemblies.** Some of the parts manufactured here include fuel pumps, waste-gate controllers and inter-coolers.

**Final assembly:** Here, a large rolling table full of matched parts for each engine rolls through a small assembly line where the cranks are built up, the crankcase assembled, and the cylinders attached.

Setting up IO-550 Fuel System on Rick Richardson's Lancair Legacy

**Incoming parts inspection and inventory.** This is where castings and other unfinished materials are inspected and put into pick bins for manufacturing.

**Final Assembly and Test.** Each engine is run for approximately 90 minutes on a test stand. The test regime ensures the engine will run under specified limit conditions.

## Highlights

### *Grinding Crankshafts*

Here's a guy who loves his job (right). He runs the workstation that cleans up the crankshafts after they come from the chemical area. He is the only person that actively works this station. He is the guy who brings the journals into dimensional compliance and then puts the final shine on them.

Without giving away too many Continental secrets, imagine this technician has a crankshaft turning on a lathe. Instead of a cutter he has a large but narrow belt sander with spring-loaded tension on the belt. He brings the moving belt down onto the journals for just the right amount of time to get them in spec.

Remember, a rod journal is moving up and down while he's doing this, so his arm has to follow that motion without varying the pressure by much. When the main journal is done, he gets into the radii by using the back side of a file to deflect the belt at just the right angle. He can check the diameter and variation while the crankshaft is turning using air-powered measurement tools.

He's been doing it 24 years and says he is still learning.

### *Cylinder Assembly*

Another operation that would be hard to reproduce outside the factory is the barrel-to-cylinder assembly.

Continental begins the process by baking the aluminum heads in an oven. The heads are then pulled from the oven one at a time. With two minutes working time, the valve seats are inserted, the barrel is threaded in to a certain torque, and the valve guides are pressed in.

After the assembly cools, the flange bolt holes at the bottom of the barrel are drilled. This is the only way to get the holes clocked correctly to the head AND to put the barrel into the head with the proper torque.


Grinding crankshaft journals

When done correctly, the result is a cylinder (jug) made up of an aluminum head and a forged steel barrel that will never leak or come apart. (Interesting Fact: Continental doesn't rebuild cylinders; if they touch this part of the engine, they install a new part.)

### *Other Impressions*

**OIL.** In reviewing the crankcases we looked at how the oil gets to critical places. On the "permold" crankcase, (used on a TSIO-550) the oil actually travels from the pump through the center of the camshaft. At the camshaft journals there are holes where the oil exits the camshaft and goes through the crankcase webbing to the crankshaft main journals. Two holes in the main journal direct the oil to the two adjacent rod journals.

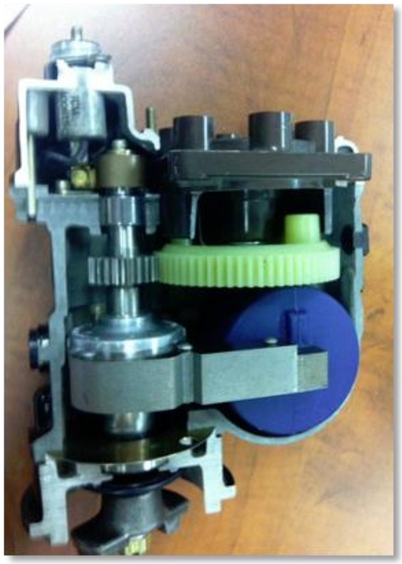
This mechanism seems reasonable enough until I have a cylinder apart on day two of the course. Here I'm holding what amounts to a 60 hp single-cylinder engine in my hand. At the end of that connecting rod is a bearing that sits on the hard metal journal. When that piston fires, it is transmitting all that force—something in the range of 16,000 pounds (1600 psi * 10 square inches)—between two metallic components: the rod end bearing and the crankshaft. The only thing preventing friction heat from destroying those two components is a thin coating of oil which comes through a little hole in the crank shaft.

And how do the pistons get oil? The piston skirt gets a spray of oil from an obscure little hole in the crankcase while the pushrods feed oil to the cylinder tops. In all, the big engines pump 24 gallons per minute.

**PART NUMBERS, ASSEMBLIES, AND SB'S.** On Wednesday we went through the fuel system. Neal remarked that the part number for a given fuel pump is not and cannot be stamped on the pump body. That's because the fuel pump has many variants. The part number for each variant is actually a pointer to a piece of paper that lists the constituent parts, right down to the washer.

Neal picked up a washer for the specific pump we were working on and turned it over, revealing a very thin black seal on the underside. Bad things happen if this particular pump is operated without that seal. This was but one of many examples of subtle assembly details that turn out to be very important. To make sure you use the right parts you need the part number (implied by the engine part number) and all the SB's addressing that specific unit. Obtaining that information before working on an engine is critical. Because of this, the course also covers how to use TCMLINK.

**WHY DID MY ENGINE BREAK?** On Tuesday, one of the attendees brought in pictures of his broken crankcase. After a brief inspection of the pictures the instructors agreed that the failure probably happened because one or more of the barrel flange hold-down bolts were improperly torqued. That permits motion, which causes stresses beyond those the crankcase was designed to withstand. The instructors also agreed a likely contributing factor



CUT-AWAY MAGNETO (TRAINING AID)

was failure to insure metal-to-metal contact at these bolts when the cylinders were attached (materials like paint can extrude over time affecting fastener torque).

Another case involved a transatlantic ferry operation. The oil breather tube iced up resulting in an increase in crankcase pressure causing the engine to pump all its oil out through the piston rings in just a matter of minutes.

Many anecdotes were shared during the week-long course about incorrect installation or maintenance procedures leading to engine failure. This makes me a lot more circumspect about choosing a shop to work on my engine in the future.

### About Mobile, AL

Mobile is right on the Gulf Coast about an hour West of Pensacola, FL. Bob and I flew his Lancair down to KBFM where Continental is headquartered.

Signature Aviation took good care of us, although fuel is a bit pricey at over $7.00/gallon. Some of the attendees chose to fly into Fairhope across Mobile Bay. Continental owns the Fairhope FBO and runs their Factory Service Center there. Cheaper gas is available at Fairhope, and at nearby Foley Municipal airport.

Mobile offers an attractive downtown area, lots of restaurants and big hotels, as well as a Science museum and IMAX Theater. Just east of Mobile is the battleship Alabama museum and several seaside seafood restaurants. At the south end of the Bay are the Dauphin Island and Gulf Shores beach areas. One night Bob took four of us in his plane to the Gulf Shores area for dinner.

Downtown hotels were expensive the week we were there, so we opted to stay at the Wingate hotel, which was 10 minutes to the west and a much better deal.

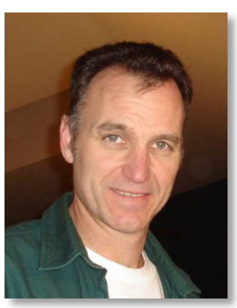
### Conclusion

Overall, the experience was well worth the trip. I achieved my goal of better understanding what's going on inside my engine. It was a bonus to see how my engine was made, meet the people who work at Continental, and learn why consulting the factory documentation is so critical.

*for questions contact colyn at c.case@lancairowners.com*

## FROM THE EDITOR

*mark sletten*



### Where's LOBO's Online Forum?

There's been a bit of discussion lately about starting a LOBO online forum. Online forums offer great benefits to the communities that use them. One of the most successful online aviation forums is Van's Air Force. Spend a few minutes at that website and it's easy to see why so many people yearn for something similar to serve the Lancair community.

Given that LOBO's mission is to foster the safe enjoyment of Lancair aircraft, and a big part of that mission is encouraging communication between members as well as between members and the rest of the Lancair community, we've seriously considered the benefits of developing a LOBO forum. The aircraft owner's groups that've made the leap (COPA is another great example) enjoy tremendous participation in robust online communities. So why hasn't LOBO taken the plunge?

There are two primary reasons:

First is time prioritization. The LOBO board is currently run by six volunteers, who are responsible for LOBO's core activities, and a smattering of secondary volunteers who've helped us with certain transitory responsibilities (committee members, event hosts, etc.). As LOBO has evolved, those six core volunteers have each assumed pretty much all the responsibilities they can—as regards keeping LOBO alive—given the amount of time available to them (bear in mind all but one have real jobs).

While we've had a couple of individuals volunteer their services to assist with the nuts and bolts of starting an online forum, it would still require a significant time commitment on the part of the LOBO Board to work out the fine details and keep it running over time. How many discussion areas? Who will moderate? What rules will they follow? And so on. The reality is our six core volunteers are already task saturated, and each is already dealing with issues we believe are higher priority than an online forum, mainly because we already have a means to communicate electronically with the Lancair community—the Lancair Mail List.

Over the decades that Lancair aircraft have been flying, no person and no venue has been more successful at enabling communication in the Lancair community than Marv Kaye and his Lancair Mail List (LML). Thanks to Marv's effort, the LML has been an invaluable resource for the Lancair community. If you have a burning Lancairian question about building, flying, which FBO to use, how to convince your significant other to get in something you built (especially after you "fixed" the washing machine), and you need an answer now, there's no substitute for the LML. Everyone who is "anyone" in the Lancair community opines on and/or monitors the LML.

Which brings me to the second reason: We have a credible concern about fracturing the community.

A LOBO forum would include LOBO members only. Although our membership has grown steadily since LOBO launched some four years ago, we do not yet represent a majority of the Lancair community. Although we believe a forum would benefit LOBO, the benefit would be offset by the hazard of excluding a major portion of the Lancair community from important public discussions.

Ultimately, we believe the majority of LOBO members would rather stick with the LML than switch to a forum where they wouldn't get the benefit of all available Lancair wisdom. (Those who feel differently feel free to drop me a line at the email address below.)

We will continue to weigh the forum issue against other organizational priorities, which will likely change as LOBO grows—something we expect to happen as long as our members continue to tout the benefits of LOBO membership! If we decide LOBO needs a forum we'll pursue that goal with as much energy as we've pursued all the issues we've dealt with.

But we're just not there yet.

*for questions contact mark at*
*m.sletten@lancairowners.com*

## LOBO Membership Initiative

***We Need Your Help!***
*LOBO board*

The reasons for being a LOBO member are many. We can't say it better than LOBO President Jeff Edwards does in his statement here on our website:

*"We see our primary mission as that of promoting the safe use and enjoyment of Lancair aircraft of all types, with an emphasis on owner, operator and builder education and training."*

There are several ways the size of our membership affects our mission. One is that that we simply need all the good ideas, inspiration, perspective, and effort that results when you get a lot of good people together. Another is that we as a group can only improve the situation to the extent that the greater part of the fleet is involved.

Sadly, many of the accident pilots appearing in the stats now are people that never had the advantage of the perspective offered by other Lancair pilots. Many didn't have access to training resources, and either weren't aware of online resources like the LML, or chose not to participate.

In other words, they were out of the loop.

We therefore set a goal at Sedona of signing 40% of the fleet by the 2013 LOBO Landing. We need some 65 more members to reach that goal.

If you are like us, you know about somebody in the fleet that could benefit from LOBO membership. That person at the end of your hangar row, or somebody you met at a regional fly in. It's highly likely you know someone that few or no other LOBO members know, and it's just as likely that person will know another someone who is unaware of LOBO.

Making an extra effort to reach out to that person you know will greatly benefit all of us. Please help if you can.

Thank you!

*for more information contact LOBO at*
*info@lancairowners.com*

### A Note About Sharing Your Contact Info

LOBO's current policy on sharing member contact info can be found on our membership application: *"LOBO uses this information for administrative purposes, to track membership statistics and to identify individuals with talents who might contribute to our goal in making LOBO the best type-club in General Aviation. Although LOBO shares summary data about our members and aircraft with the EAA, FAA and insurance agencies to facilitate safety initiatives and insurability, your personal contact information will not be shared without your express consent."*

Because of this, we recently denied a new LOBO member looking to contact other members access to the membership roster. On review, we realized this policy conflicts with our mission of fostering fellowship. Consequently, we decided member-to-member contact requests should be allowed. LOBO will answer requests only from members, and information will be limited to your name, email address, Lancair type/registration and city of residence. This policy change will be reflected on our new Membership Application.

If you do not wish LOBO to share your contact information with other LOBO members please contact Bob Pastusek (r.pastusek@lancairowners.com) and we will exclude you from this program.