

**Lancair/Meyer r-Evolution N844X
PILOT'S OPERATING HANDBOOK**

**Manufacturer's Serial No. 030
Flight-Plan Filed as EVOT**



TYPES OF OPERATIONS AND LIMITS

APPROVALS:

This aircraft is FAA Approved in the EXPERIMENTAL Category based on FAR 23.
This airplane is approved for the following types of flight when the required equipment is installed:

1. VFR, day and night
2. IFR, day and night

WARNINGS:

- Flight operations with passengers for hire is prohibited.
- Flight into known icing is prohibited.
- Spins are prohibited

PLACARDS:

- The word "EXPERIMENTAL" must be placed where it can be prominently seen upon entry into the cabin.
These letters must be at least 3 inches high, and contrast sufficiently to be seen on entry.

• A passenger warning statement should contain the following wording:
"Passenger Warning: This aircraft is amateur built and does not comply with the Federal Safety Regulations for Standard Aircraft."

• The following statement about flight into known icing conditions:
"Flight into known icing is prohibited."
Evolutions, with their smoothly-rounded wings and bodies, are known to pick up ice faster than many other aircraft types.
Very, very little time should ever be spent in conditions where ice may form.

The service ceiling of the aircraft is 28,000 feet.
The shoulder altitude where compressibility effects become important is 24,000 feet.
Above this altitude, equivalent airspeeds must be reduced to maintain a constant Mach number.

OVERVIEW

N844X started its life as a Lancair Evolution kit: A carbon-fiber, turbine-powered, pressurized, retractable-gear, single-engine prop.

But, there are some mods that I thought might be good ideas:

The standard Lancair Evolution has an air inlet that does not look to me to be quite streamlined with the local airflow around the cowling... could a cowling be designed with a more streamlined inlet that reduces drag and adds speed?

While the entire airplane is carbon fiber to save weight, the propeller was metal, adding significant weight. Could a composite propeller be used to reduce the total aircraft weight?

The standard Evolutions were running CLOSE to 300 knots... could a bigger engine with more high-altitude power push it to OVER 300 knots?

The airplane had 3 mechanical backup gauges in case the Garmin EFIS failed... could they be replaced with a synthetic vision system to do a much better job keeping control up after primary avionics failure at night or in IMC?

The airplane had XM Weather broadcast to its Garmin avionics... could ADS-B weather be added as a backup?

Could this new airplane have a panic button that caused it to right itself if the pilot started to lose control, and bring itself down to a nearby airport at the touch of a single panic button?

Could it bring itself down to the best airport within gliding range after an engine failure with the touch of that single panic button?

Could it bring itself down to a safe altitude with NO pilot intervention in the event of cabin de-pressurization?

Could it do all of this while having LOWER parts count, LOWER weight, FEWER items on the instrument panel, and an EASIER user interface, like an iPad?

The answers are all YES, and here is how to operate it.

CONTRACTORS

The major subcontractors and suppliers on this project are:

Lancair: Supplier of the base kit.

Ryan Harris: Base airframe build-shop: They (with me) built the carbon fiber airframe.

RDD: Finishing build-shop: They (with me) installed all the systems to finish the airplane.

Pratt and Whitney: Supplier of the Pratt and Whitney PT6A-42 engine.

MT: Supplier of the light-weight composite propeller (which offsets most of the weight of the heavier engine)

Aerotek: Supplier of the low-drag cowling that houses the bigger engine and fairings to the lighter-weight prop.

Garmin: Supplier of the G900 PFD and MFD.

Aertronics: Instrument panel, including the avionics mounting racks, wiring, and panel face itself.

Tom Connors: Painter, delivering an extra light-weight paint job by using only thin layers of off-white colors.

Oregon Aero: Interior, saving weight in materials-selection and installation of only primary interior components.

Mortiz, then Radiant: Touch-screen systems control.

Kollsman, then Kaps, then Enviro Systems: Pressurization Outflow Valve. (www.enviro-ok.com)

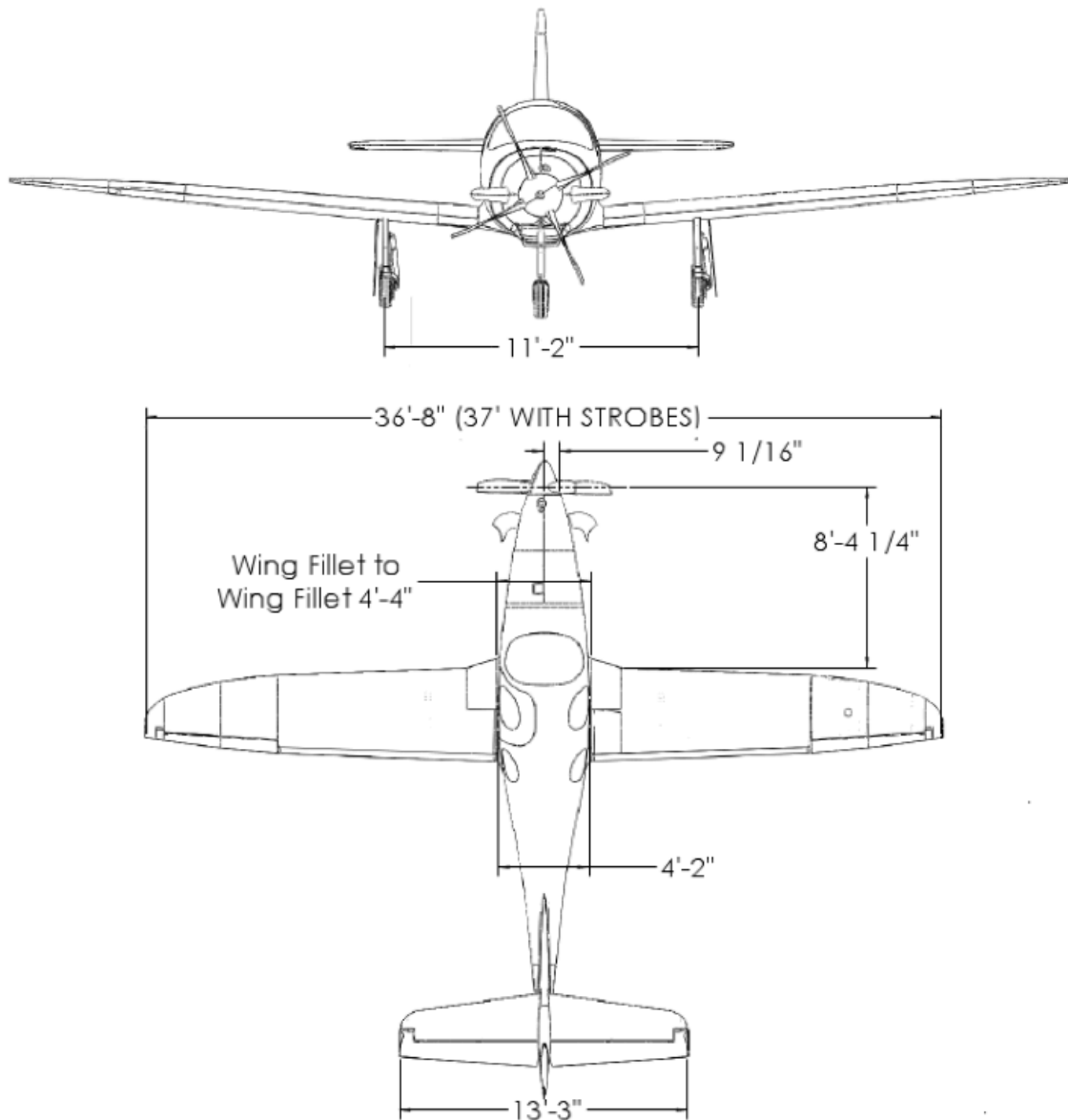
Advanced Flight Systems: AOA indicator, stall warning, and gear warning.

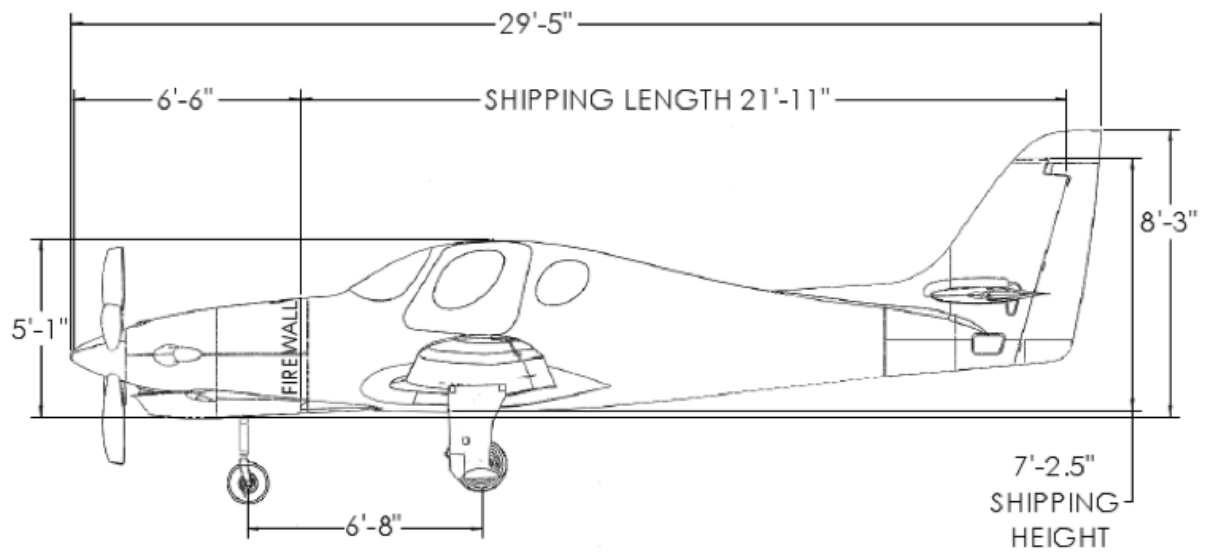
Austin Meyer: N844X builder, and author of Xavion, which acts as a backup suite of avionics in an iPhone.

While the aircraft was designated as a Lancair Evolution for the first half of the design process, one of the suppliers (I don't remember who) submitted electrical schematics with the name r-Evolution as the project designation within his company... and the r-Evolution name stuck.

CONSTRUCTION AND 3-VIEW

The aircraft is made of high temperature prepreg Carbon Fiber skins over a high temperature Divinycell or Nomex Honeycomb core. With the exception of a few parts, all preformed parts are vacuum bagged and oven cured at 250°F at a pressure of nearly 11.3 psi. These are similar to almost all modern commercial transport construction methods. In addition, the resin systems used are low in styrene and are safer to handle and use than most other systems.





ENGINE LIMITS

PT6A-42 OPERATION LIMITS

OPERATING CONDITIONS (2)	REDUCTION GEARBOX TORQUE (1)		MAX. OBS. ITT	GAS GENERATOR MAX. SPEED	PROP SHAFT MAX. SPEED (11)	OIL PRESSURE (7)	OIL TEMPERATURE
	lb. ft.	psi	°C	RPM	RPM	psig	°C
Max. Continuous	2230	72.95	PT6A-42 800	38100	2000 (13)	100 – 135	0 to 99
Minimum Idle (3)	–	–	750 (8)	21000 Minimum	–	60 minimum	–40 to 99
Starting	–	–	1000 (4)	–	–	0 – 200	–40 minimum (6)
Transient	2750 (4)	–	880 (4) 850 (12)	39000 (5)	2205 (9)	40 – 200	99 to 104 (10)

NOTES: ()

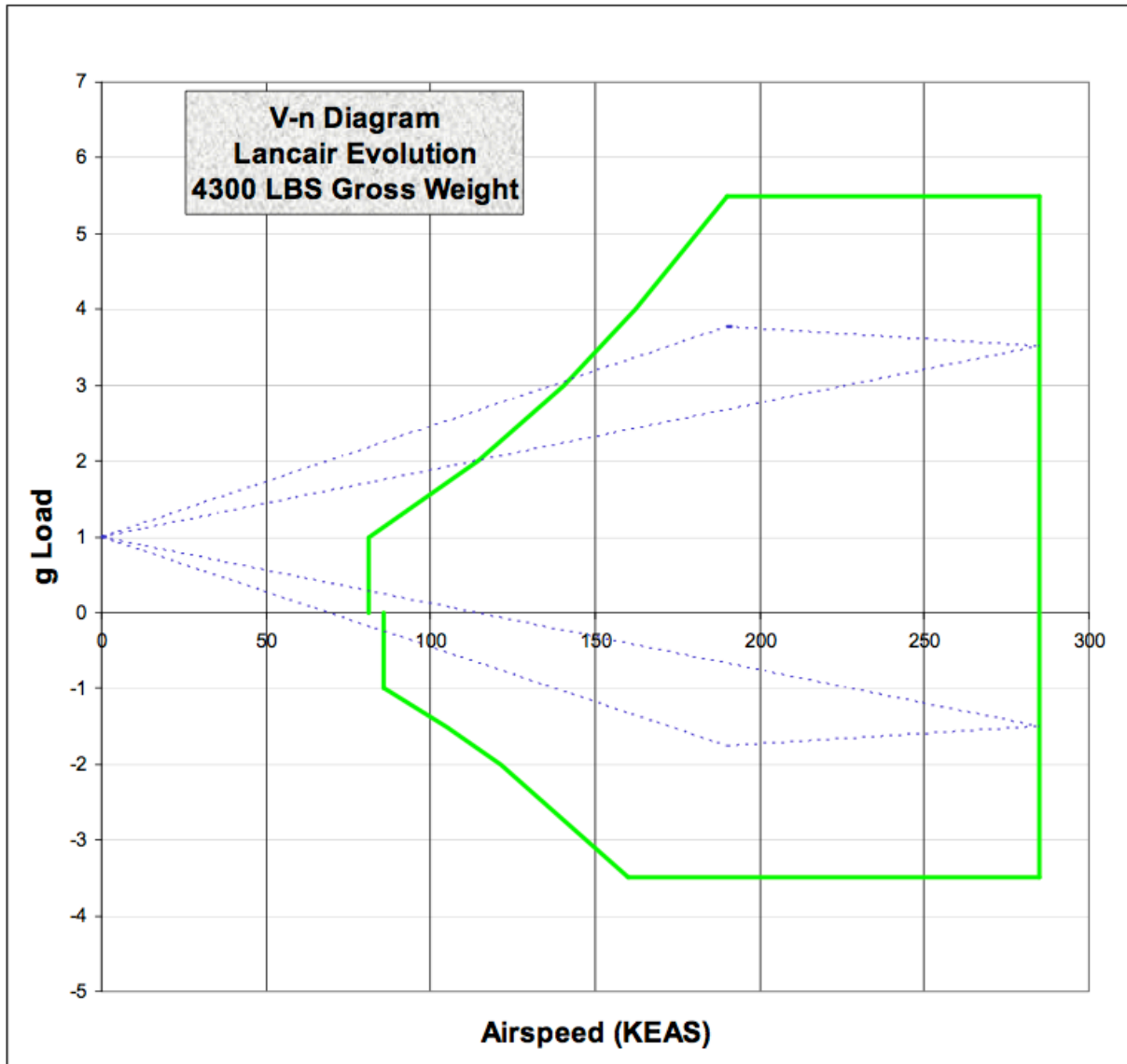
1. Torque limit applies within range of 1600 to 2000 rpm prop shaft. For take-off and max. continuous operating conditions, a variation of +45 lb.ft. is permitted to account for power setting accuracy and steady state fluctuations. Below 1600 rpm torque is limited to 1100 lb.ft.
2. Engine inlet condition limit for engine operation: (a) temperature: to 57.3°C; (b) altitude: ground level to 35000 ft. (temperature lapse rate of 2.0C° per 1000 ft. assumed). Minimum temperature for starting is defined on Page 2-1.
3. During aircraft flight development the minimum flight idle Ng rotor RPM must be established by the airframe manufacturer. This evaluation must determine the combination of maximum ambient temperature, air bleed and accessory loads to be allowed during landing.
4. This value is time-limited to 5 seconds, refer to Figures 2-4 or 2-5 as appropriate.
5. This value is time-limited to 10 seconds.
6. Limited by oil temperature.
7. Normal oil pressure with gas generator speed above 72% speed. With engine torque below 1970 lb.ft. minimum oil pressure is 85 psig at normal oil temperature (60 to 70°C). Under emergency conditions to complete a flight a lower oil pressure limit of 60 psig is permissible at reduced power level, not exceeding 1100 lb.ft. torque.
8. Applies over gas generator speed range 21000 to 23000 rpm.
9. May be employed in an emergency condition, at all ratings, to complete a flight.
10. Time limited to 10 minutes at any operating condition.
11. In flight in the absence of a minimum 40 psig oil pressure, continuous steady state propeller rotation must be prevented by propeller feathering. On the ground, with the engine shutdown, continuous propeller rotation must be prevented.
12. This value is time limited to 20 seconds. Refer to Figure 2-4.
13. A variation of +40 rpm is permitted to account for power setting accuracy and steady state fluctuations.

LOAD-FACTOR LIMITS

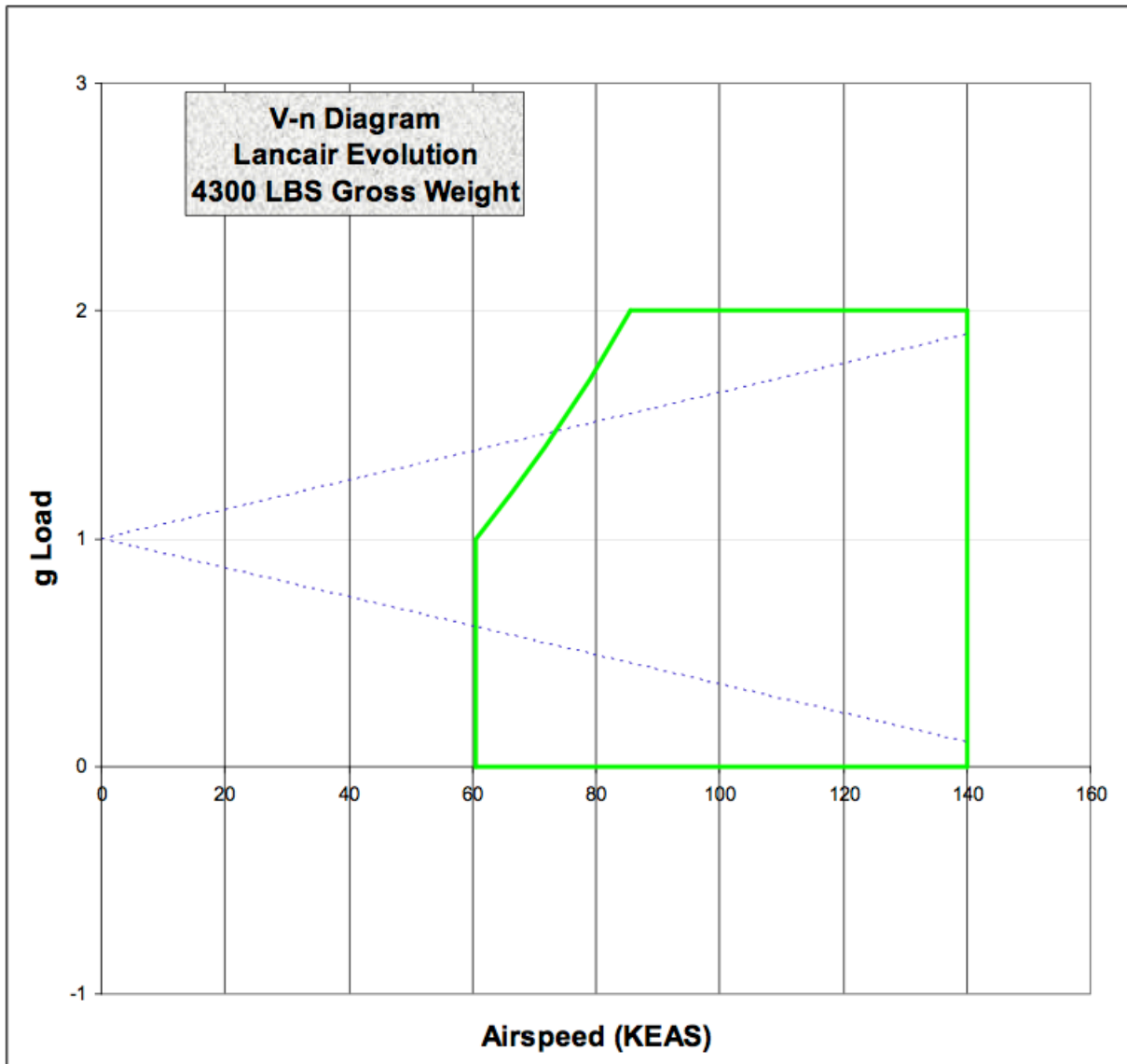
FLIGHT LOAD FACTOR LIMITS

Flaps up +4.4 G to -2.2 G

Flaps down +2.2 G to 0 G



V-n Diagram at Gross Weight.
Gust Factors for 24,000 Ft Altitude



V-n Diagram Landing Flap Configuration at Gross Weight. Gust Factors for 12,000 Ft. Altitude

WEIGHT AND BALANCE

Standard Empty Weight
Basic Empty Weight
Payload
Useful Load
Maximum Ramp Weight
Maximum Take-Off Weight
Maximum Landing Weight
Zero Fuel Weight
Tare

Weight including unusable fuel, full operating fluids, and full engine oil.
Standard empty weight plus any optional equipment.
Weight of occupants, cargo and baggage after full fuel is added.
The difference between ramp weight and basic empty weight.
Maximum aircraft weight approved for ground maneuvering.
Maximum aircraft weight approved for the start of the take-off run.
Maximum aircraft weight approved for the landing touchdown.
Weight exclusive of usable fuel.
The weight of chocks, blocks, stand, etc. used on the scales when

weighing.

Jack Points
airplane.

Points identified by the manufacturer as suitable for supporting the

AIRPLANE WEIGHTS

Max gross takeoff	4300
Max landing weight	4200
Max weight in baggage compartment	225

CENTER OF GRAVITY LIMITS (Gear Extended)

The datum is located 78" forward of the firewall.

The bottom firewall joggle is 51.25".

The allowable Center of Gravity (CG) range is from Fuselage Station (FS) 120.0 to FS 130.4 or 9.0% to 32% of the wing mean- aerodynamic-chord (MAC).

This data was recorded by RDD on Feb 20, 2015, upon aircraft completion and acceptance.

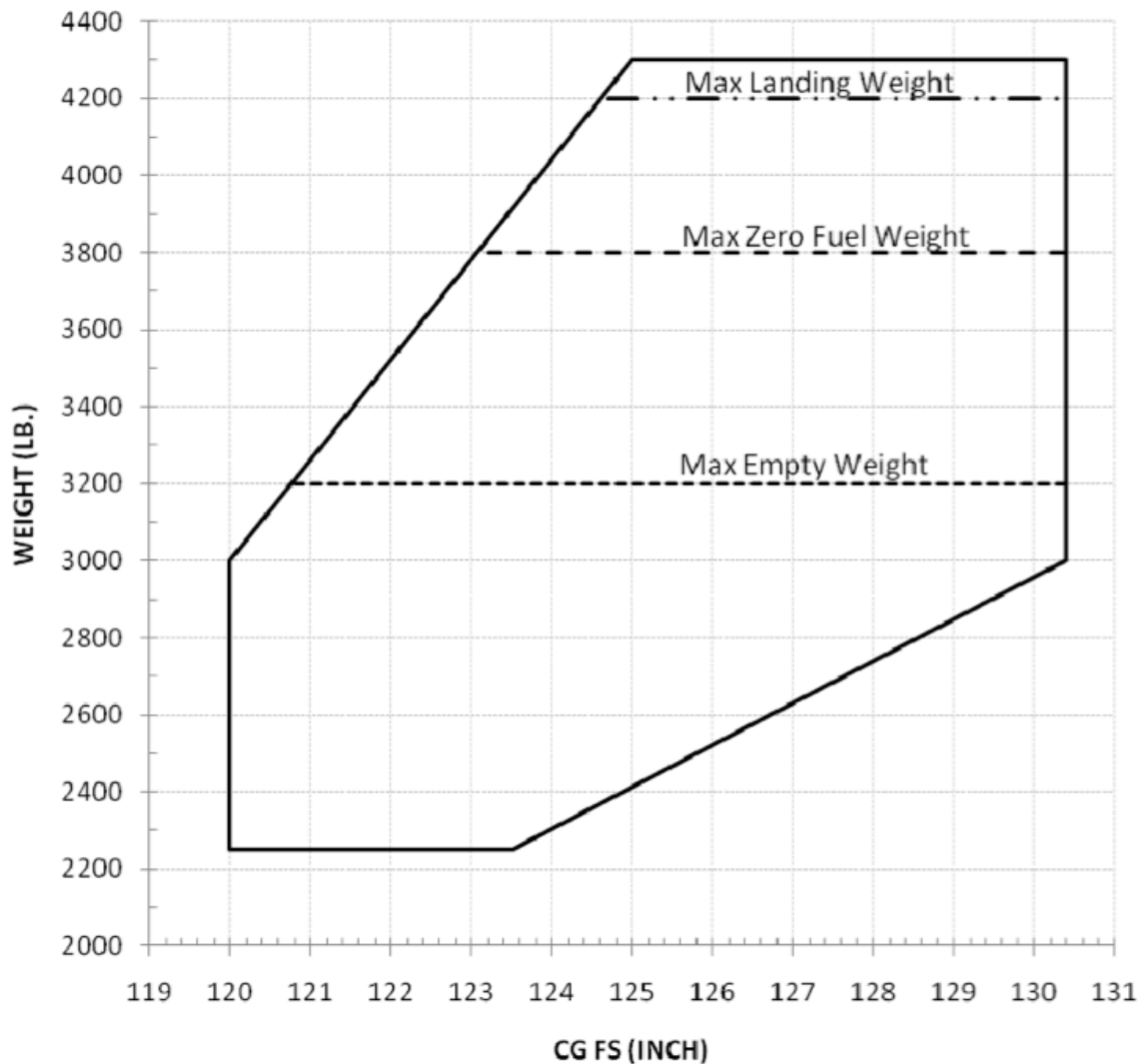
N844X Weight and Balance

	weight	arm	moment
nose	619	60	37140
left	1010	136.5	137865
right	982	136.5	134043
	2611		309048
		118.4	

max fwd			
aircraft	2611		309048
pilot & co-p	180	128	23040
fuel, 10 gal	70	136.4	9546.6
rear pass		164	0
baggage		192	0
totals	2861	119.4	341634.6

max aft/gross			
aircraft	2611		309048
pilot & co-p	360	128	46080
fuel (160gal)	1114	136.4	151927.3
rear pass	360	164	59040
baggage	50	192	9600
totals	4495	128.1	575695.3

EVOLUTION WEIGHT AND CG ENVELOPE



PANEL LAYOUT

The panel is laid out with a Garmin G900 PFD on the left, a Moritz systems controller in the center, and a Garmin G900 MFD on the right.

An iPhone with Xavion as a backup avionics suite sits top-and-center.

Switches for generators and batteries are all grouped on the left.

Switches for starting, lights, and environmental control all run from left to right across the bottom of the panel, flowing across in the order they are used in flight for the quickest-possible access.

De-ice controls, typically less-frequently accessed, are on the far right.

FLIGHT HANDLING

Like many airplanes, N844X DOES have a take-off power limit. But this take-off power limit is different: For take-off in N844X, you are only allowed to use about HALF power, since more power would over-power the rudders' and ailerons' ability to counter the engine torque. So, we take off at 1250 ft-lb of torque, and only feed in more power as the speed increases enough for us to be able to add it without running out of elevator or rudder to hold the airplane straight under the torque load from the engine. Climb at 110 KIAS can give a 5,000+ ft/min climb (That is 60 miles per hour vertical component of speed. Stand by cars as they come by you on the highway to see what that vertical speed is!) At this climb rate, you reach the traffic pattern from take-off in about 12 seconds... so try to stay ahead of the airplane mentally, or use partial power.

One interesting note here is that the tailfeathers on all airplanes act like weathervanes, keeping the nose pointed into the wind so the airplane likes to fly straight. This works because if the tail of the airplane displaces up, down, or to the side, the wind blowing from the direction of flight blows the tail right back behind the airplane again, just like a weathervane. But, what if the prop was so big, and the propwash was so strong, that the tail was completely blanketed by propwash, and the propwash was always aligned with the airplane? In that case, the stabilizers would have ZERO stabilizing effect, because when the plane slipped or pitched, the airflow over the tail would simply aim with the airplane, and the tail would never see any sideforce at all, and have no tendency to push back behind the front of the airplane! In other words, there would be no stability!

Now, with the Evolution, that is NOT entirely the case, of course, but the prop is huge, the propwash from 850 hp is significant, and the stabilizers are surely blanketed in that flow. As a result, the elevator and rudder are perfectly EFFECTIVE as they deflect in all that propwash, but since the propwash aims with the airplane, the stabilizers are not as STABILIZING as they are on some other aircraft. As a result, the controllability of the airplane is fine, but you have to fly it every second, since the natural stability is not as strong as some other aircraft.

The ailerons also require constant attention. Any power change, with an engine that puts out this much torque, has a roll effect on the airplane. Add power? The plane rolls left. Take it away? The plane rolls right. If you add full power at low speed, there may not be enough roll authority to stay right side up! (Thus, the 1250 ft-lb take-off limitation). The engine is allowed to put out 2,230 foot-pounds of torque at max power. That is the weight of a small car hanging on a one-foot lever-arm on the left side of the airplane. You CANNOT just add full power at low airspeed!

One note is that there is some vibration at full power at low speeds. This is due to the propeller slipstream airfoil going around a small oil vent in the nose, and is normal.

So, the stability is such that the plane needs constant attention, and any change in power requires control input on every axis (Counter the torque with aileron, the slipstream with rudder, and the speed change with elevator). In other words, this airplane speeds like a jet, but handles like a helicopter!

With the prop forward, you have a HUGE airbrake up front.

With the (huge) flaps down, you drop like a STOL plane with no power.

With the (huge, trailing-link) landing gear extended, the drag is such that the plane feels like it is stuck in pudding.

Glide ratio is about 5.

So, the drag of the plane is tremendous with flaps, gear, and prop all deployed.

But, with gear up, flaps up, and prop feathered, the plane has a glide ratio of about 18!

So the plane has 2 different power-off personalities: A glider when everything is clean, and a falling speedbrake when everything is dirty. Configure the airplane accordingly if there is power loss.

OPERATING SPEEDS

V _{so}	61
V _s	76
V _x	85
V _y	105
V _{bg}	110

Vfe 140 for 100% flaps (50°)
Vlo 150
Vfe 160 for 50% flaps (25°)
Vle 165

Va 190
Vno 220 -4 knots for each 1000 feet above 24,000 feet pressure altitude.
VNE 256 -4 knots for each 1000 feet above 24,000 feet pressure altitude.
Mmo 0.621

Max demonstrated crosswind 25 kt

The Max demonstrated crosswind is the crosswind component for which adequate control of the airplane during take-off and landing was actually demonstrated. The value in this handbook is that demonstrated by Lancair test pilots and considered safe.

Flutter has been tested to at least 284 KIAS, 350 KTAS, and designer Tim Ong says it is higher than that for sure.

PERFORMANCE

Climb:

Climb speed: 110 KIAS
Climb rate at nominal load: 5,000 FPM

Cruise:

You can cruise at 2000 RPM, but the KingAirs cruise at 1900, and the ride is much quieter at 1700.
Cruise is faster for a given fuel flow, though, at 2000 rpm!

SYSTEMS

Flight Control:

The aircraft is conventional in its control configuration except for the side stick controls. Lancair's airfoils are a combination of NASA and NACA designs with their own unique airfoils designed specifically for the Lancair mission. All primary airfoils are High-Laminar flow designs with noncritical characteristics. This means that the airfoils are capable of maintaining laminar flow over 50- 60% of their chord, generating greatly reduced drag. Should laminar flow be lost due to surface contamination (i.e. bugs, etc.) no dramatic loss of lift is incurred.

The aircraft uses three-axis electric trim. All tabs are built into the control surfaces. Trim controls are located on the pilot and co-pilot stick.

Tires:

The main gear tires are size 18 x 4.4, six ply, 160 mph Michelin (part no. 021-611-0). Inflate with nitrogen to 80 to 100 psi (85 psi recommended).

The nose gear tire is size 5 x 5, six ply, Michelin (part no. TRMA- 5.00x5-6). Inflate with nitrogen to 45 to 55 psi.

Brakes:

Ground handling:

Parking brake is on the right... pull the pin, move the brake 90 degrees, and pump the pedals to hold position.

Replace in stowed position and pin it to release the brakes.

In flight:

You should get in the habit of checking your brakes on downwind before landing. To do so, simply depress each pedal to verify a "firm" pedal.

Engine Description:

The engine is the Pratt and Whitney 850-hp PT6A-42. This engine has a three axial and one centrifugal compressor that pressurize air before it goes to the combustion chamber. In the combustion chamber, fuel is added and the air expands on its way out of the engine, turning a turbine (just like a windmill) on its way out. Since that windmill is geared down through a transmission to the propeller, the propeller turns and the plane is pulled. Another turbine drives a shaft right back to the compressor, so the whole process keeps working.

Engine Controls:

Igniter button turns on the spark.

Fuel Pump button turns on an electric fuel pump for start and near-ground operations.

Black handle: Power Control Lever.

Forward of idle it increases fuel flow.

Aft of idle (pull a trigger to get there) it pulls the prop into beta (reverse-pitch).

Aft MORE of idle and it adds fuel flow again to give reverse thrust.

Use beta for taxi, and reverse as needed for landing.

CAUTION: Do not move the power control lever into the reverse range (Beta) before engine start, as damage to the linkage will result. Reverse (Beta) may only be selected with the engine running and the propeller turning.

Blue handle: Prop Control.

Forward for max RPM.

Aft for feather.

Feather as needed for engine failures, and always right before shut-down.

Red handle: Condition Lever

Full forward is high idle, which we do not use in this plane.

Middle is low idle, where we set that lever for flight.

Aft is shut-off, which is how we shut down.

Engine Instruments:

Prop RPM to read the RPM of the propeller, which is not directly connected to the compressor.

Torque to read the torque on the prop, which comes from the turbine in the output airstream from the compressor.

ITT is temperature sampled between the compressor turbine exit and the power turbine vane inlet. Read temperature in degrees Centigrade.

Ng is the percentage (of the maximum 38,000 rpm) of the compressor, which drives the whole thing.

Engine Start and Taxi:

FIRST be sure that ALL THREE KNOBS are ALL THE WAY DOWN (but not in Beta!)

THEN turn on the igniters on to get a spark.

THEN turn on the fuel pump on to get fuel.

THEN hit the starter to get the compressor up to at least about 13% compressor speed, watching for the oil pressure to come up as well.

THEN bring in the fuel by moving the condition to low idle, and HOLD THAT STARTER until the ITT peaks and then comes down again.

A problem with this engine: It runs so HOT that it needs cooling air INSIDE THE ENGINE or it will MELT ITSELF. This cooling air actually sits between the flame and the engine walls, protecting the engine! This cooling air is only available in adequate supply if the compressor is turning at least 13% speed... any slower than that, and the flames of combustion will not be insulated from the interior of the engine, and the engine will destroy itself. So, to keep the engine from self-destructing, ONLY HAVE FUEL RUNNING THROUGH THAT ENGINE IF IT IS TURNING AT LEAST 13% COMPRESSOR SPEED, SO THAT INSULATING WALL OF AIR IS FLOWING! Do this by simply checking the condition lever is at CUT-OFF, and then engaging the fuel pump, spark, and starter FIRST, and THEN bringing in the condition lever once the compressor has spun up to at least 13% speed. Also, put in the SPARK FIRST, FUEL SECOND. You know why, right? If you put in the fuel first and THEN the spark, then the spark could light up an excess of fuel in the engine all at once, and the result will be.... spectacular. And expensive. But spectacular! But mostly expensive. So the name of the game is to check that the condition lever is at cutoff, then put in the spark, then the fuel pump, and then spool up the compressor with the starter, and THEN throw fuel into the spark once you have that 13% compressor speed needed to insulate the engine. If, at any point during the start, you decide that your compressor speed is below 13% and you have, or are about to have, combustion: THEN YANK THE CONDITION LEVER TO THE BOTTOM! That shuts off the fuel.

A problem with the engine: It idles so high that you might wind up taxiing too fast with the engine at idle. The solution is to pull the trigger on the throttle and pull it aft, going into beta. As you pull back, the prop pitch goes flat, and even negative! That reduces thrust and the plane is slowed. KEEP pulling back and the engine takes MORE fuel, speeding it UP for REVERSE! If you do this during taxi, then you will be spending MORE fuel to go SLOWER! Argh. So get your ducks in a row before engine start and taxi. Once the engine is started, the clock is ticking. Pull the black knob back as far as you can in taxi without actually increasing the compressor speed and you will at least get the most manageable taxi that you can... but you will be burning about 25 gallons per hour, and taxiing at maybe 25 miles per hour... so in taxi you get about one mile per gallon. Prep for flight BEFORE engine start!

The aircraft is controlled on the ground using differential braking to control the castoring nose gear. Don't ride the brakes in taxi. Ease the throttle into beta instead.

Prop:

The light-weight, composite, German MT prop is almost as much lighter than the standard metal propeller as the -42 engine is heavier than the standard (-135) engine, so the weight gain from the extra power is largely offset. The MT prop has no resonance modes with the engine, so can be operated at any speed (something that has to be avoided at certain prop speeds with the metal prop).

Electrical System:

We only have one bus, because that is all the Moritz can handle.

But, we have a generator **and** an alternator (ONLY RUN ONE AT A TIME! The alternator is a backup only! Running them both at once would result in them interfering with each others voltage regulators), and 2 batteries, and we should always fly with an iPhone running Xavion to effectively act as a second suite of avionics on a second bus.

Note that the overhead lights continue to run even if ALL electrical breakers are OFF. This is so we can get light in the airplane with very minimal current draw on the batteries.

The left panel-lighting dimmer controls the switches.

The right panel-lighting dimmer controls the flood-lights.

Note that whenever a GPU is plugged in, it is charging the batteries. Really very simple. This happens no matter what is turned on or off. Then for GPU starts, simply turn on the batteries and operate as normal! There is ZERO change to operating procedures: The GPU is simply charging the batteries! The only thing you might do differently is NOT turn on the GENERATOR OR ALTERNATOR until the GPU is clear, so you are not fighting with the GPU voltage regulator, is all.

Bus voltage is shown on the Garmin MFD.

Batteries:

Two lead-acid batteries from Hi-Tek.

They are sealed, no-maintenance batteries, sitting just forward of the rudder pedals, in the inside of the cabin.

They are not known to have maintenance problems, smoke, need water, or things like that.

As well, combined, they are 25 pounds lighter than the standard batteries!

Weight result of engine, prop, and batteries:

Weight of the PT-6A-135: 338 lb

Weight of the PT-6A-42: 402 lb

Weight of Hartzell: 145 lb

Weight of MT: 103 lb

So we weigh 22 pounds more in propulsion.. and save more than that with the light-weight sealed batteries.

Pressurization:

Pressurization happens as follows: There is an output from the compressor section of the engine that goes to a valve called the bleed air valve, since it bleeds some air from the compressor. This bleed air valve fails and de-powers to the CLOSED position, but a small amount of current (less than 5 amps) keeps a solenoid open that keeps a flow of hot, high-pressure air flowing out of the compressor section of the engine. This air flows to a valve that sends the (very hot) air to an intercooler to cool it down for us. The intercooler sits behind a NACA duct in the cowl to scoop up outside air and run THAT through the intercooler. That cools the pressurized air, which is really nice for us because the next stop for this pressurized, cooled air is: The cockpit!

Note: In initial test-flights, when the intercooler was just mounted entirely in the mid cowling bay, just sitting there, so it had no air FORCED through it at all. Temperatures in the cockpit in flight at 28,000 feet were about 100 degrees F. Since no interior was installed, and the temperature was maybe 50 degrees BELOW zero outside, ice was still forming on the cabin walls in the cockpit. So, we were sitting in 100 degree temperatures in the cockpit, but if that ever felt too warm, we just put out our hand and touched the ice forming on the cabin walls 3 inches away. A spring day on the beach, this isn't! But that is now fixed with the technique mentioned above, and with a nice, insulating, interior installed, no more ice under your hands either.

One other note: There is a small knob just left of the throttle quadrant that you can pull that BYPASSES the intercooler, letting bleed air directly enter the cabin! On COLD days, at low altitudes and low power settings, the compressor is not compressing (and thus heating!) the bleed air very much. On those days, the bleed air is just not as hot, and if it is then cooled by an intercooler, the air entering the cabin will just be too cold. So, in those cases, you can bypass the intercooler to get the hot bleed air directly. Nice thing: No gas-burning heater. No electric heater. No running air over a hot exhaust system and then into the cockpit. Instead we just get some nice hot, high-pressure air right out of the compressor of the engine, in the part of the engine that compresses (and therefore heats!) the air, BEFORE the fuel is introduced, of course.

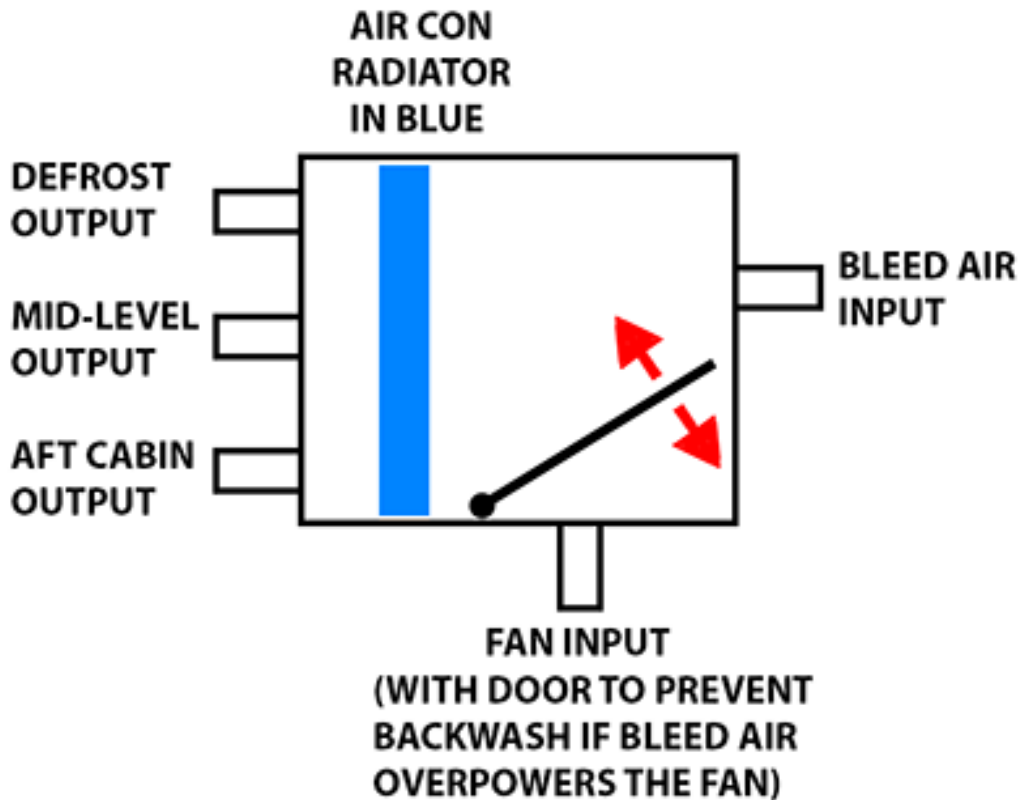
So that is HALF the pressurization system: The part where you get high-pressure air from the engine and MAYBE intercool it with cold outside air. But there is another half: Letting the air OUT! And THAT is the job of the outflow valve. The outflow valve is an electrically-powered valve that lets none, some, or all of the air out of the cockpit. How much does it really let out? Well, just the right amount, of course! Maybe right before engine-start, we enter the DESTINATION into the Garmin. Garmin then sends the destination altitude to the outflow valve. That valve is then constantly saying "HHHmmm... he wants to land at some place that is 3,000 feet above sea level, and I am now 28,000 feet above sea-level, how much air should I keep in the cabin to provide a nice gradual pressure change to ambient during the descent?" Based on the valves' decisions, it always keeps just the right amount of air in the airplane to be at ambient pressure on the ground, and hold the desired pressure inside the airplane when at altitude, and transitions smoothly between the two during climb and descent. And, it does all this simply by deciding how much air to let OUT of the airplane! The bleed air, as long as it is turned on, is always dumping air IN. The outflow valve just holds the desired pressure by deciding how MUCH of that air to let OUT. Really, quite simple. And quite elegant, since very few parts are required. And quite safe, since the air coming in from the bleed air valve has no chance of fuel or smoke or exhaust contamination, because the air is coming out of the engine compressor, which as you may

recall is the part of the engine that compresses the air BEFORE any fuel is applied!

In the aft portion of the starboard boat locker of the baggage compartment, there is a switch that is currently closed. This puts the pressurization in manual override, which seems to work, but always seems to want to pressurize us to sea level.

Taking the switch OUT of manual override seems to turn off all pressurization completely, currently.

Environmental Control:



So the bleed air comes from the bleed air valve (via a really high-airflow intercooler to cool it down, if selected by the pilot) into what we call "The Box". This box has 2 inputs and 3 outputs.

One input into the box is the bleed air. The other input into the box is the air circulation fan. You turn on the bleed air by turning the bleed air switch to ON in the cockpit, just exactly like a light switch. You turn on the air circulation fan in the Moritz ECB screen. So this is interesting: There are TWO air INPUTS into the box: The BLEED air from the engine and intercooler (on/off, enough pressure in the flow to pressurize the airplane) and the FAN air from the air circulation fan which simply takes air from somewhere in the airplane and blows it into the box with enough force to circulate air through the airplane, but of course no chance of pressurizing it, since it is just a weak little fan that is circulating air around IN the cabin. So, there are TWO air inputs into the box: One for pressurization, one simply for circulation. Now, BOTH of those inputs go through a radiator! And this radiator is kept cold by the air conditioning system. Coolant is pumped through this radiator to keep it cold, so the bleed air and recirculating air are cooled. How MUCH is it cooled? That depends on what you have the re-circulation fan set on. Fan off? Then no air-conditioning. Fan LOW, MEDIUM, or HIGH? Then the air conditioning compressor works correspondingly harder to keep the radiator cold. So, turn on the bleed air with a switch if you want to pressurize the cabin, and crank up the AC if you want to cool it. The air conditioning is currently controlled in the Moritz circuit breaker page.

So those are the two inputs. What about the 3 outputs? Well, there are three pipes leading OUT of the box. And each

pipe has a red-dot electric servo in it to open or close that outflow.
Pipe #1 is the UPPER output, to the window for defrost.
Pipe #2 is the MID-LEVEL output, to 4 vents in the cockpit, and 2 vents in the back.
Pipe #3 is the LOWER output, just to the back of the plane.

Now, Evolutions do have a known failing in enviro control: They run about 20 degrees COOLER in the back, since all the heat comes in the front, and the airplane is in temperatures that are BELOW ice-cold. The 20-degree cooler aft section may not seem like TOO big a deal... until you realize that I like to fly with it about 50 degrees in the cockpit to keep me alert, and my wife likes to sit in the back. Do the math on her temperature back there. So what do we do? Well, we have two weapons against this problem. One is the fact that the lower vents only go to the back, so with the defrost turned off and the forward vents closed, ALL the heat goes to the back. As well, the cabin air re-circulation fan (which runs at the same speed as the rest of the system for now) takes air from the COLDEST place in the airplane (the back, in the baggage compartment) and pipes it forward to the overhead vents in the cockpit. This way, we simply take the coldest air in the airplane and bring it forwards to the cockpit (the hottest place in the plane) to keep the air equalized.

So, there you have the pressurization and environmental control:
Bleed air comes from a safe (no-fuel, no-exhaust) part of the engine when turned on by a switch.
The bleed air can be intercooled in an intercooler in the cowl.
The bleed air comes into the box.
The cabin fan blows air into the box as well.
The air moves through a cold radiator on its' way out of the box, where it can go to upper (defrost) mid-range (instrument-panel vents), or lower (rear) output vents.
A separate fan moves air from the back of the plane to the front to try to equalize the temperature.

The bleed air is turned on like a light.
The air conditioning fan is turned on through a few levels automatically by the temperature-request in the Moritz.
The cabin re-circ fan runs along with that.
On the Moritz touch-screen, you can select where the output air goes.
And, finally, on the Garmin, you can quickly enter the airport you are going to, and the outflow valve will keep just enough air in the airplane to hold it at the ideal internal pressure for each point in the flight.

(NOTE: Some Evos have had the air conditioning shut down in flight due to a pressure sensor thinking there is inadequate cooling fluid pressure at altitude, just due to the low air pressure up there... N844X has this pressure switch re-located from the tail to the aft cabin to prevent this).

Landing Gear:

The landing gear is made of welded 4130 steel tubing.

The nose gear is a conventional air/oil oleo strut with internal viscous shimmy dampening. WARNING: The nose wheel shimmy dampener must be checked on a regular basis. Air/oil struts should have from 20-50 ft. pounds of torque. Also check the rotational resistance of the wheel. If more than one free revolution of the wheel occurs upon firmly spinning the tire, the axle bolt must be tightened. The split nose gear doors are operated through the retract linkage and are held open by a gas strut in the same linkage.

Here is how the retraction system works:

This is the standard Lancair 2000-psi hydraulic landing gear system. The gear is hooked to hydraulic lines that run to a hydraulic reservoir. When the pilot moves the gear handle up or down, a little solenoid flips left or right to indicate what direction the hydraulic fluid will run from the pump. If the gear handle is up, then pressure from the pump is directed to hydraulic cylinders that push the gear UP. If the gear handle is down, then pressure from the pump is directed to hydraulic cylinders that push the gear DOWN.

Switching the gear handle position will drop the pressure sensed by the hydraulic pump, since the solenoid just switched to the other side of the hydraulic system, which was not pressurized. The hydraulic pump will sense the low hydraulic pressure, and immediately begin pumping to pressurize the hydraulic system up to its' desired pressure. Since the solenoid is now placed such that the hydraulic fluid flows in the right direction, the gear is driven up or down. Once the gear gets as far as it will go, the hydraulic pressure will increase rapidly, and the pump will see that

there is enough pressure and shut off. (There is an accumulator to soften any shocks on the system, since hydraulic pressure is not compressible. As well, this accumulator stores enough pressure for one gear extension! But not two, so plan accordingly if the pump seems to have failed).

As well, there is a hydraulic dump valve right in front of the pilots' seat which goes horizontal to dump ALL hydraulic pressure.

When the gear has come down, three switches will make contact, lighting up 3 green lights on the panel.

When the gear has come up, three switches will make contact, extinguishing a yellow light on the panel. This shows "gear unsafe", since the plane is NOT detecting contact on all of the contact-switches.

When the hydraulic pump is running to pressurize the system, a yellow light on the panel is illuminated. This shows that the desired hydraulic pressure has not yet been reached.

So, to raise the gear, raise the switch, expect to lose the green lights as those contactors are lost, see the yellow "unsafe" light (center) activate as no contactors are closed, and see the yellow hydraulic pump (aft) light up as the system is pressurized as the gear moves into position.

To lower the gear, lower the switch, expect to see the yellow "unsafe" light (center) activate as no contactors are closed, and see the yellow hydraulic pump (aft) light up as the system is pressurized as the gear moves into position.

The yellow (center) "gear unsafe" light should go out when you have 3 up or 3 down contactors.
The yellow (aft) hydraulic pump light should go out when the pressure is as desired.

Now, if the gear is not going UP, and the pump is not running, check the circuit breakers!
Now, if the gear is not going UP, and the pump IS running, check the hydraulic dump valve!
If it is open, then all pressure is dumped, and the pump will run forever and accomplish nothing, running the fluid in a circle.

Now, if the gear will not go DOWN, then check the gear circuit breakers on the right panel.
If the pump IS running, then check the hydraulic dump valve to make sure it is closed!
If the pump is NOT running, then it is broken or not sensing the low pressure needed to trigger it.
In that case, SLOW to 90 knots and OPEN the hydraulic dump valve to let the gear FREE-FALL.
A high pressure gas strut will push the nose gear forwards.
Some sideslip in each direction will lock down the mains.

Once extended, ball bearings will lock the gear in place, hydraulic pressure or not.

On engine-stop once parked, it is a good idea to open the dump valve! Here is why:
Gear downlocks SPRING to LOCKED, and are DRIVEN to UNLOCKED by hydraulic pressure.
Now, once stopped, hydraulic pressure might build from heating on one side of the system or the other, and that could retract the gear on the ground. So, instead, count on the non-hydraulic gear down-locks to hold the gear in place on the ground, and dump all hydraulic pressure with the dump valve so no residual heat heats up the the hydraulic fluid and brings up the pressure on the retract side of the system.
There are NOT any uplocks at all, of any sort, on the airplane. Hydraulic pressure alone holds the gear up.

Of course, if the hydraulic system is RUNNING, like during taxi, then the pump will keep up the pressure on the correct side to also help hold the gear in position, so we only need to worry about the dump valve when the system is NOT running.

So, you see how to pressurize the landing gear hydraulics, control the direction that the hydraulics push (to push the gear up or down), see contactor switches get touched whenever the gear hits the up or down limits, and bypass the whole system for emergency extension or ground-towing.

For Service: Use only MIL-L-5606 "red" hydraulic fluid.
Go to the baggage compartment, pull the left side carpet and open the boat-locker, and see the red fluid in the tube going around the reservoir. That is acting as a sight gage to confirm that we have enough fluid.

Now, for the gear WARNING system: We have an AOA indicator that says "LANDING GEAR" below a certain

SPEED.

This operates as follows: A SEPARATE contact switch than any of the OTHER landing gear contactor lives up in the RIGHT wheel-well.

This switch only makes contact when (at least the right) gear is down.

Once that happens, the AOA indicator knows to not give a warning when it detects a landing angle of attack.

One note: The hydraulic pump should not run below 70 knots, due to a switch that locks it out below that speed.

ACCUMULATOR SERVICING

1. Discharge the hydraulic pressure as follows:
 - a. With the gear switch in the down position and the system on, pull the hydraulic pump breaker.
 - b. Open the emergency by-pass valve.
 - c. Verify the hydraulic manifold gauge now reads zero pressure.
2. The gas pressure, with zero hydraulic pressure, should read between 1000 psi and 1100 psi.
3. Use the method that prevents gas leakage during measurement such as a strut service valve.
4. Add gas to attain this pressure as needed.

De-Ice:

Ice usually forms when it is around freezing. But not TOO cold! If too cold, then any moisture in the air is ALREADY in ice pellets, so it just bounces off the plane. Ice only forms on a plane when the moisture is WATER, but, on contact with the airplane, is very CLOSE to turning into ICE. So it happens in a rather narrow temperature range. The lower atmosphere gets colder the higher you go, and warmer the lower you go. So, since ice only forms in a certain temperature range, it really will only form on the airplane in a certain altitude range. So, one solution to get out of icing conditions is to change altitude, which this plane can do rapidly, so that should be kept in mind during flight in visible moisture near freezing temperatures.

The de-ice switches are all on the right side of the panel: You turn them on like a light for use, and they are:

Pitot Heat: This heats up the pitot tube so you can see how fast you are going, enabling you to climb out of the ice at the best climb speed.

Inlet Heat: This heats the air inlet to the engine just enough to keep ice from forming on it, so the engine still keeps the power to pull you out of the icing situation. If you ever want to ruin your cowling inlet, just leave the heat on on the ground and walk away! The inlet will melt from the overheat and ground the plane. One shop-tech helpfully proved this one day!

Prop Heat: This heats up the propeller to shed the ice off of it, to keep the prop pulling the plane strongly to climb up and out of an icing situation. If you ever want to ruin the prop heat, just run it on the ground without turning the prop! The contact point will rapidly overheat and destroy the system!

Ice Door: This causes the air to make an abrupt 90-degree turn to make it to the engine. The freezing water or hail won't turn that sharp, so it goes overboard without entering the engine. You should also use it on the ground if there is

any dust or sand expected, to avoid getting that stuff in the engine!

Windshield Fluid Squirter: This is just like the windshield cleaner squirters in a car, but it shoots de-ice fluid onto the windshield instead. The button is right by the throttle quadrant. Open the boat-locker floor-storage in the right baggage compartment to get to the de-ice fluid reservoir to re-fill it.

Using these systems, 844X should be able to produce full power, deliver it to the prop, and give proper speed indications to the pilot to go to best climb speed, to enable a rapid climb out of icing conditions the moment they are encountered, and then clear the windshield to let the pilot see what is going on.

Of course, if you hit icing conditions at 28,000 ft (as high as you are allowed to climb) then it must be around 10 to 30 degrees F, more or less. This is a REALLY hot day. Just pull power and descend in that case, and the ice should melt right off.

And, the right way to avoid an impending icing disaster in the first place is to take a pretty simple look at your flight plan: For each step of the trip, is the freezing level way above the ground, so that if you get into icing, you can descend to warmer air to melt the ice off without hitting the ground first? Or, if the freezing level is BELOW the ground (because it is really cold) is it SO cold that any moisture in the air is already in ice form, so cannot stick to your airplane? If you can just fly in these conditions (or VFR, where ice does not form), then you should never find yourself in the one un-survivable ice scenario: Where you are getting ice on your plane, and have lost too much power and lift to climb, and are too close to the ground to descend into warmer air. Because, in that case, you will crash.

Autopilot:

Tru-Trak Sourcerer.

This autopilot runs servos on the ailerons and elevator.

As well, it controls a little box that then proceeds to run the elevator trim servo as well, as needed, in flight. (But it does not run the aileron trim servo, or ever touch the rudder).

Auto ON hold attitude.

Dial the altitude into the G1000.

Then hit SEL on the autopilot.

Then push the unlabelled knob slowly to pre-select it.

Then hit the VVI button to go there at the desired speed.

The TruTrak should show 1 foot higher on the alt to show that it is armed.

Hit GPSS to GPS steer to the Garmin.

Hit EXT to follow the external heading bug.

AOA indicator:

We have an Advanced Flight Systems angle of attack indicator mounted on the glare shield, front and center. It shows AOA in colors of green, yellow, or red, and calls out a stall warning if impending.

Moritz:

This has 3 useful pages: Pressurization, Enviro and ECB.

After engine-start, in the ECB page, power all the lights and the left-two enviro control ECBs.

The lights are now ready to use, and the enviro control is on auto.

Once the left-two enviro control ECBs are on, the cabin alt and pressure differential in the pressurization page should show correct values.

Once the left-two enviro control ECBs are on, climate system should start working.

The pressure and pop-governor tests do nothing in this airplane.

The HVAC actuators control red-dot servos to direct airflow.

CPCS stands for Cabin Pressurization System.

Garmin G900 PFD and MFD:

There are separate manuals for those.

Note: In this version of the G900, the VSR ONLY shows descent rate when in close to the descent, and drops that out if we get too steep, most annoyingly.

Cowling:

The cowl is 6 feet long, all carbon fiber, and you can lift each half (upper and lower) with ONE FINGER. Carbon fiber components are amazingly light when properly engineered. The inlet is designed to be aligned with the local streamlines at the front of the nose, hopefully minimizing drag. This inlet smoothly expands the airflow coming into the cowl. As it does this, the air slows and goes to a higher pressure (the exact reverse opposite of a wing, which speeds the air up and takes it to a lower pressure). Since this air is now at higher pressure: Surprise! You just got some turbo-charging for free. The first tiny little bit of compression that the engine compressor would otherwise have to do is now done for free by the carefully-designed inlet and cowl. Somewhere in this air delivery process, the air can get re-directed by an ice door, which will cause the air to take a circuitous route to the engine, so any ice pellets or gravel or sand should, hopefully, continue straight, thus not entering the engine.

Now, the cowl has 3 bays in it, separated by 2 firewalls. The forward bay is ambient pressure. The aft bay is only slight more interesting, because the starter/alternator, generator, hydraulic fluid reservoir for the brakes, and environmental control hardware is mounted there.

The MIDDLE bay is the interesting one: This is where the inlet dumps its slow-moving, high-pressure air, and where the engine air inlet is, so it can get pre-pressurized air to help with its' job. The bulkheads between the bays, of course, are baffled to be in tight contact with the cowl to keep air from leaking out of the middle, high-pressure section. Better to keep that high pressure maximized in the middle bay to keep force-feeding that engine high-pressure, dense, air! Interesting note: In flight-test, the air pressure in the center bay was so high at max cruise speed that it BENT THE METAL BULKHEAD AFT! The moment that happened, the high-pressure air escaped, and the engine power dropped a little bit! So RDD built a metal brace to hold the bulkhead in place, and keep the pressure in the center engine bay, where it pressure-feeds the engine!

Paint:

This aircraft has no "stickers", and uses an OFF-white paint to save weight. (The body of the plane is a light beige). OFF-white paint can go on in a MUCH thinner coat, with many fewer layers, so this saves some aircraft weight (approx several gallons). As well, the beige coloring will do something to mitigate the gray/brown exhaust path left on the side of the plane by the engine.

PRE AND POST FLIGHT HANDLING

Baggage Compartment:

The baggage compartment is located directly behind the passenger seats. Its capacity should never exceed 225 pounds. The aircraft weight and balance may limit the maximum baggage to less than the maximum stated herein. All baggage carried should be secured for every flight. Even a flight in smooth air could encounter unexpected clear air or wake turbulence or require an evasive maneuver which could become a hazard to the flight anywhere from a nuisance to being catastrophic.

Fuel:

The standard Lancair has a very simple fuel system. It feeds fuel to the engine pump through a fuel selector, inline filter, electric boost pump then a gascolator. Each wing tank has a screen at its outlet. On pre-flight, check that the gascolator (which you feel on the right side of the airplane inside the nose-wheel well) does not have its' button popped, indicating filter blockage.

This engine burns Jet-A (168 gallons in the tank), but is allowed to burn 100LL (PISTON FUEL!) for up to 10 hours between engine overhauls. In other words, if someone puts 100LL in the plane by mistake, it should not result in an accident.

BUT!!!! The engine temperature will be much higher (very hard on the engine!) because the fuel will vaporize a lot more. 100LL vaporizes much, much easier than Jet-A. This means that during start, if you have fuel vapor in the engine at the moment that you hit the igniters (like if you accidentally engage the fuel and THEN the igniters) then the engine will be a bomb, since a spark will be introduced to fuel vapor in an enclosed space. The result really will be a real explosion. So, if 100LL goes in by mistake, have them take it out! But if you discover after the fact that they put 100LL in, do not emergency-terminate the flight... just be very careful to have igniter and plenty of NG before you introduce fuel, to be sure that you do not put spark into an engine with fuel vapor in it!

Put in fuel with PRIST.

This lowers the congeal-temperature of the fuel, so it stays liquid in flight, even if it gets really cold up there.

As well, Prist kills the ALGAE that might otherwise grow in the fuel tanks!

ARGH! YES! You read that right. ALGAE will sometimes grow in the fuel tanks, and then break off in bits and pieces and head to the fuel filter, and block the filter!

Then, the fuel filter is bypassed, and we are getting un-filtered fuel to the engine, and do not even find out about it until the next annual! (Or whenever the fuel filter is removed and checked).

So, best to throw in jet fuel with PRIST from time to time to kill any algae so we keep a clean fuel filter.

For approved fuel and additives refer to the latest revision of Pratt and Whitney Service Bulletin P&WC S.B.1244.

Do not take off with less than 10 gallons in each tank. There is no interconnection between the wing tanks. Allow no more than 10 gallons differential between the left and right tank for safe operation. With less than 10 gallons per tank, do not accelerate or pull the nose up too much... the fuel could slosh aft of the pick-ups.

The gascolator drain should be checked on preflight inspections for evidence of water, and the filter checked for solid foreign material.

WARNING: When fueling, ensure that the aircraft is grounded at the nose gear tow bar bracket to eliminate static electrical discharges.

Oil:

We carry 2.3 gallons of oil, and run between 4 and 6 units from max to keep from dumping oil out of the engine, where it runs to the tail, finds its way into the fuselage at the rudder, and then runs inside the airplane, forwards down the tail, and then drips down the ADS-B antenna and onto the hangar floor. So, we run down from the maximum to avoid overflow.

For approved oils refer to the latest revision of Pratt & Whitney Service Bulletin No. 1001.

OIL SYSTEM SERVICING APPROVED OILS

Oil is BP-2380... thin like water!

Should need it very rarely.

Run about 3 or 4 quarts below the max.

Oil dripping from the ADSB antenna will happen if I overfill... it comes in through the rudder!

OIL LEVEL CHECK

CAUTION: When the filler cap and dipstick/gauge assembly is installed and locked, no movement is allowed.

To avoid overfilling the tank and consuming excess oil, an oil level check is recommended within 30 minutes after engine shutdown. The ideal interval is 15 to 30 minutes. If more than 30 minutes has passed, and the dipstick indicates that oil is needed, start the engine and run at ground-idle for five minutes, and recheck the oil level as follows:

1. Unlock the filler cap and dipstick from the filler neck on the accessory gear box and remove the filler cap. Wipe the dipstick with a clean lint free cloth.
2. Install the cap/dipstick and lock. Remove the cap/dipstick.
3. Install dipstick.
4. Remove dipstick.
5. Check the oil tank contents against the markings on the dipstick (markings correspond to U. S. quarts) and service as required.

Note 1: Graduations on the dipstick indicate oil level in U. S. quarts below the maximum capacity of the oil tank. Normal cold oil level is the MAX COLD mark on the dipstick. Normal hot oil level is the MAX HOT mark on the dipstick. A dipstick reading of 3 will indicate the system requires two U. S. quarts to replenish to normal level if the oil is cold and three U. S. quarts if the oil is hot.

Note 2: If the engine is nose high or nose low, compensation must be made to avoid over or under servicing.

Note 3: Filling the oil to the maximum level may result in a high consumption rate, with the oil exiting through the AGB breather. On some engines, this may also occur with the oil level at one or two U. S. quarts below the maximum level. In such cases, operators are advised to service the oil to the level that results in acceptable consumption, down to 3 quarts below the maximum, if necessary. This practice is acceptable due to the large usable oil quantity, and providing the oil level is monitored using the engine maintenance manual, making sure the consumption allowance and operation are within the recommended oil temperature and pressure.

6. If the oil level is too low to register on the dipstick due to possible excessive consumption, or if low or fluctuating pressures have been recorded, refer to Fault Isolation Engine Lubrication for action to be taken, then proceed as follows:

- a. Fill the oil tank to normal level and record the quantity of oil added.
- b. Install the filler cap/dipstick making sure the cap is locked.
- c. Run the engine at ground-idle for approximately five minutes.
- d. Check the oil level (Steps 1 through 6.)

OIL CHANGES

Refer to the latest revision of the Pratt & Whitney Maintenance Manual for oil change service intervals.

Control Locks:

The normal control lock for the Lancair is the use of a seat belt secured over one or both of the control sticks.

Tying down:

Tie-downs are kept behind the pilots seat, and screw into the airplane at the tail and behind the wing landing lights. The TIE-DOWN points are the ones right forward of the main landing GEAR (and in the tail). Do not confuse those with the jack points at the wing root.

Towing:

Probably best to engage the emergency gear extension valve first, so there is no pressure in the system. That simply leaves the down-locks in place, with no hydraulic pressure that might retract the gear.

CAUTION:Nose gear rotation is limited to 50° either side of center

CAUTION: Avoid pivoting on one main gear while taxiing to avoid undue stress.
Attempt to limit inboard main gear turn radius to 25 feet.

CAUTION: If the nose wheel must be raised, apply weight on the rear fuselage forward of the horizontal stabilizer.
With the nose wheel off the ground, the aircraft can be pivoted around the main gear as required.

Jacking:

Jack adapters are included with the airplane.
Each adapter works with standard jacks.
The JACK points are the ones right at the wing ROOT.
Do NOT put the jacks out at the tie-down points!
Those points cannot bear jack loads!!

Toolkit:

Travel with microfiber cloth for windshield.

Cold-weather Operations: PREFLIGHT INSPECTIONS

Since Lancairs use laminar flow airfoils, their performance goes way down if there is any frost or snow on them. Once these things have been removed (preferably by warming in a hangar) the preflight should include special emphasis on freedom of control movements.

Cold-weather Operations: CRUISE OPERATION

Cold weather operation may require an occasional cycle of the propeller control. This could be particularly true after long duration cruise just prior to descent where lack of governor control could cause overspeeding.



These are the Moriz pages for pressurization, HVAC, and lighting.

Page 1 simply SHOWS the cabin pressure, and should be monitored in flight.



Page 2 lets you select:
HVAC OFF or AUTO,

Output to:

VENT (mid-level front and back gaspers),
DEFOG (upper windshield)
FLOOR (aft output)

as well as TEMP UP OR DOWN for the HVAC.

Seat heat is not installed in 844X. (This is exactly the type of thing that does not justify the wiring and complexity).

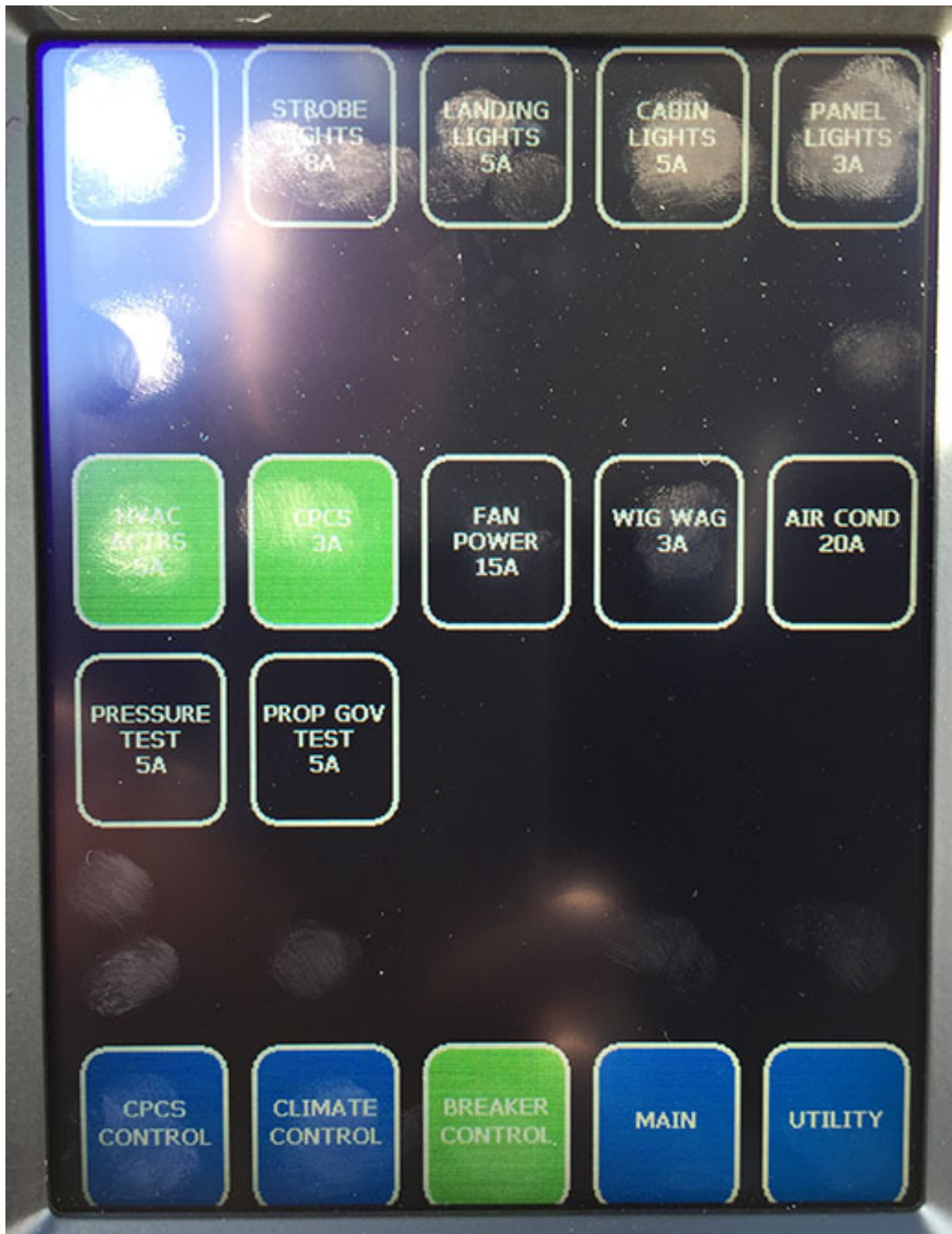


Enable the lighting circuit breakers to power the lights so the physical switches work.

Hit the HVAC and CPCS to power the HVAC and pressurization system.

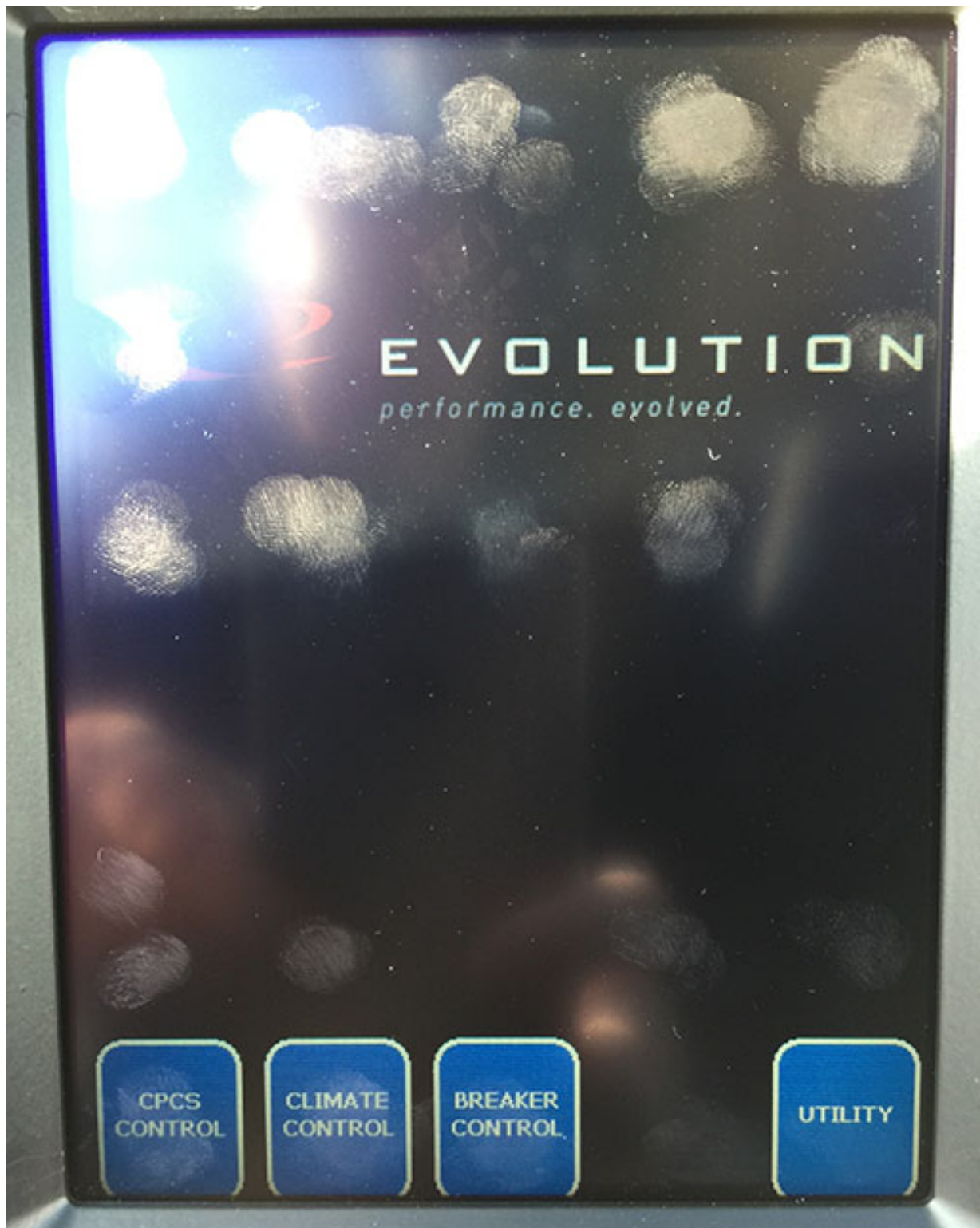
(Set HVAC to OFF after enabling the breakers, though, if no HVAC is wanted at the moment, since enabling the

breakers turns the system on automatically!)

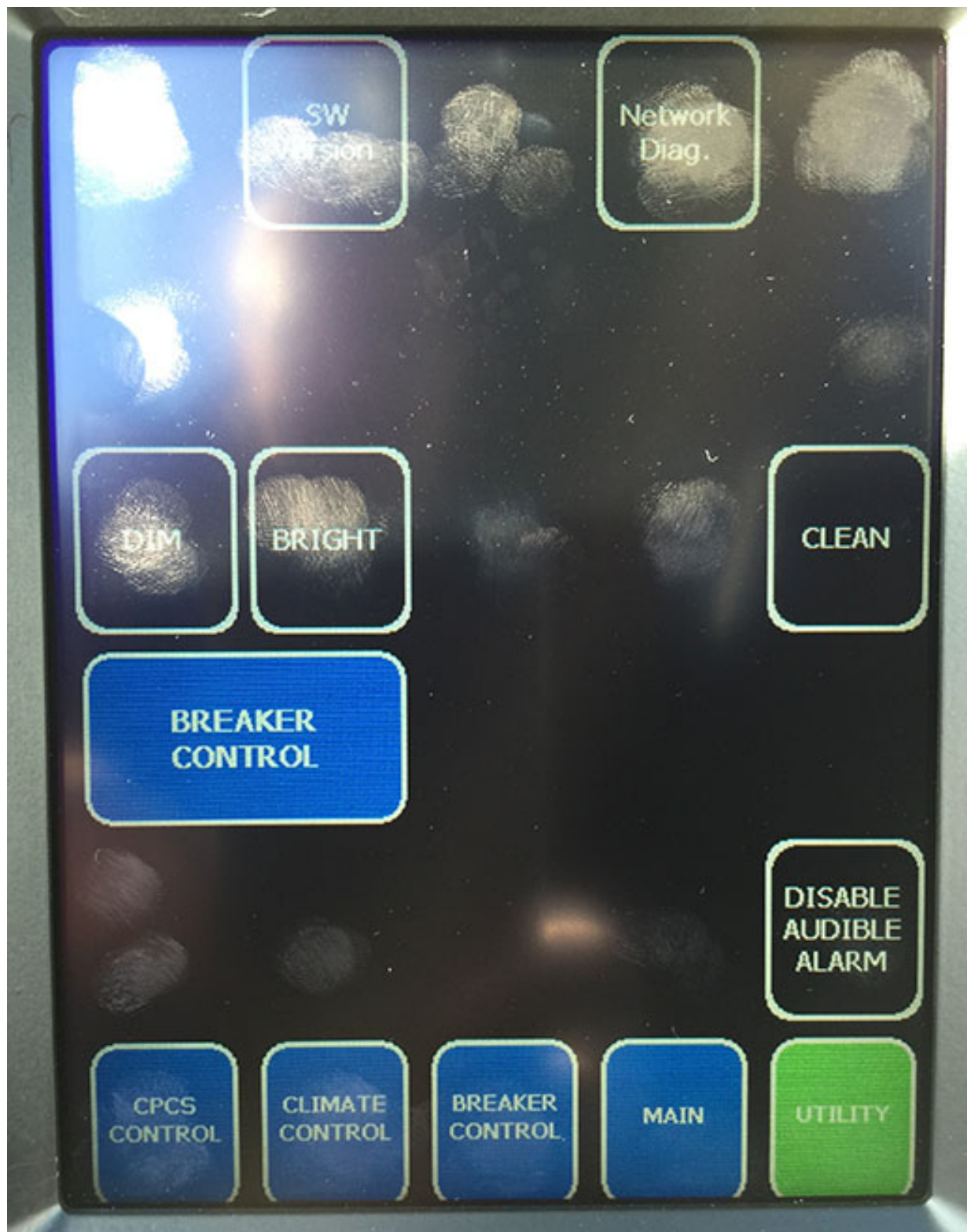


A page with little discernible function... I am annoyed at the inconsistency of NOT showing the "MAIN" page button

here.



Diagnostic and brightness control... I am annoyed at the inconsistency of showing the big "BREAKER CONTROL" button here.



PRE-FLIGHT PROCEDURES

COCKPIT CHECK

Aircraft Status Log
Required Forms/Certificates
All Electrical Switches
Circuit Breakers
Gear Handle
Batteries
Aircraft Battery
Fuel Gauge
Fuel Selector
Oxygen Quantity
Trim Servos
Flaps
Pitot Heat Cover
Pitot Heat
Pitot Tube
Exterior Lights
Pitot Heat
Battery Switch

CHECKED
ON BOARD/CHECKED
OFF
CHECK IN
DOWN
ON
24 VOLTS MIN
CHECK QUANTITY, BALANCE & RESET
FULLEST TANK
CHECK
CHECK
DOWN
REMOVE/STOWED
ON (10 SEC)
VERIFY WARM
ON & CHECK
OFF
OFF

LEFT FUSELAGE

Main Entry Door
Step
Rear Window
Upper and Lower Antennas
Static Port
A/C Vent
Horizontal Stabilizer/Elevator
Elevator Trim Tab
Rudder

CLOSE AND CHECK EXTERNALL Y
SECURE
CHECK CONDITION
CHECK CONDITION
CLEAR
SCREEN CLEAR
UPPER/LOWER SURFACES, ATTACH POINTS, FREE
SECURE, ATTACH POINTS, FREE
CONDITION, ATTACH POINTS, FREE

RIGHT FUSELAGE

Horizontal Stabilizer/Elevator
Baggage Door
Static Port
Windows

UPPER/LOWER SURFACES, ATTACH POINTS, FREE
CLOSED & LOCKED
CLEAR
CHECK CONDITION

get the hydraulic check stuff in there in the preflight as well.. pull up the baggage rug to get to those

RIGHT WING

Right Main Gear Door
Right Main Gear Mount
EXTENSION
Right Main Tire
Right Flap
Aileron Push Rod
Right Aileron
Nav / Strobe Lights
Fuel Tank Vent
Right Fuel Tank Cap
Leading Edge/Stall Strips
Underwing Panels
Fuel Sump Drain
Wing Root Fairing

CONDITION, ATTACH POINTS
ATTACH POINTS, HYDRAULIC & BRAKE LINES/PADS,
CONDITION, INFLATION
ATTACH POINTS, MOVEMENT
CHECK CONNECTION (INSIDE WING)
ATTACH POINTS, FREE
CONDITION, SECURE
CLEAR
VISUALLY CHECK FUEL & SECURE
CONDITION, SECURE
SECURE
SAMPLE
SECURE

NOSE

Cowling

SECURE

the 4 lines in the nosewheel well are oil overflows and if we see anything there it is bad news!

Propeller Hub/Blades	CONDITION, SECURE, LEAKAGE, FREE
Propeller Spinner	SECURE
Exhaust Stacks	CONDITION, COVERS REMOVED
Engine Intakes	CLEAR
Nose Gear Strut	CONDITION, EXTENSION
Nose Gear Tire	CONDITION, INFLATION
Landing Light	CONDITION
Oil Level	CHECK
Oil Cap & Door	SECURE
Windshield	CHECK CONDITION
LEFT WING	
Wing Root Fairing	SECURE
Fuel Sump Drain	SAMPLE
Underwing Panels	SECURE
Leading Edge/Stall Strips	CONDITION, SECURE
Left Fuel Tank Cap	VISUALLY CHECK FUEL & SECURE
PitotTube	NOT BLOCKED, WARM
Fuel Tank Vent	CLEAR
Nav / Strobe Lights	CONDITION, SECURE
Left Aileron	ATTACH POINTS, FREE
Aileron Trim	ATTACH POINTS, FREE
Aileron Push Rod	CHECK CONNECTION (INSIDE WING)
Left Flap	ATTACH POINTS, MOVEMENT
Left Main Tire	CONDITION, INFLATION
Left Main Gear Mount	ATTACH POINTS, HYDRAULIC & BRAKE LINES/PADS,
EXTENSION	
Left Main Gear Door	CONDITION, ATTACH POINTS
BEFORE ENGINE START	
Seat Belts/Shoulder Harness	ADJUSTED & LOCKED
Passenger Brief	COMPLETE
Emergency Gear Extension Valve	VERTICAL
Emergency Fuel Control Knob	FULL AFT & PINNED
Fuel Condition Lever	CUTOFF
Propeller Control Lever	FEATHER
Power Control Lever	IDLE (OUT OF BETA)

EMERGENCY PROCEDURES

The following checklists are presented in a compact format. Those procedures requiring immediate action should be committed to memory and reviewed periodically using the cockpit to become familiar with locations of all controls and switches as well as checklist flow patterns. This checklist should be readily accessible in flight for quick reference if needed. In any emergency, aircraft control should be your first priority. Be aware that each situation will have its unique aspects which should be approached using good judgment and common sense.

FALSE START / HUNG START

Power Control Lever	IDLE
Fuel Condition Lever	CUTOFF
Start Switch	OFF
Fuel Pump	OFF WHEN BELOW 10% Ng (PROVIDES LUBRICATION)
Ignition Switch	OFF
Fuel Drain Period	30 SECONDS
Dry Motor	15 SECONDS BEFORE START

ENGINE FIRE ON START/SHUTDOWN

Fuel Condition Lever	CUTOFF
Ignition Switch	OFF
Start Switch	ON
Fuel Shutoff Valve	CHECK OPEN
Fuel Pump	OFF WHEN BELOW 10% Ng (PROVIDES LUBRICATION)
Start Switch	OFF (FIRE OUT OR STARTER LIMIT)

IF FIRE PERSISTS

Fuel Pump	OFF
Fuel Shutoff Valve	OFF
Battery Switches	OFF
Exit Aircraft	

FIRE ON THE GROUND

Power Control Lever	IDLE
Propeller Control Lever	FEATHER
Fuel Condition Lever	CUTOFF
Fuel Selector Valve	OFF
All Switches	OFF
Exit Aircraft	

ENGINE FAILURE DURING TAKEOFF ROLL

Power Control	IDLE
Lever Brakes	AS REQUIRED TO STOP IF COLLISION IS LIKELY
Fuel Condition Lever	CUTOFF
Fuel Selector Valve	OFF
Battery Switches	OFF

ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF

Pitch to Glide Attitude	110 KIAS
Propeller Control Lever	FEATHER
Fuel Condition Lever	CUTOFF
Power Control Lever	IDLE
Fuel Selector Valve	OFF
Land!	

ERRATIC OR UNRESPONSIVE ENGINE OPERATION

Fuel Selector	DIFFERENT TANK
Power Control Lever	MID RANGE
Propeller Control Lever	FULL FORWARD
Fuel Condition Lever	GROUND IDLE

ENGINE FIRE/MECHANICAL FAILURE AIRBORNE

Pitch to Glide Attitude	110 KIAS
Propeller Control Lever	FEATHER
Fuel Condition Lever	CUTOFF
Power Control Lever	LOW IDLE
Fuel Selector Valve	OFF

NOTE: Shut off all equipment operated by engine bleed air.
Perform Forced Landing Procedure

AIRSTART PROCEDURES

WARNING: Do not attempt to restart a failed engine caused by a known mechanical failure (Ng – 0%) or fire if Ng is above 50%.

AIR-START IF NG>50% (HOT AIR START)

Power Control Lever	IDLE
Check Fuel Level	SWITCH TO FULLEST TANK

Ignition		ON
Fuel Condition Lever	CHECK ON	
Ng / ITT		MONITOR
WHEN ENGINE RELIGHTS ABOVE 51% Ng AND 400°C ITT		
Ignition		OFF
Power Control Lever	AS REQUIRED	
Land at Nearest Suitable Airfield and Investigate		

WARNING: During airstarts above 14,000' or with Ng<10%, starting temperatures tend to be higher and caution is required, if Ng is below 50%.

AIR-START IF NG<10% (COLD AIR START)

Airspeed		110 KIAS (90 KIAS MINIMUM, 260 KIAS MAXIMUM)
Power control Lever		IDLE
Fuel Condition Lever		CUTOFF
Gen/Alt/Non-Essential Equipment	OFF	
Battery Switches		ON
Fuel Pump		ON (CHECK 5 PSI MINIMUM, Ng 12% MINIMUM)
Ignition Switch		ON
Fuel Condition Lever		GROUND IDLE, AFTER 5 SECONDS STABILIZED Ng
ITT		MONITOR (1090°C MAXIMUM FOR 2 SECONDS)
Power Control Lever		AS REQUIRED
Land at the Nearest Airfield		
If Unable to Restart		USE AIRSTART WITH STARTER ASSIST PROCEDURE

AIR-START IF NG<10% (COLD AIR START, WITH STARTER ASSIST)

Fuel Condition Lever		CUTOFF
Power Control Lever		IDLE
Gen/Alt/Non-Essential Electrical	OFF	
Battery Master Switches		CHECK ON
Fuel Selector Valve		ON
Fuel Pump		ON (CHECK 5 PSI MINIMUM)
Ignition		ON
Start Switch		ON
Fuel Condition Lever		ON, AFTER 5 SECONDS STABILIZED Ng
WHEN ENGINE RELIGHTS ABOVE 51% Ng AND 400°C ITT)		
Starter		OFF
Ignition Switch		OFF
Power Control Lever		AS REQUIRED
Land at the nearest suitable airfield and investigate		

DE-PRESS

red button descrip, with power off to get down

ENGINE FAILURE

red button descrip

PILOT DIS-ORIENTATION

red button descrip

FORCED LANDING

VP-400 Runway-Seeker	ENGAGE
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If normal Runway-Seek not possible:

The use of gear UP versus gear DOWN is a function of the type of landing site. If the site is relatively hard and smooth, a gear DOWN landing is recommended. Conversely, if the site is soft or rough, a gear UP landing is recommended. This procedure can be used for practice, and actual engine failure or a precautionary landing.

NOTE: For feathering, a minimum oil pressure of 15

psi should be registered if propeller is windmilling.

Landing Gear	UP
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Flaps	UP
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Propeller Control Lever	FEATHER
Airspeed	110 KIAS

The above configuration should give maximum glide performance with approximately 500 fpm descent and an 18:1 glide ratio. This should result in approximately 3.5 nm glide distance per 1000' of altitude lost.

Fly Directly to Intended Landing Site

Fuel Pump Switch	OFF
Ignition Switch	OFF
Fuel Condition Lever	CUTOFF
Power Control Lever	IDLE
Fuel Selector Valve	OFF
Cabin/Baggage Door Seal Switches	OFF

Enter Forced Landing Pattern Overhead at high/low key (whichever altitude permits), using an initial aim point 1/3 of the way down the runway/intended landing site. Use approximately 2500' AGL for High Key altitude (overhead)
Use approximately 1300' AGL for Low Key altitude (abeam)

Flaps25°	AT LOW KEY
Gear	DOWN, WHEN LANDING SITE APPEARS ASSURED
Flaps	FULL, WHEN THERE IS NO DOUBT ABOUT LANDING SITE
Battery Switches	OFF
Flare & Land	BE AWARE OF HIGHER DESCENT RATES AND THE NEED TO FLARE EARLIER

Emergency Landing Pattern

To be used for:
Engine Failure
Precautionary Emergency landing
Practice Precautionary Emergency landing

1 Glide - 110 KIAS
Gear - Up
Flaps - Up
Prop - Feathered



EVO

Complete Landing Checklist
Prior to Touchdown



2
High Key - 3000' agl 110 KIAS
Over intended touchdown point
1/3 down the runway
Throttle - CLOSED
Prop - Feathered
Turn to Low Key (15°-20° bank max)

Low Key - 1600 - 1800' agl, 110 KIAS
Wingtip distance abeam of
intended point of landing

3
Flaps - AS REQUIRED
Prop - AS REQUIRED
Gear - AS REQUIRED & Checked

Final
Flaps - FULL when assured
Practice - Prop FULL INCREASE
when assured
Master - OFF (Day, actual only)
Landing Checklist - Complete

5 For Training
Purposes Only

4
Base Turn - 1200 ft agl

NOTES:

- **1** Convert airspeed to altitude as you turn toward landing area, restart checklist (if applicable), secure engine (if applicable)
- From **3** to **5** vary turn radius, gear and flaps depending upon your actual altitude in relation to the high and low key reference altitudes.
- When intended landing point is assured, move your reference point toward the approach end of the runway.
- Remember; prop, slipping and speed brakes (if installed) are available if you are high on your profile.
- Be aware of your high descent rate and the need to begin your flare earlier than normal.
- The ability to feather your prop will decrease your descent rate by as much as 25-50%.

PROPELLER OVERSPEED
Power Control Lever

IDLE



Oil Pressure	CHECK
Propeller Control Lever	REDUCE RPM
Airspeed	REDUCE AS REQUIRED TO MAINTAIN RPM
Power Control Lever	REDUCE AS REQUIRED TO MAINTAIN RPM

If overspeed was significant or vibration is experienced Land at the Nearest Suitable Airfield

PRESSURIZATION SYSTEM MALFUNCTION

The regulations limit flight altitudes to 12,500 feet when operating without pressurization or oxygen. Hypoxia is the result of an insufficient supply of oxygen to the blood the result of which is insufficient oxygen to the brain cells. The manifestations of hypoxia vary from individual to individual and day to day however in general the following are symptoms in the order in which they occur:

1. Loss of peripheral (side) vision
2. Bluish fingernails vs. reddish color
3. Sense of euphoria or well being
4. Seemingly darker than normal lighting conditions
5. Grey-out
6. Black-out

Somewhere in this sequence an in-flight decision can be made which is wrong or improperly reacted to, or simply ignored. Loss of control or over-control of the aircraft is a typical result and an accident occurs. This type of loss of control is serious – an accident is almost inevitable. Hypoxia is a dangerous condition. It is not limited to VFR pilots. IFR-rated pilots who are not up to par because of medicines, mental stress, turbulence, or other condition are also subject to hypoxia. All pilots should be particularly wary of and on the lookout for these symptoms. Their lives and the lives of their passengers depend on it!

Hyperventilation, a relative of hypoxia, is another breathing anomaly. However, rather than lack of oxygen, it is the result of over-breathing which upsets the balance of oxygen and carbon dioxide in the blood. The resulting symptoms are similar. The correction is rather the opposite; hold your breath followed by slow and deliberate breathing. The general cause of hyperventilation is stress, nervousness, anxiety, fright, etc. Upon the realization of the symptoms, evaluate the potential cause and take the appropriate action. Recovery from hypoxia is dependent upon obtaining oxygen, thus moving to a lower altitude. Hyperventilation requires a few seconds for the blood balance to be restored. Both of these problems are aggravated by smoking and alcohol which also upset the blood's ability to carry oxygen to the brain. Avoid them for your safety and that of your passengers. The presence of carbon monoxide in the cockpit can result in similar symptoms.

An open vent to increase cabin ventilation should be used even to the extent of colder than desirable temperatures. This latter should be anticipated if an exhaust heater is being used. A carbon monoxide detector in the cockpit is good insurance for winter operations.

ALTITUDE REACTION – IN FEET

5,000' – Use of supplemental oxygen at and above 5,000 feet for night flying will benefit the pilot, particularly towards the end of flight. Smoking reduces visual acuity and service altitude of the individual.

8,000' – Over prolonged flights, there are measurable changes in blood pressure and respiration. Mild hypoxia can result. It is generally assumed that the normal, healthy individual is unlikely to need supplementary oxygen at, and below, this altitude.

10,000' – Fatigue, drowsiness and sharp headaches can occur with increasing quickness if flights are made without supplemental oxygen at this and higher altitudes.

18,000' – This is the halfway point in the earth's atmosphere and pressure is reduced to 7.32 psi and oxygen saturation in the body is only 75%. Without supplemental oxygen, hypoxia is almost immediately apparent and efficiency deteriorates quickly and drastically. Unconsciousness can occur if supplemental oxygen is not used.

20,000' – Unconsciousness can occur in as little as 5-7 minutes without supplemental oxygen.

25,000' – Hypoxia rate increases rapidly, usually less than five minutes of consciousness without supplemental oxygen.

28,000' – Immediate 100% loss of coordination without supplemental oxygen.

30,000' – Unconsciousness in two (2) minutes without supplemental oxygen.

The VP-400 will flash the screen red if the cabin altitude exceeds 14,000 ft.

depress checklist:

-power idle, red button (this will take us downhill at idle power to get us to an airport)

or

-manual autopilot descent (this will bypass the auto-descent since the vvi will show a controlled descent)

or

-leave power alone, touch nothing (this will work us down under the auto-system, but may encounter high speeds and engine loads if i never reduce power)

DE-PRESSURIZATION:

Power	IDLE
Red Button	HIT (This will be a standard red-button approach)
O2	GRAB A MASK AND TURN ON THE O-2

EMERGENCY DESCENT

Power Control Lever	IDLE
Propeller Control Lever	FULL INCREASE
Speed	140 KNOTS
Flaps	DOWN
Landing Gear	DOWN

Differential Pressure Exceeds 6.5 psi:

Cabin Pressure Dump Switch	DUMP
Oxygen Masks	DON & ACTIVATE
Emergency Descent	EXECUTE

Sudden Loss of Pressure:

Cabin Pressure Gauge	CHECK CABIN ALT/PRESS DIFFERENTIAL
Cabin Pressure Dump	CHECK OFF
Cabin Entry/Baggage Door Seal Switches	CHECK ON
Cabin Pressure Control	CHECK SETTINGS
Emergency Descent	EXECUTE, IF CABIN ALT CONTINUES TO RISE
Oxygen Masks	DON & ACTIVATE

SMOKE/CONTAMINATION IN CABIN

Cabin Pressure Dump	DUMP
Door Seals	DUMP

IS SMOKE COMING FROM SOME PLACE OTHER THAN THE VENTS?

Bleed Air	ON
CCS Fan	MAX
All Airbox Outputs in VP-400	OPEN TO MAXIMIZE FRESH AIR INFLOW

IS SMOKE COMING FROM THE VENTS?

Bleed Air	OFF
CCS Fan	OFF
All Airbox Outputs in VP-400	CLOSED TO STOP INFLOW

Emergency Descent

Oxygen Masks	EXECUTE
Land at Nearest Suitable Airfield	DON & ACTIVATE

GENERATOR FAILURE

Ammeter	CHECK TO VERIFY FAILURE
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Generator Switch	OFF
Starter/Generator Circuit Breaker	CHECK & RESET
Electrical Load	REDUCE
Generator	ON
If Generator Operation is not restored:	
Generator Switch	OFF
Land at Nearest Suitable Airfield	

CAUTION: With the generator inoperative, battery power should last approximately 45 minutes with all unnecessary electrical equipment off-oaded. When possible, turn the battery switches OFF to conserve electrical power and back ON for landing. If total electrical failure is experienced, it will be necessary to perform an Emergency Gear Extension and land without flaps.

LOW OIL PRESSURE (<75 PSI)

(Do not change power setting or engine seizure may occur)

Engine RPM (Ng)	CHECK ABOVE 72%
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Torque (Np)	MAINTAIN 1000 TO 1200 FT-LBS UNTIL THE FIELD IS ASSURED
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Land at Nearest Suitable Airfield

LOW OIL PRESSURE (<40 PSI)

(Do not change power setting or engine seizure may occur)

Land at Nearest Suitable Airfield Using Minimum Power Setting

(Consider entering a HIGH Key position for a precautionary Forced Landing pattern.)

HIGH OIL PRESSURE (>105 PSI)

Land at Nearest Suitable Airfield Using Minimum Power Setting

LOW OIL TEMPERATURE (<0 DEG C)

Fuel	MONITOR PSI & FLOW
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Electric Fuel Pump	ON
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NOTE: Fuel heater operation not guaranteed.

HIGH OIL TEMPERATURE (>99 DEG C)

Power Setting	REDUCE AS NECESSARY
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Land at Nearest Suitable Airfield

HYDRAULIC SYSTEM MALFUNCTION

Whenever extending/retracting the landing gear, monitor the HYD PUMP light for operation, listen for pump operation, and feel for gear retraction/extension. If the pump fails there will be no HYD PUMP light or noise from the pump. If the pressure switch fails, the pump will either not run or run continuously. If both the solenoids are off because of no power, the gear will remain retracted if the counter balance is adjusted properly or drop out of the wheel well if it is not. If both solenoids are on (failure of gear switch), the gear will drive down slowly and lock. To extend the gear with any of the above malfunctions, use the EMERGENCY GEAR EXTENSION Procedure.

EMERGENCY LANDING GEAR EXTENSION

Landing Gear Lights TEST (SET TO DAY POSITION)

IF LIGHTS TEST GOOD & ONE OR MORE GEAR INDICATE UNSAFE

Airspeed	BELOW 140 KIAS
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Landing Gear Handle	DOWN
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IF THE LANDING GEAR DOES NOT GO DOWN

Airspeed	140 KNOTS OR LESS
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HYD PUMP Circuit Breaker	PULL
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GEAR SWITCH Circuit Breaker	PULL
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Emergency Gear Extension Valve	ROTATE CLOCKWISE
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Landing Gear Position Lights	CHECK INDICATIONS
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IF LEFT MAIN GEAR STILL UNSAFE

YAW LEFT AND HOLD

IF RIGHT MAIN GEAR STILL UNSAFE

YAW RIGHT AND HOLD

IF NOSE GEAR STILL UNSAFE

PITCH APPROXIMATELY 10° NOSE HIGH AT APPROXIMATELY 2

