Contents

PREFACE

"One thing to consider before you begin your Lancair training, is the psychological aspects of training. Think seriously about what you are preparing for. You are training to fly one of the highest performance single engine piston aircraft in the world. Develop the proper habit patterns now. They will serve you well when you must rely on your most basic skills, such as during an emergency situation, at night, in weather, picking up ice, unable to communicate with ATC, when your hands turn to ice and your IQ has dropped to 14. Approach your training with the serious professionalism it warrants."

Charlie Kohler, 2001

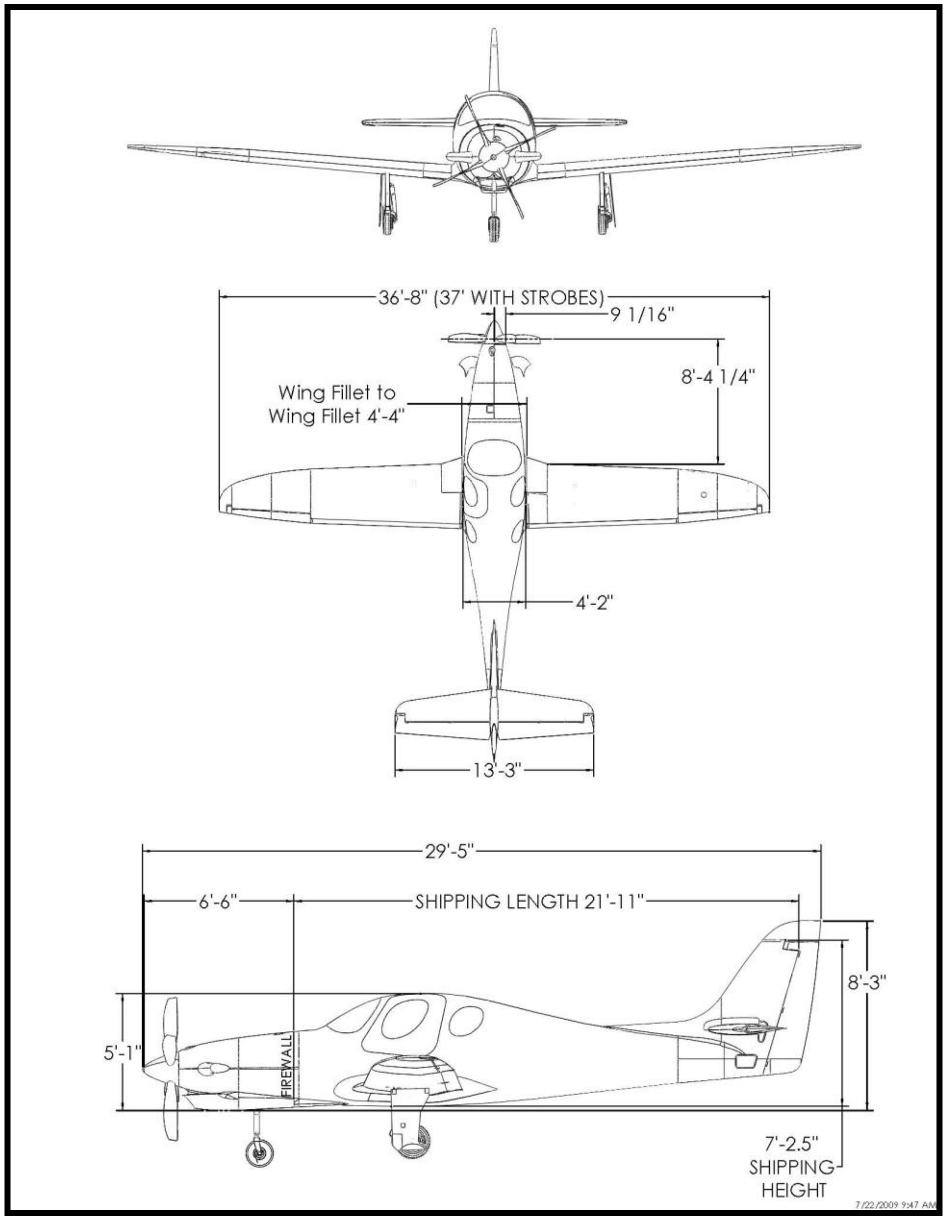
INTRODUCTION

This Lancair Evolution training manual is adapted from Charlie Kohler's Pilot Training Manual published in 2001. The material contained herein is designed to transition a current, proficient and qualified certificated pilot into the Lancair EVOLUTION amateur built experimental series aircraft when combined with the companion flight training syllabus. This manual covers a variety of topics related to high altitude, high performance single pilot, single engine flying, including: weather, aerodynamics, aircraft performance, physiology, navigation, and Lancair aircraft systems.

This manual does not cover every conceivable and inconceivable instrument or radio installation or engine or airframe modification. Many modifications to the basic airframe have also occurred both with builders and at the factory. Some of those items are discussed here but many are not.

While this manual covers many technical aspects of flying the Lancair Evolution at high altitude, it does not ignore the most important and most often the weakest link in airplane—the pilot. Flying is an extremely hazardous activity. The risk of flight can be managed to an acceptable level if the pilot is willing to invest the time, effort and financial resources to stay proficient. Like any other extreme sport, flying demands continuous study, training, practice and review. This is especially true of flying aircraft like the Lancair Evolution.

Jeff Edwards June 2019 (rev. 6/2/2019)


36'-8" (37' WITH STROBES)
9 1/16"
8'-4 1/4"
Wing Fillet to
Wing Fillet 4'-4"
4'-2"
13'-3"
29'-5"
6'-6"
SHIPPING LENGTH 21'-11"
8'-3"
5'-1"
FIREWALL
7'-2.5"
SHIPPING
HEIGHT
7/22/2009 9:47 AM

The Standard of Care of Private Pilots and General Aviation Risk Factors

The standard of care of Private Pilots certificated in the United States is outlined in many government and industry documents ranging from Federal regulations found in, but not limited to,14 CFR § 61 and 91 series and a multitude of advisory materials published by the federal government (Federal Aviation Administration--FAA) and aeronautical industry. The advisory material expands and explains the regulatory information. The core subject aeronautical knowledge areas are found at 14 CFR §61 and in the Practical Test Standards for the various Pilot certificates. The Pilot Practical Test Standards contain a listing of the advisory materials that expound on the core subject areas. The FAA also publishes a variety of handbooks including the Pilot's Handbook of Aeronautical Knowledge and the Airplane Flying Handbook, among other publications, to convey important aeronautical information to prospective and current pilots. These subject areas include regulations, aircraft performance, weight and balance calculations, takeoff and landing distance calculations, aircraft maintenance and airworthiness, aeronautical decision making, and aerodynamics, among a few.

Unfortunately, when there is an aviation accident, it is sometimes discovered that the Pilot in Command (defined by 14 CFR 1.1and 91.3) has strayed from the standard of care by failing to abide by prudent operating practices that he or she was taught. The reasons for this are varied. Some pilots, by nature, do not believe that the regulations apply to them—they intentionally violate or disregard the regulations. Some other pilots may have forgotten what good prudent practices are and have failed to maintain their knowledge to an acceptable level and have an unintentional slip or lapse. Other pilots have let their aeronautical skills deteriorate to a dangerous level—often without the realization they are no longer a "safe" pilot.

According to 14 CFR § 91.3 the Pilot in Command (PIC) is ultimately responsible for the safety of the flight. The PIC is responsible for the airworthiness of the aircraft and shall abide by the aircraft operating limitations. 14 CFR 103 preflight conditions and prudent pilot procedures advise that the Pilot in Command is responsible for becoming familiar with all information concerning a flight. It is the pilot's responsibility to calculate weight and balance, determine runway lengths and conditions, calculate takeoff and landing distances, determine airport elevation, density altitude etc. associated with the proposed flight. Sometimes pilots fail to properly calculate weight and balance, determine takeoff performance and provide themselves with an adequate margin of safety causing an accident. The aircraft flight manualfor certified aircraft contains performance charts that pilots should refer to. Additionally, 14 CFR § 91.9 states the pilot must abide by aircraft operating limitations. Weight and balance is an operating limitation specified in the aircraft flight manual (for all aircraft) and type certificate data sheet (for certified aircraft).

Significant risk factors are associated with pilots and accidents. These include:
Age at first certificate
Present age
Certificate level

Prior accident history
Prior enforcement history
Test failure history
Time in Type
Training history
Flight time accrual rate
Regulatory and Standards Compliance
Lack of Participation “The Unreachable”

In 1999, the AOPA stated, “AOPA Air Safety Foundation studies have shown that low time in type is often a contributing factor in accidents. Transitioning to a new aircraft, even one that is simpler than the one the pilot usually flies, can cause problems even for experienced pilots.” (2000 NALL Report: General Aviation Accidents Trends and Factors for 1999, AOPA Air Safety Foundation)

The NTSB conducted an annual review of aircraft accident data for U.S. general aviation accidents occurring in 1999. “Of the 1,647 accidents in 1999 for which data are available about pilot experience in the accident aircraft make and model, 85.5% involved pilots with 1,000 or fewer hours of time in the accident aircraft make and model” (NTSB Annual Review of Aircraft Accident Data, U.S. General Aviation Accidents, Calendar Year 1999 pg. 26). Pilots with 200 hours or less accounted for 58.1% of 1,647 accidents analyzed in the study. Pilots with minimal time in type are more likely to experience an accident than those pilots with more time in type.

2016 LOBO White Paper — Lancair Safety

Introduction

Lancair aircraft are a family of high-performance experimental amateur-built kit airplanes. The product line ranges from the 2-seat, 100hp Lancair 200 to the 4-seat, 750shp pressurized Lancair Evolution. Design changes over the years have given each Lancair model its own unique set of handling characteristics and mechanical features. The common thread among the various Lancair models is all-composite construction and very high performance compared to certified aircraft of similar horsepower.

Safety Record

Since its founding in 2008, the Lancair Owners and Builders Organization (LOBO) has worked with the FAA and insurance companies to find solutions to Lancair fleet safety problems. Today, the fatal accident rate for Lancair aircraft is 10 per 100,000 flight hours, which is disproportionately high compared to the GA fleet (approximately 1 fatal accident per 100,00 hours) and other experimental amateur-built aircraft (approximately 2 fatal accidents per 100,000 hours) (NTSB, 2010).

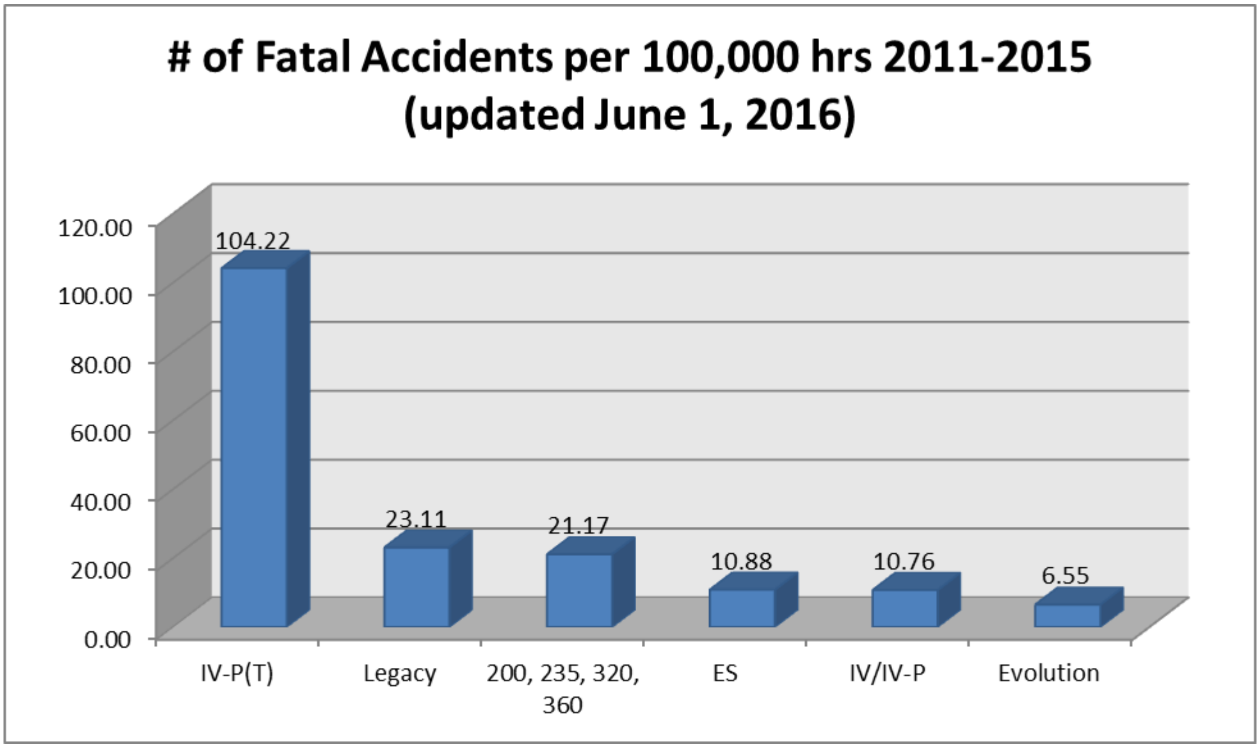


FIGURE 1

Initial Response

In 2009 LOBO developed a training syllabus which subsequently received FAA/Industry Training Standards (FITS) acceptance. Insurance companies agreed to offer coverage to pilots who received training in accordance with LOBO's FITS-accepted syllabus. Despite available training, on average less than 11 pilots per year participate in LOBO flight training, with only three obtaining transition training per year. These numbers represent less than 1.5 percent of the total Lancair fleet and are consistent with data on training rates supplied by the American Bonanza Society. Additionally, LOBO conducts dedicated ground training at its annual fly in, which is attended on average by 36 pilots.

Long-Term Results

The requirement for formal training is not regulatory in nature, but rather is driven by the economic interests of the insurance industry. Some insurance underwriters mandate transition and recurrent training; however this requirement currently applies to Lancair IVP, IVPT and Evolution.

Economic Forces

The 2008 economic downturn saw a significant drop in aviation activity across the entire GA fleet. At the same time, more of the Lancair fleet went up for sale on the used market at significantly reduced prices, making them available to pilots who could not previously afford them. With the softening of the insurance market due to reduced demand, insurance companies began relaxing training mandates, making it easier for new owners to fly newly acquired planes with little or no transition training. The result has been a number of Lancair accidents directly attributable to a lack of familiarity with the aircraft.

2012 Safety Effort

LOBO leadership met with Mr. John Allen, FAA Director of Flight Standards (AFS-1) and his staff in April 2012 to review Lancair safety concerns. LOBO made three proposals we believed would address the highest risks:

- Mandatory transition training for new owners.
- FAA to notify LOBO of Lancair sales (to facilitate LOBO advice and assistance to new owners).
- Approval for a second pilot during Phase 1 flight testing of new EAB aircraft.

The FAA has since implemented the second-pilot program. This initiative (AC 90-116) has been successful in reducing risks during Phase 1 testing.

2016 Safety Study

The FAA's General Aviation & Commercial Division (AFS 800) approached LOBO in March 2016 requesting assistance in addressing Lancair safety concerns. Their goal was to identify risks factors, develop ways to mitigate them and implement procedures to improve overall fleet safety. As a first step, LOBO formed a Safety Working Group (SWG) comprised of experienced Lancair owners/ builders and instructors. LOBO's SWG conducted an in-depth study of the Lancair fleet accident history. This study followed the same processes as the GA-JSC research, with LOBO categorizing accidents and incidents using common taxonomy recommended by the Commercial Aviation Safety Team and the International Civil Aviation Organization. We studied the NTSB's accident database, the FAA's incident database and foreign safety databases. We supplemented that data with news reports, social media posts and first-hand accounts with additional information on the pilot and aircraft where possible. Charts detailing the data may be reviewed in the Addendum at the end of this document.

Safety Study Results

There have been 557 known accidents and incidents in the Lancair fleet since 1988, including 116 fatal accidents involving 192 fatalities. The leading cause of these accidents is broadly "pilot error." Specifically, the number one issue of all accidents and incidents is failure to follow and/or unfamiliarity with aircraft procedures (see Figure 11). Loss of Control In-flight (LOC-I) is the leading cause of fatal accidents. Analysis also shows that pilot experience is a factor in these accidents and incidents. Pilots with less than 100 hours in model are at the greatest risk of an accident (see Figure 2).

Highest Risk Group

We have determined that pilots with little or no time in Lancairs are at the highest risk of an accident. This risk group includes pilots with extensive flight experience in other aircraft. For the first two decades most Lancair pilots were the original builders. As builders, they had intimate knowledge of their aircraft systems, making their low time-in-type the main risk factor. As Lancairs enter the used market and change hands each new owner faces the two-pronged threat of unfamiliarity with the aircraft and little or no experience in make and model. The NTSB identified second owners as having a higher risk of accident than the original builder due to lack of familiarity with the aircraft and recommended transition training to mitigate this risk (NTSB, 2010).

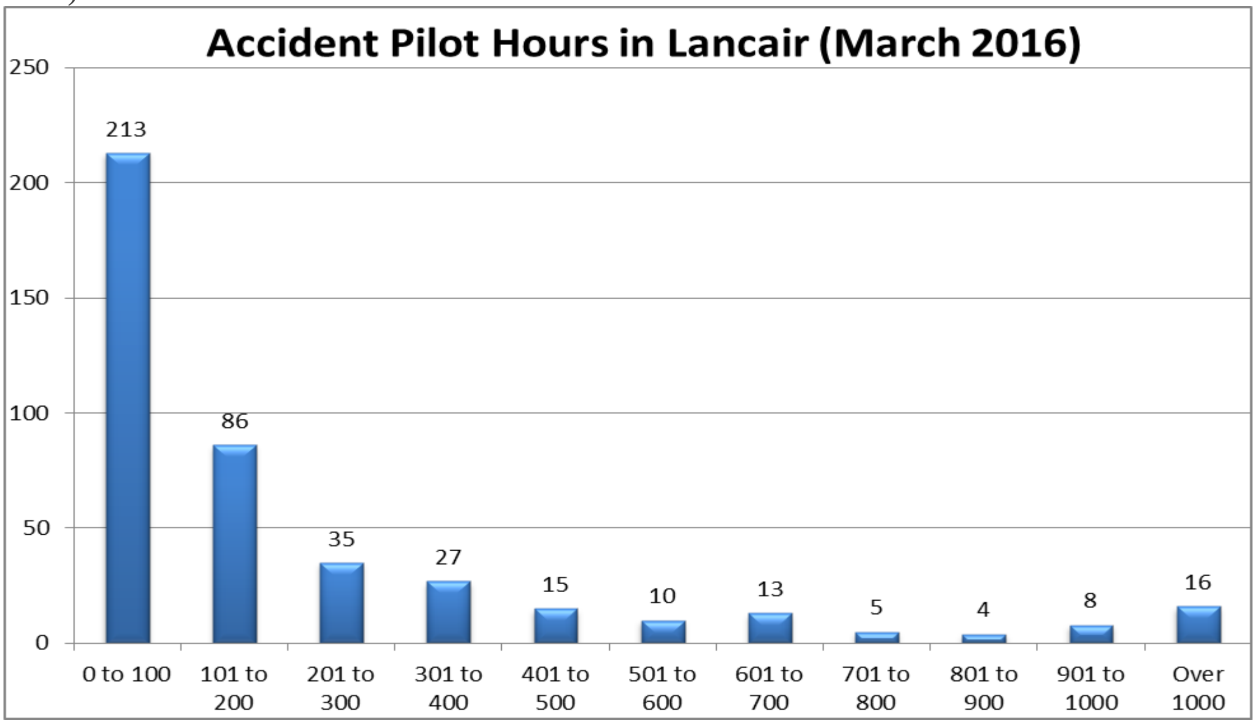


FIGURE 2

LOBO Annual Flight Training

Only 1.2 percent of Lancair pilots seek and receive recurrent flight training. Forty-six percent of all LOBO members report having received no Lancair-specific flight training. Eleven percent report LOBO flight training; twelve percent report training with independent training provider High-Performance Aircraft Training (HPAT) and 31 percent report “other” training. The following table shows the LOBO and Elite Pilot Services (currently the other active Lancair training provider) training output since 2009.

	Initial	Recurrent	Totals
2009	-	5	5
2010	1	5	6
2011	4	5	9
2012	-	1	1
2013	8	9	17
2014	7	15	22
2015	4	14	18
2016	1	8	9
Total	25	62	87
Avg./Year	3.3	8.2	11.6

Figure 3

Identifying the Risks

Loss of control inflight—the leading cause of fatal accidents for all GA aircraft, including Lancairs—is of utmost concern. Almost all Lancairs have high wing loading (some as high as 40lb/sq ft at maximum gross weight) resulting in stall speeds well in excess of 61 knots. The Lancair fleet does not have abnormal stall spin characteristics. FAA AVP analysis indicated that IVP spins are unrecoverable. Pilots have reported recovering from a steady state spin—albeit with a significant loss of altitude. AVP reported the time from loss of engine power to stall as “fast.” This is also not true. The airframes have very low drag for their operating weight and do not decelerate with loss of power as fast as a Cessna or Piper. In fact, the Lancair fleet has excellent glide characteristics—for example, the IVP model glide ratio approaches 20:1 with the prop at high pitch.

What is of significance is that most experimental aircraft have not been stall tested to the same level as certified aircraft. Like their certified brethren, it is unlikely that the angle of incidence on a given Lancair aircraft is exactly the same on both wings. Certified aircraft mitigate this issue with sufficient testing and the addition of stall strips and/or other aerodynamic devices. Most Lancair aircraft lack these aerodynamic devices which can result in poor stall characteristics. In addition, the average general aviation pilot does not have sufficient knowledge with respect to aerodynamics and experience to test and mitigate stall characteristics. LOBO transition and recurrent training emphasizes these factors. LOBO also discourages Lancair IV pilots from performing stalls and that recommendation seems to reduce the number of LOC-I events in that series. The word is out and pilots who get LOBO training are respectful of that corner of the envelope. Additionally, although most Lancairs do not have classic stall warning devices, many

are equipped with angle-of-attack indicating systems—the most common being the Advanced Flight Systems, Inc. unit developed by Mr. Jim Frantz, a former Lancair builder.
Lancair aircraft have a reputation for unforgiving handling characteristics. That is not true of all Lancairs.

The small 200 and 300 series have very light stick forces, especially in the longitudinal axis, resulting in difficulty learning in the landing phase as reported by LOBO instructors and many PIO-related accidents.

Reducing the Risks

The key to reducing the accident-related risks discussed above is training. When done properly, type-specific transition training can make pilots safer by improving stick-and-rudder skills, teaching aircraft-specific techniques, driving home emergency procedures and instilling a healthy respect for proper operating practices.

Insurance-required training received from approved organizations has proven helpful, however an insurance requirement is not a substitute for an FAA mandate. Insurance requirements vary from company to company, and even from one year to the next within the same company. If a single underwriter drops the training mandate when the insurance market softens the rest typically follow suit to remain competitive. The NTSB recognized these issues in its study of Glass Cockpit Safety (NTSB, 2010b). In an ideal world every Lancair pilot would undergo initial and recurrent training from an accredited organization. Thus far this year LOBO has trained seven pilots in the Lancair fleet. Independent training provider Elite Pilot Services reports similar numbers.

Training Challenges

Providing Lancair instruction presents unique challenges. There are a limited number of instructors with Lancair experience in the various models. The instructor pool is basically limited to Lancair owner-builders who are also CFIs. Additionally, there is wide variation in aircraft configuration within each model, especially in instrument panel layout and avionics. Even if mandated, the current pool of Lancair instructors could not train all Lancair pilots every year; however they are sufficient to train new transitioning pilots.

It has been suggested that LOBO acquire a flight training device and offer training in that. The fleet variations make designing such a flight simulator or flight training device technically infeasible.

LOBO Survey

LOBO surveyed members in 2012 to determine attitudes and opinions regarding FAA mandated transition training. Approximately 80% of the members who completed the survey supported mandatory transition training for new Lancair pilots. A survey of our members completed on July 22, 2016 shows 90% of respondents favor mandatory transition training as a means to reduce accidents (Figures 12-14).

Based on the available resources and economic impact to owners, LOBO believes that mandatory initial transition training is the best solution for reducing the current accident rate.

Since insurance industry training requirements are not regulatory, any training mandate must come from the FAA. Mandatory training has been successful in reducing the fatal accident rates. The flight review requirement supported by NAFI reduced the fatal accident rate by 15 percent in one year. Likewise, the Special Federal Aviation Regulation (SFAR) requiring mandatory training for Robinson R22 and Mitsubishi MU2 aircraft significantly reduced accidents in those communities.

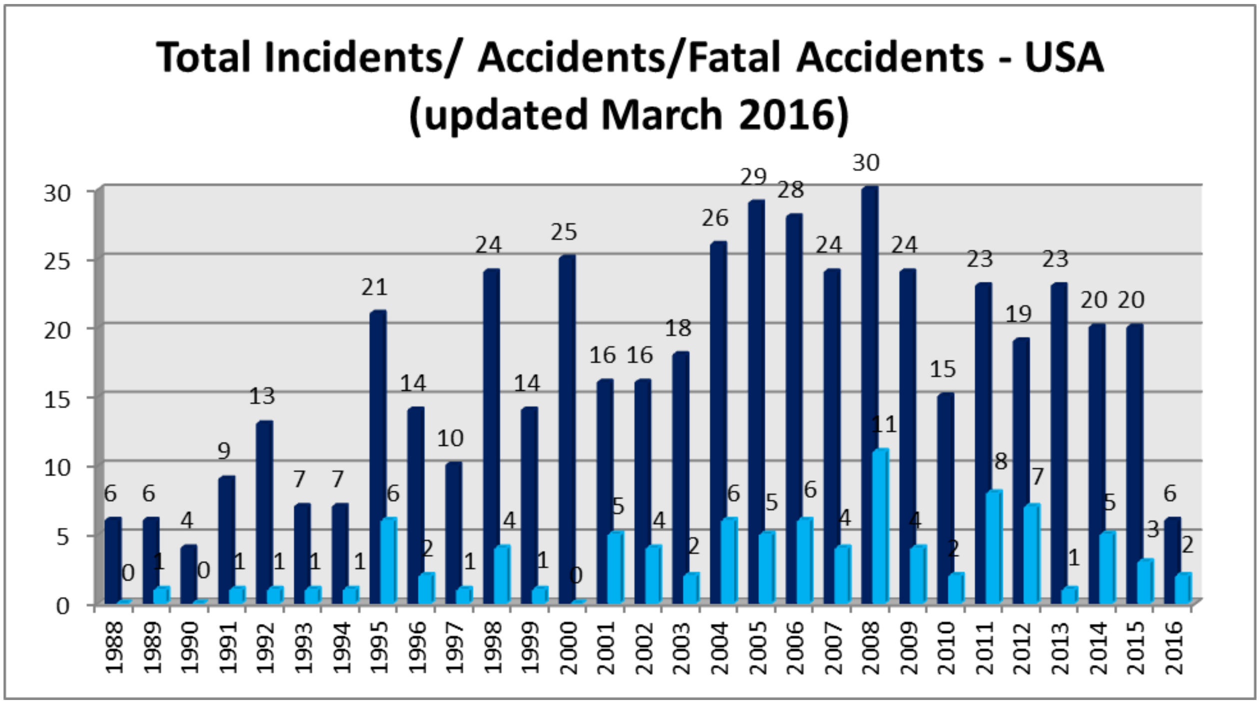


FIGURE 4

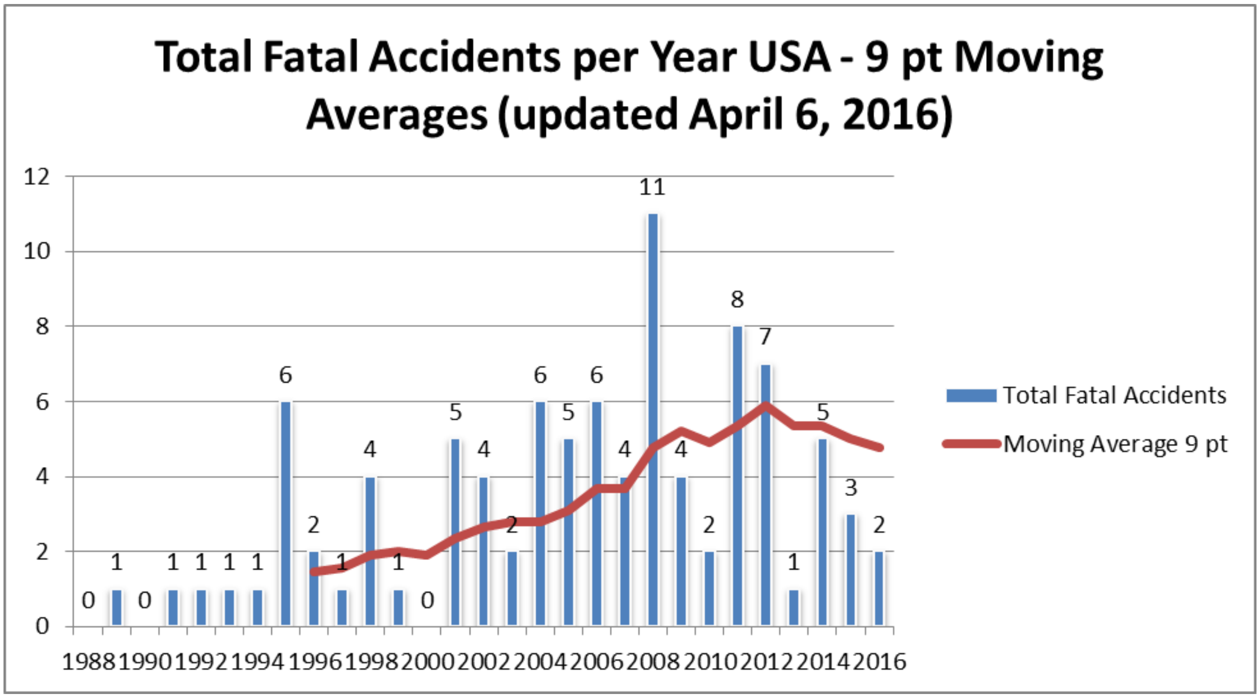


FIGURE 5

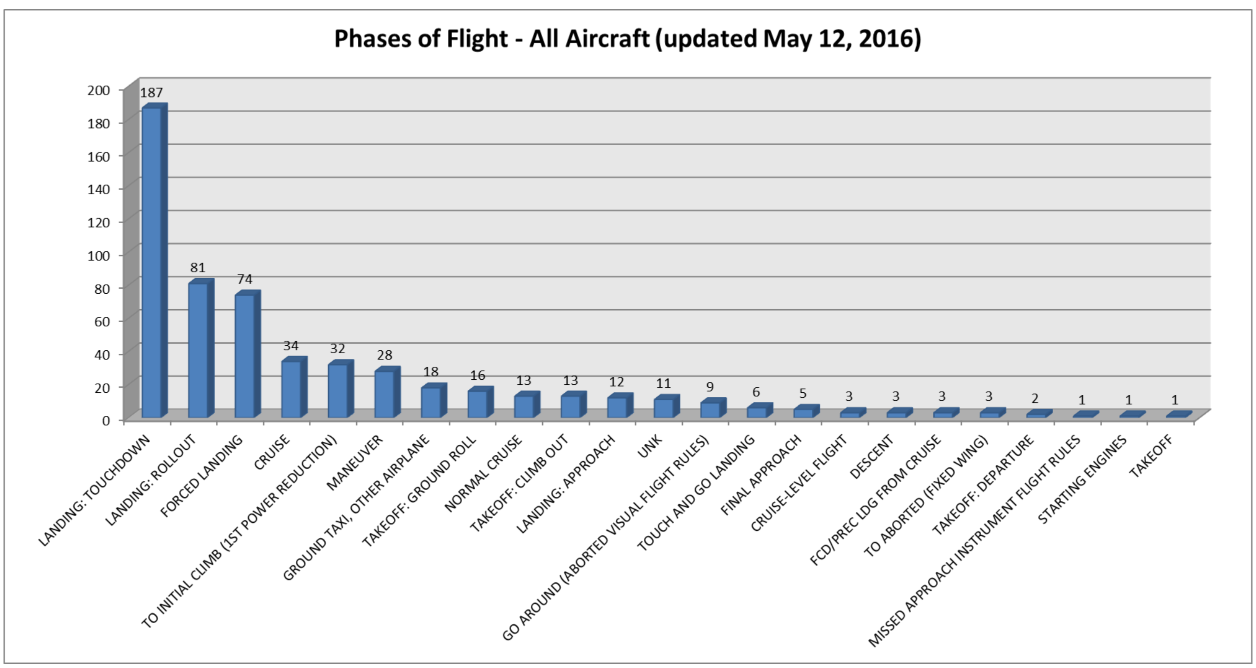


FIGURE 6

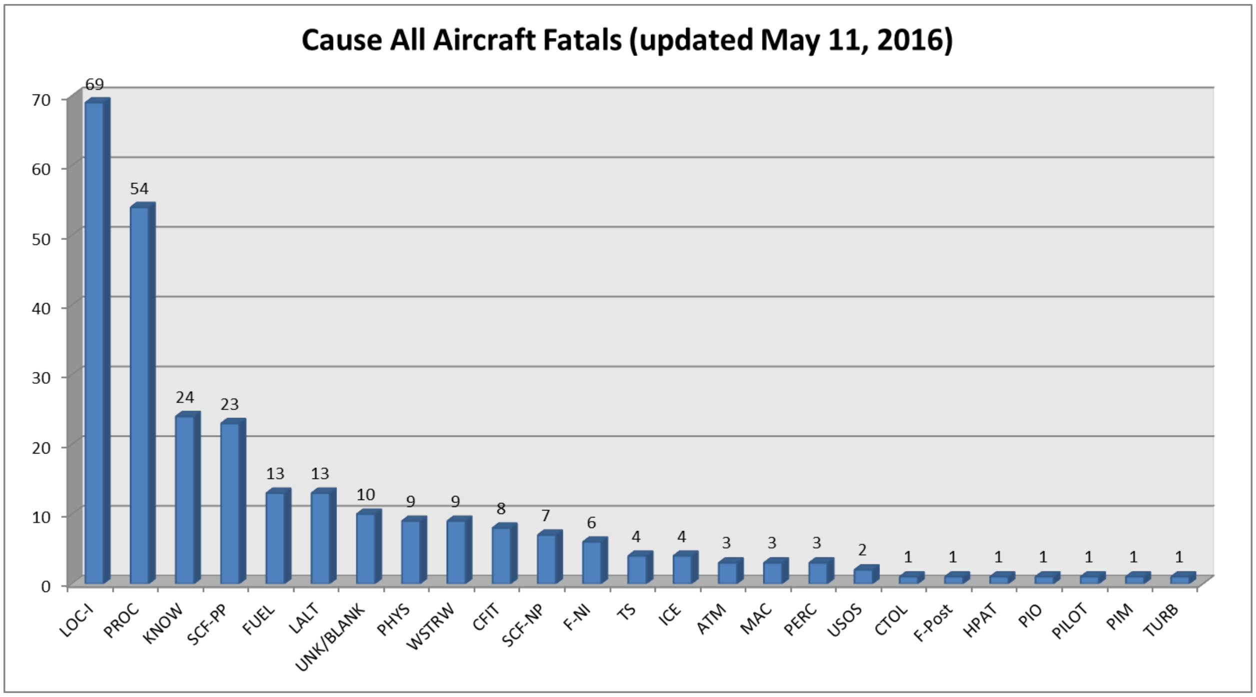


FIGURE 7

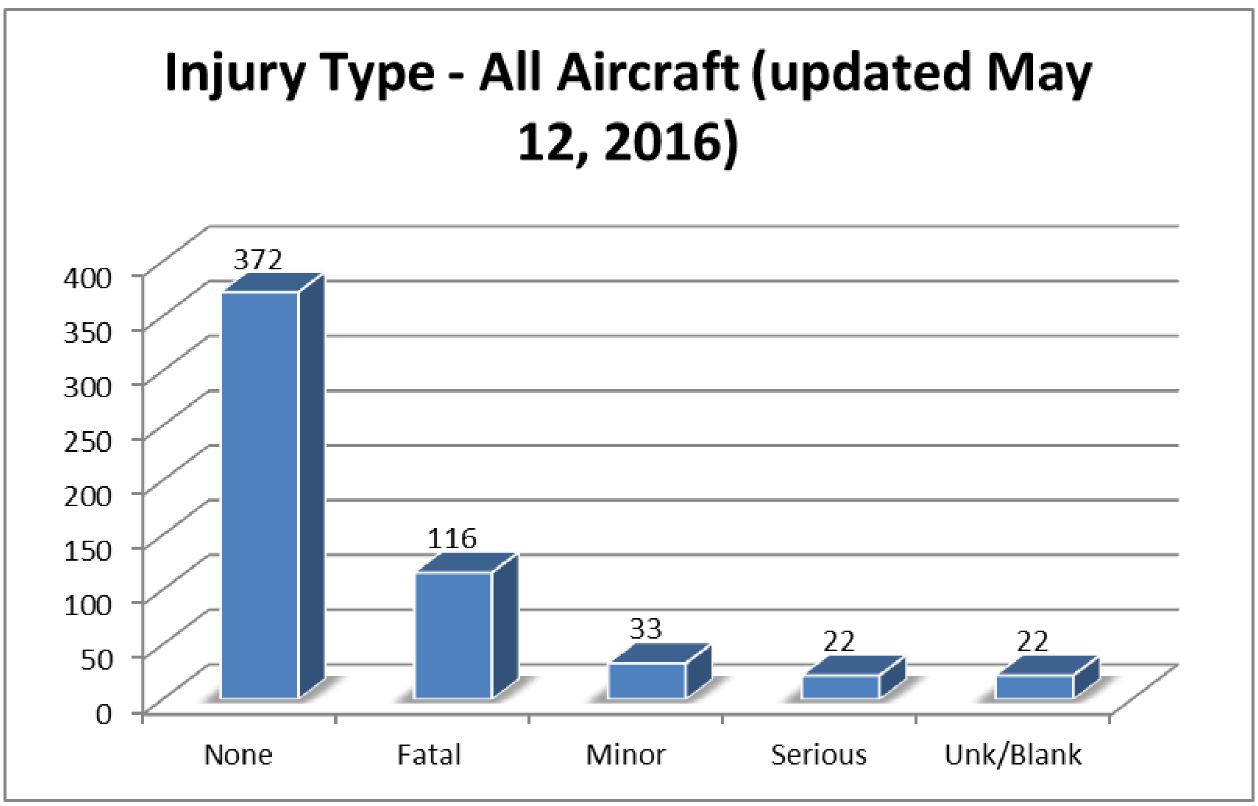


FIGURE 8

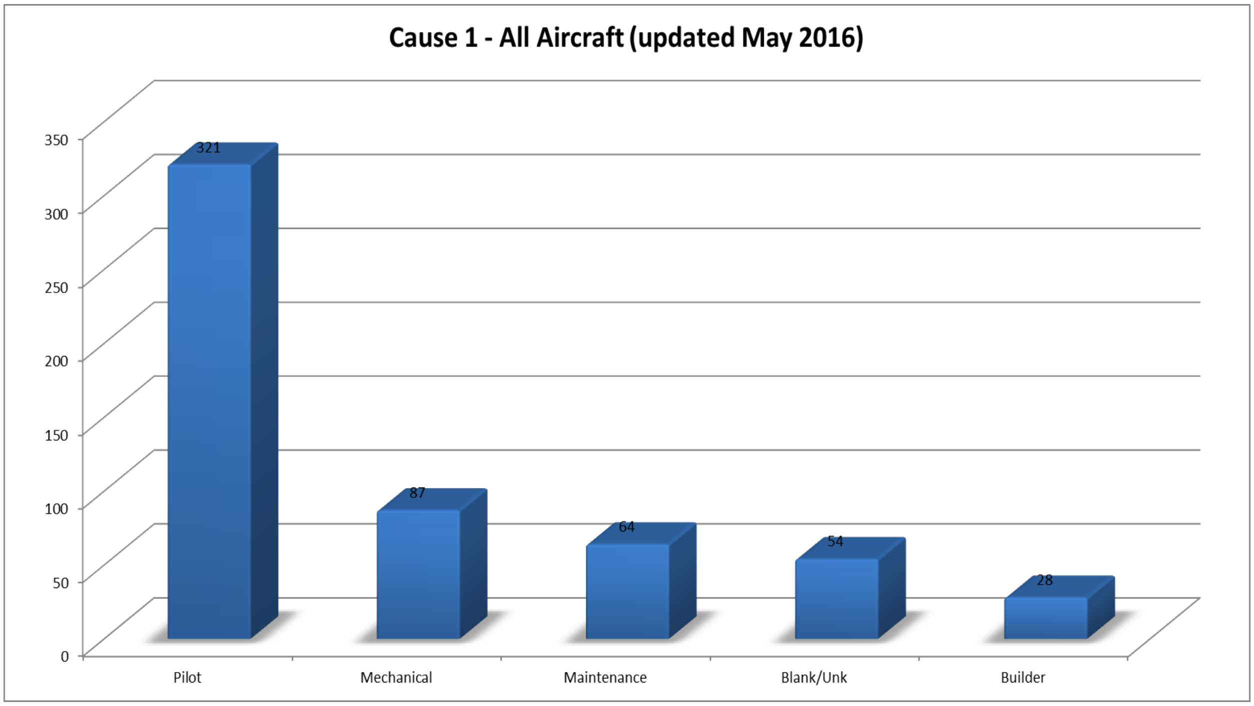


FIGURE 9

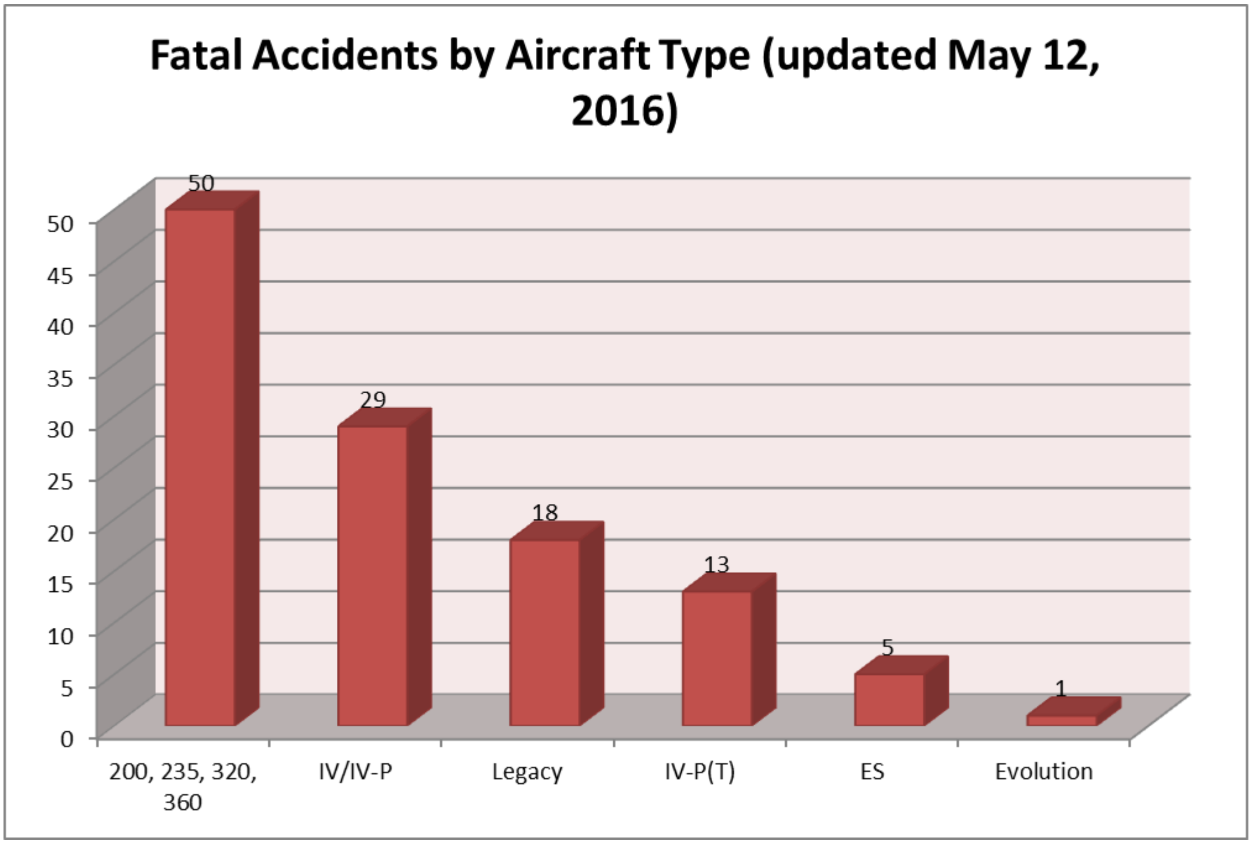
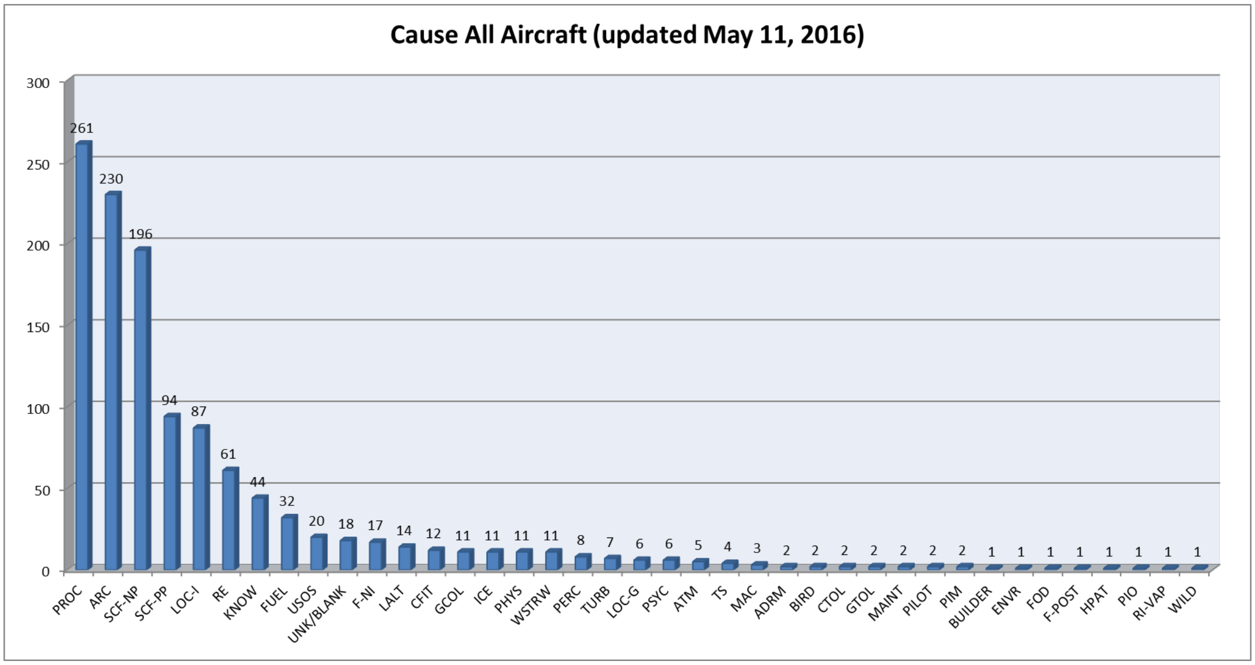


FIGURE 10



Cause All Aircraft (updated May 11, 2016)
300
250
200
150
100
50
0
261
230
196
94
87
61
44
32
20
18
17
14
12
11
11
11
11
8
7
6
6
5
4
3
2
2
2
2
2
2
2
1
1
1
1
1
1
1
1
PROC
ARC
SCF-NP
SCF-PP
LOC-I
RE
KNOW
FUEL
USOS
UNK/BLANK
F-NI
LALT
CFIT
GCOL
ICE
PHYS
WSTRW
PERC
TURB
LOC-G
PSYC
ATM
TS
MAC
ADRM
BIRD
CTOL
GTOL
MAINT
PILOT
PIM
BUILDER
ENVR
FOD
F-POST
HPAT
PIO
RI-VAP
WILD

FIGURE 11

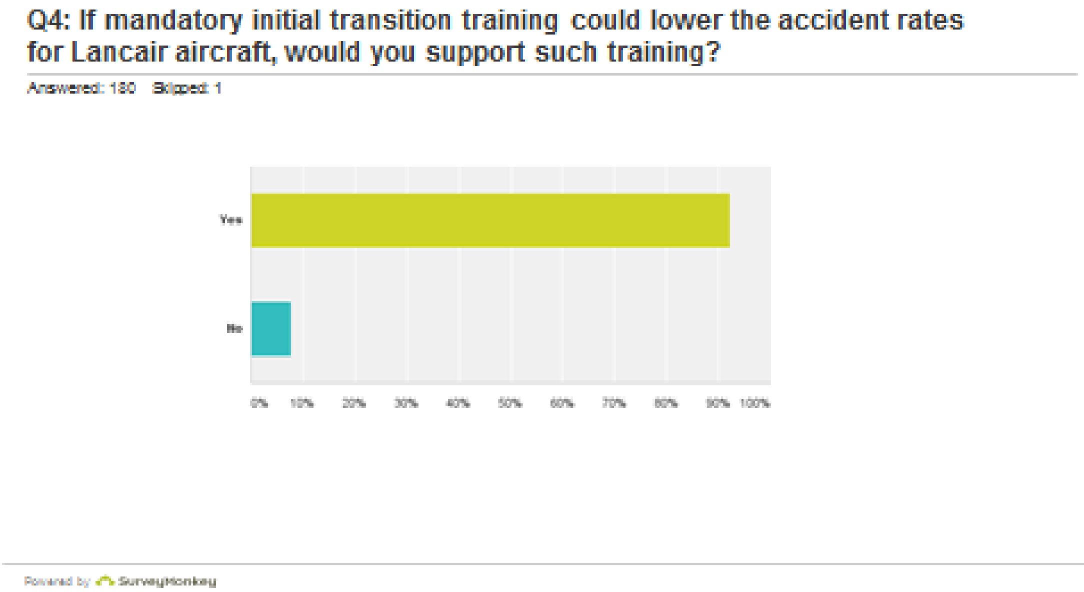


FIGURE 12

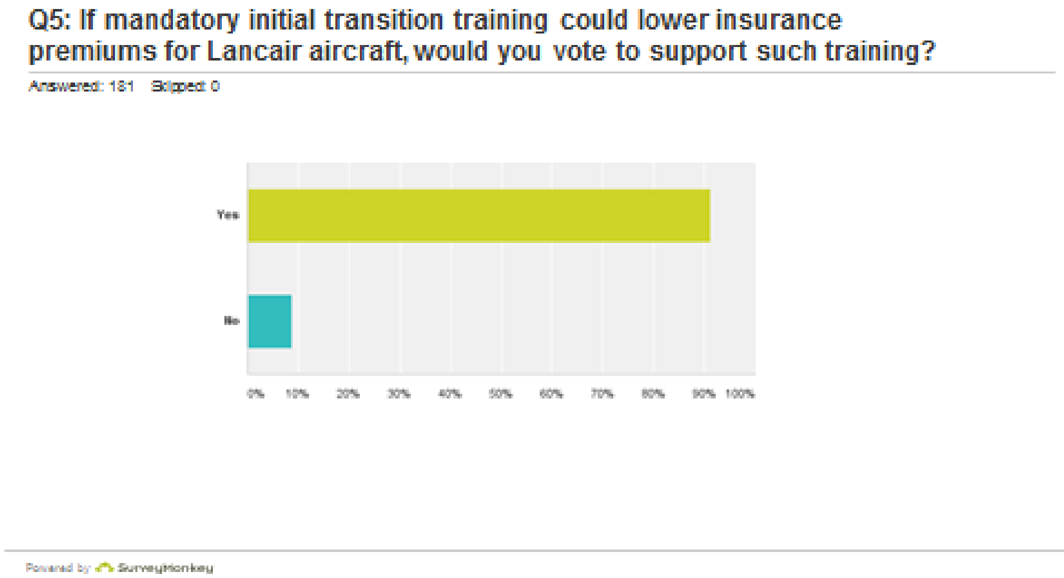


FIGURE 13

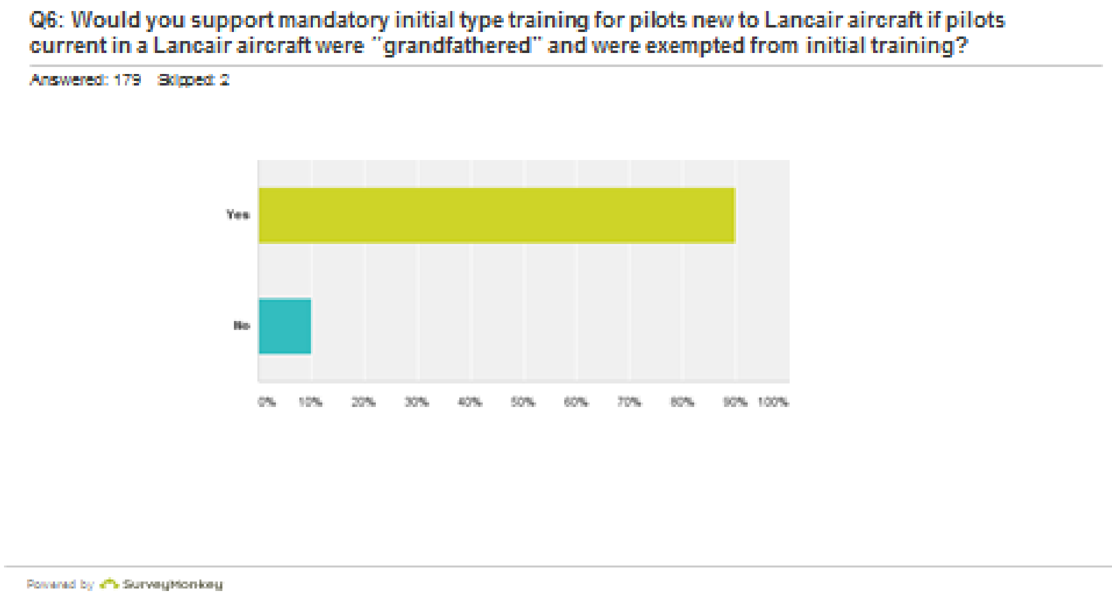


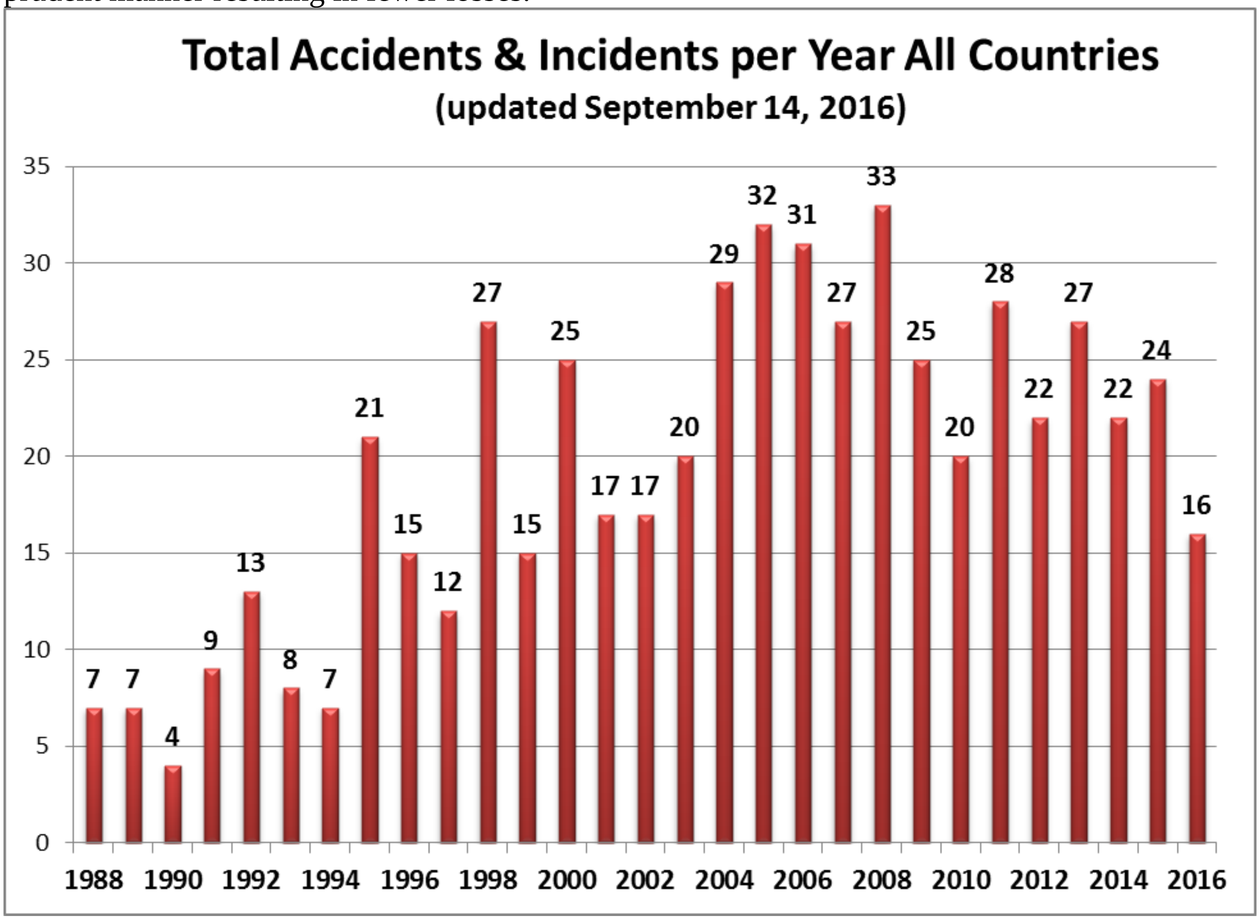
FIGURE 14

References

NTSB. (2010). *The safety of experimental amateur-built aircraft.* Washington, DC: National Transportation Safety Board.

NTSB. (2010b). *Introduction of glass cockpit avionics into light aircraft.* Washington, DC: National Transportation Safety Board.

There are approximately 550 reported Lancair accidents and incidents in the LOBO maintained database. The first fatal accident in a Lancair occurred at Fond Du Lac, WI on August 1,1989 during Airventure and involved a fatal stall/ spin accident during a base turn to final. Since the first accident involving a Lancair, Lancair accident numbers every year have been trending up. The accidents peaked in 2008 with 18 serious accidents and 19 fatalities. LOBO was formed in the fall of 2008 to reverse this trend. 2009 saw a downward trend with seven serious accidents involving five fatalities. LOBO accident statistics follow other type club statistics, like Cirrus Owners and Pilots Association, where association members generally operate aircraft in a more prudent manner resulting in fewer losses.



LOBO has been working vigorously to reduce the Lancair accident rate. LOBO's efforts will be discussed elsewhere in this paper.

In 1999, the AOPA stated, "AOPA Air Safety Foundation studies have shown that low time in type is often a contributing factor in accidents. Transitioning to a new aircraft, even one that is simpler than the one the pilot usually flies, can cause problems even for experienced pilots." (2000 NALL Report: General Aviation Accidents Trends and Factors for 1999, AOPA Air Safety Foundation) This is true for pilots transitioning to the Lancair.

LOBO is committed to reducing the Lancair accident rate. Encouraged by EAA's Earl Lawrence, five Lancair owners formed LOBO in October 2008. It was no coincidence that LOBO was

formed during the worst year for Lancair accidents. Type clubs work—people who belong to type clubs have a significantly lower accident rate than non members.
LOBO encourages and fosters responsible flying through its newsletters, social events, bylaws, website and training events. LOBO wrote a FITS-endorsed training syllabus and had it approved by the insurance industry. LOBO members and non members can seek flight training from LOBO endorsed flight instructors who have completed LOBO's standardization and evaluation training program. Pilots must complete the entire FITS syllabus to receive a graduation certificate.--NO EXCEPTIONS. LOBO is committed to raising the bar.

In addition to flight training, LOBO has been educating Lancair owners with respect to maintenance of their aircraft. The goal is to raise the level of knowledge of Lancair maintenance requirements and reduce EXP-AB maintenance related accidents.

Loss Of Control (Stall/ Spin)

Over half of all Lancair accidents involved a "Loss of Control". Some of these involved pilots stalling the aircraft in the pattern or at low altitude. Some have involved pilots who are involved in buzzing homes or airports. Some have involved pilots who failed to complete departure checklists and lost control after a canopy came open. Other cases involved loss of control after continuation into deteriorating weather. Improvements can be made in this area with emphasis from the beginning on improved training focusing on high angle of attack training, aircraft control and sound decision making. Skills that barely met PTS standards on the day of the private pilot checkride can be improved with good training.

There have been 73 loss of control accidents involving Lancair aircraft since 1989. Loss of Control (LOC) as defined by LOBO involves an accident whose cause can be attributed in part to the pilot's inability to properly control the aircraft. The pilot stops flying the airplane and the airplane starts flying the pilot. This can be a classic stall or spin, a runway excursion, etc. The aircraft involved in the LOC accidents have been all Lancair models except Sentry and Evolution.

Twenty five of those accidents involve a classic stall/ spin either as a primary cause 1 or secondary cause 2-5. Eleven of those accidents involved a Lancair IV series aircraft. Six IV series LOC accidents the LOC was the primary event. Five IV series accidents involved an initiating event (loss of power, thunderstorm penetration, etc.) before control was lost. One involved wake turbulence encounter on takeoff, one involved a fuel starvation and one involved a thunderstorm penetration and loss of control. Two of the stall spin accidents have occurred with flight instructors aboard giving stall training. Three of the accidents involved flight testing in Phase I.

Weather related loss of control statistics shows that thunderstorm penetration by Legacy and IVP pilots leads the list. Five additional losses due to ifr or vfr into imc by pilots unprepared to fly on instruments make up the majority of the remaining weather related accidents. One particular egregious case ES case involved an owner pilot and his pilot friend who filed an instrument flight plan even though neither pilot held an instrument rating. In spite of multiple weather briefs they departed into known icing conditions and crashed within thirty minutes of departure killing all three aboard. Obviously better aeronautical decision making training is necessary and the

LOBO FITS syllabus emphasizes ADM and risk management.

Most Lancair aircraft do not have any stall strips to give a solid aerodynamic buffet pre-stall or encourage a Part 23 type stall response. Many later vintage Lancair aircraft are equipped with EFIS like Chelton that have internal “bitchin Betty” stall warning systems or the Proprietary Systems AOA system.

The calibration of the stall warning systems is important for proper function on the aircraft. The Evolution, if it is equipped with stall strips is most likely 14 CFR 23.49 and 14 CFR 23.201, 203 and 207 compliant for stall and stall recovery—if not, it can be a real bad ride. The Lancair IV series aircraft does not appear to have a significant risk of stall accidents once the other factors are understood.

Aeronautical Decision Making

Aircraft accidents are rarely caused by a single factor or event. Instead it is often a series of factors, events, and circumstances that combine to cause an aircraft accident. These events are arranged in a hierarchy with each level influencing the next level. Specifically breakdowns in supervision lead to preconditions which in turn create an environment conducive to a person committing unsafe and/or inappropriate acts. Aeronautical Decision Making for Student and Private Pilots, FAA,1987 is a manual written by the DOT/FAA to "explain the risks associated with Student and Private pilot flying" However, the risks associated at any level of general aviation are similar. All pilots are susceptible to decisional errors that contribute to the cause(s) of aircraft accidents. Nine of the ten accident causes are ascribed to poor decision making by pilots. Aircraft accidents are rarely caused by a single factor or event. Instead it is a series of factors, events, and circumstances that combine to cause an aircraft accident. These events are arranged in a hierarchy with each level influencing the next level. Specifically breakdowns in supervision lead to preconditions which in turn create an environment conducive to a person committing unsafe and/or inappropriate acts. Lancair accident pilots have demonstrated poor aeronautical decision making and the LOBO FITS training syllabus emphasizes development of good aeronautical decision making skills.

For example, pilots travelling to and from Oshkosh, Wisconsin for the Airventure, as a general population, tend to suffer from get-there-itis (also referred to as Get-home-itis). The Pilot's Handbook of Aeronautical Knowledge describes Get-there-itis as a "disposition [that] impairs pilot judgment through a fixation on the original goal or destination, combined with a disregard for any alternative course of action." (p. 16-9) Lancair pilots are not immune to this type of fixation on getting there or getting home. Three fatal Legacy accidents involved low time pilots flying to or leaving from Sun N Fun or Oshkosh. All three involved significant poor aeronautical decision making by the PIC. One pilot in particular was counseled by others to get his ailing engine fixed before departing Airventure for home. Unfortunately over Madison, Wisconsin his engine finally failed; he flew a poor emergency approach and hit a light pole on a city street killing himself.

The High-Altitude Flight Environment

The FAA dictates, in many respects, the flight training requirements that pilots must successfully meet. From the time you first start as a student pilot up through the captains that fly for the airlines, the FAA determines what you must learn, as a minimum, to operate an aircraft. The material in this manual reflects compliance with the FAA requirements. For example, the FAA requires that pilots operating aircraft capable of flying above FL250 receive special training on high altitude flight. The following information is reprinted from AC 61-107A and contains that training.

FAR PART 61.31 says

“(f) *Additional training required for operating high-performance airplanes.*

(1) Except as provided in paragraph (f)(2) of this section, no person may act as pilot in command of a high-performance airplane (an airplane with an engine of more than 200 horsepower), unless the person has ---

(i) Received and logged ground and flight training from an authorized instructor in a high-performance airplane, or in a flight simulator or flight training device that is representative of a high-performance airplane, and has been found proficient in the operation and systems of the airplane; and

(ii) Received a one-time endorsement in the pilot's logbook from an authorized instructor who certifies the person is proficient to operate a high performance airplane.

(2) The training and endorsement required by paragraph (f)(1) of this section is not required if the person has logged flight time as pilot in command of a high-performance airplane, or in a flight simulator prior to August 4, 1997."

"(g) *Additional training required for operating pressurized aircraft capable of operating at high altitudes.*

(1) Except as provided in paragraph (g)(3) of this section, no person may act as pilot in command of a pressurized aircraft (an aircraft that has a service ceiling or maximum operating altitude, whichever is lower, above 25,000 feet MSL), unless that person has received and logged ground training from an authorized instructor and obtained an endorsement in the person's logbook or training record from an authorized instructor who certifies the person has satisfactorily accomplished the ground training. The ground training must include at least the following subjects:

(i) High-altitude aerodynamics and meteorology;
(ii) Respiration;
(iii) Effects symptoms and causes of hypoxia and any other high-altitude sickness;
(Evolution) Duration of consciousness without supplemental oxygen;
(v) Effects of prolonged usage of supplemental oxygen;
(vi) Causes and effects of gas expansion and gas bubble formation;
(vii) Preventative measures for elimination gas expansion, gas bubble formation, and high-altitude sickness;
(viii) Physical phenomena and incidents of decompression; and
(xi) Any other physiological aspects of high-altitude flight

(2) Except as provided in paragraph (g)(3) of this section, no person may act as pilot in command of a pressurized aircraft unless that person has received and logged training from an authorized instructor in a pressurized aircraft, or in a flight simulator or flight training device that is representative of a pressurized aircraft, and obtained an endorsement in the person's logbook or training record from an authorized instructor in a pressurized aircraft, or in a flight simulator or flight training device that is representative of a pressurized aircraft, and obtained an endorsement in the person's logbook or training record from an authorized instructor who found the person proficient in the operation of a pressurized aircraft. The flight training must include at least the following subjects:

(i) Normal cruise flight operations while operating above 25,000 feet MSL;
(ii) Proper emergency procedures for simulated rapid decompression without actually depressurizing the aircraft; and
(iii) Emergency descent procedures.

(3) The training and endorsement required by paragraphs (g)(1) and (g)(2) of this section are not required if that person can document satisfactory accomplishment of any of the following in

a pressurized aircraft, or in a flight simulator or flight training device that is representative of a pressurized aircraft:

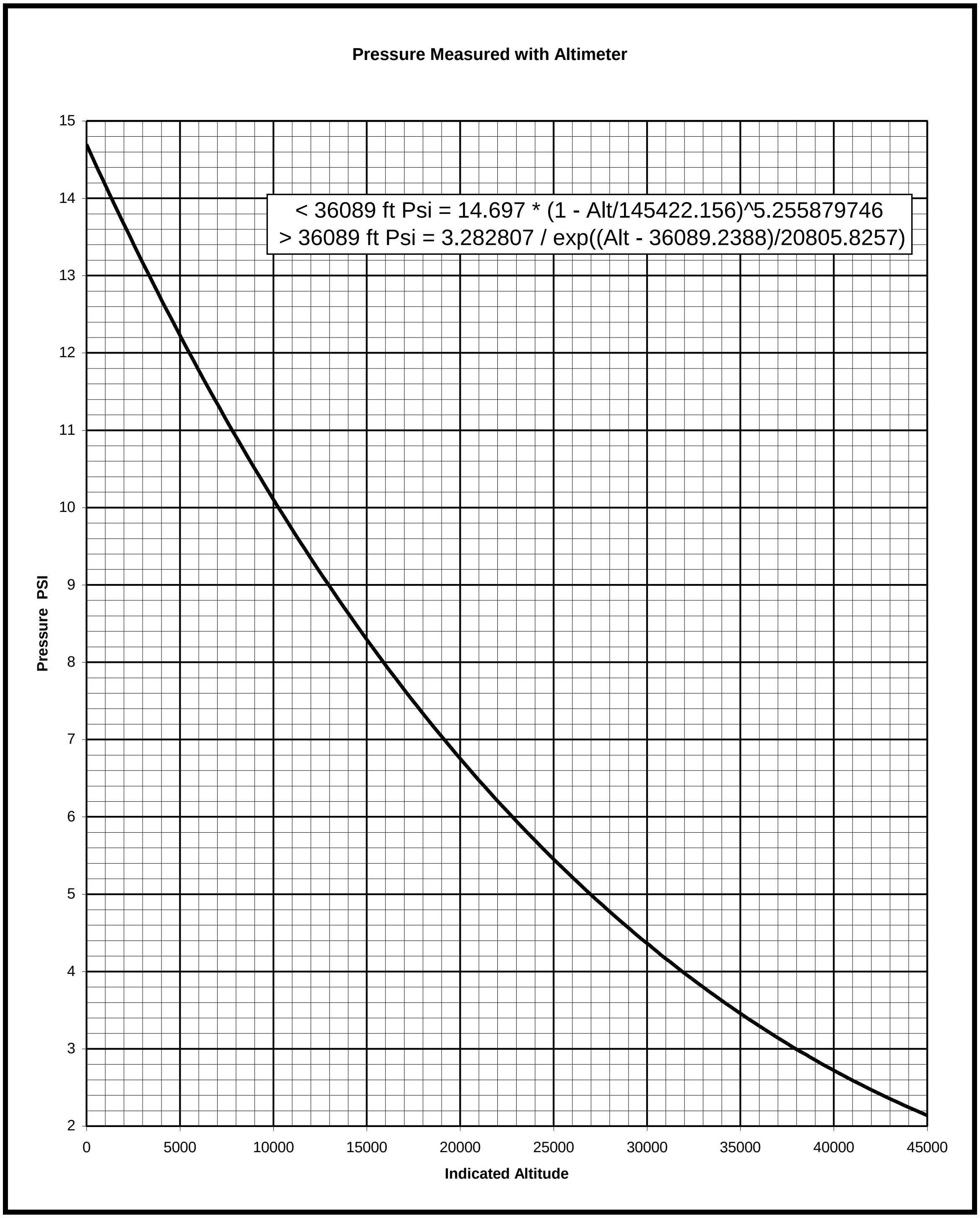
(i) Serving as pilot in command before April 15, 1991;
(ii) Completing a pilot proficiency check for a pilot certificate or rating before April 15, 1991;
(iii) Completing an official pilot-in-command check conducted by the military services of the United States; or
Completing a pilot-in-command proficiency check under Part 121, 125, or 135 of this chapter conducted by the Administrator or by an approved pilot check airman."

Physiology

Operating the pressurized Evolution at FL240 at 6 psid will put the cabin above 8000 feet. There is no need to use an oxygen mask under normal circumstances at this cabin altitude, but there is always the possibility that circumstances would arise that would put our cabin up to our flight level. It is for that circumstance that we must prepare.

IVP Dorr Window Failure

N846PM Evo Windshield Loss at FL250 NTSB report #WPR17LA104



The physiology of human oxygen requirements is well known and documented. It has almost nothing to do with your physical condition or "toughness". The numbers used in this manual apply to a healthy non-smoker in good physical condition, except where noted. Human oxygen requirements have no "macho" factor. Modern oxygen equipment is comfortable and relatively inexpensive. If flying a pressurized EVOLUTION, consult oxygen equipment manufacturers and purchase equipment that will provide adequate volume for the descent to 10,000 feet. Check that equipment before departure.

As part of its charter to promote aviation safety, the FAA conducts regular courses in high-altitude physiology (with altitude chamber) at FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City.

This course meets the requirements for the physiological portion of FAR 61.31 (g)(1) ground instruction. Flight, or approved simulation training is also required for section (g)(2).

CAMI's course is given twice a week. A nearly identical program is conducted at some military bases. All you need do to qualify is have a current medical, be free from nasal congestion or ear blockages and be clean shaven at the time of the chamber ride. CAMI's Airman Education Programs obtains a list of training dates from each base that are available to anyone interested in the training. These dates can be accessed by calling 405-954-4837.

Remember the basic gas laws: Boyle's, Henry's, Charles's, Dalton's? It's a dangerous misconception that pilots of low-performance, non-pressurized GA aircraft needn't worry much about gas problems. They explained that gas maladies manifest themselves in two forms: trapped gas and evolved gas.

Trapped gas can be an unforgettable lesson in Boyle's Law at work. Simply stated, air trapped in body cavities such as the middle ear, sinuses, stomach and even teeth expands as pressure decreases with altitude. At the least, this can cause mild bloated feeling. At worst, it can result in debilitating pain.

Evolved gas phenomenon is the tendency of gas dissolved in the blood to come out of solution at higher altitudes and is usually more threatening than trapped gas. Most of us are familiar with the bends – the result of nitrogen bubbling out of the blood of a diver who surfaces quickly without decompression stops. Pilots are susceptible too. Bends can occur at altitudes as low as 12,000 feet. Lesser known evolved gas problems include Central Nervous System Disturbances (CNS), paresthesia and the chokes. CNS is probably the most serious evolved gas problem with symptoms ranging from lines or spots before the eyes to sensory disturbances and partial paralysis. Paresthesia is tingling or cold and warm sensations caused by local nitrogen bubbling. The chokes result when smaller pulmonary blood vessels are blocked by bubbles, causing a stabbing pain in the chest that's often accompanied by intense coughing or the sensation of suffocation.

A chamber ride will teach us to recognize our own hypoxic symptoms. You may think that hypoxia is just hypoxia, but there are in fact four varieties: hypoxic hypoxia, histotoxic hypoxia, hypemic hypoxia and stagnant hypoxia.

Hypoxic hypoxia occurs when there's just not enough oxygen available, such as from flying at high altitudes. Histotoxic hypoxia is caused by the body being unable to absorb oxygen at the tissue level. It's generally the result of alcohol or drug consumption. When the heater cuff burns through (not in a EVOLUTION-P of course), you're likely to suffer hypemic hypoxia. Even at low-altitude, where there's otherwise plenty of oxygen, carbon monoxide will prevent the blood from absorbing it. Stagnant hypoxia is what happens when G-loads pool the blood in areas away form the brain. Supplemental oxygen probably won't help.

CAMI's lecture on basic gas laws and hypoxic physiology reviews some of what you already know (or thought you did) but it introduces some new material too. The lasting lesson relates to the onset of hypoxia itself. When you truly experience hypoxia under controlled conditions, you realize how little you really understand it. Further, you know that being relatively resistant to hypoxia is more of a dangerous handicap than being highly susceptible to it. The chamber ride will cure you of your tendency to remain off oxygen until the onset of symptoms.

Finally, the oxygen paradox event makes you less inclined to experiment with hypoxia in an airplane. You will consider yourself an oxygen wimp. Given the alternatives, that's not a bad way to be. Consider the affects of hypoxia given below.

Hypoxia's effects

The earth's atmosphere by volume is approximately 21 percent oxygen and 79 percent nitrogen. There are other gases in the atmosphere, but only in trace amounts. So, for the purposes of understanding hypoxia, those two percentages are adequate.

Wherever you are in the earth's atmosphere, those proportions remain unchanged. In dry air, the ambient pressure is always 21 percent due to oxygen and 79 percent due to nitrogen. At sea level, the atmospheric pressure on a standard day in dry air is equivalent to a column of mercury 760 mm high. If the air is dry, the ambient oxygen (partial) pressure is 160 mm. The ambient nitrogen pressure is 600 mm. Again, that is at sea level on a dry day.

When that air is inhaled, it passes through the trachea where it is fully saturated with water to prevent damage to delicate lung tissues. This water vapor is another gas, which exerts its own partial pressure, alternating the arithmetic:

Ambient air (S.L.): 760 mm
Water vapor partial pressure: -47 mm
Tracheal air pressure: 713 mm

Once the tracheal air is saturated with water vapor, oxygen and nitrogen together are only responsible for 713 mm of partial pressure. Twenty-one percent of 713 mm equals 150 mm of oxygen pressure in the trachea. At sea level on a standard day in dry air, yours lungs receive oxygen at 150 mm of partial pressure.

In the lungs, oxygen diffuses through the permeable membranes of the alveoli into the red corpuscles, flowing through the blood capillaries at a rate roughly proportional to that partial pressure. Predictably, when oxygen partial pressure drops sufficiently, blood saturation also falls. And although partial pressure and saturation do not change at the same rate, the correlation is close enough for the purposes of this discussion.

Naturally, any increase in altitude above sea level involves a reduction of total pressure and concomitant reduction in the oxygen partial pressure in the lungs. When partial pressure in the lungs falls, so does your blood saturation – with very predictable results.

The problem with hypoxia is its subtlety. Hypoxia is an insidious, virtually undetectable condition in which you progressively lapse into unconsciousness while retaining absolute faith in your ability. If you have not experienced hypoxia in the controlled environment of an altitude chamber, you **must** assume that you will **NOT** recognize its effects in yourself, even to the point of unconsciousness.

In order to put all this in perspective; consider the hypoxic effects of altitude on a normal, healthy pilot at particular, benchmark altitudes. And don't miss the elementary but important fact that all altitudes are above sea level.

5,000 Feet: Total atmospheric pressure is down to 632.3 mm Hg (inches of mercury), with an oxygen partial pressure to the lungs of approximately 122 mm. This reduced partial pressure cannot fully saturate the blood corpuscles, which, in turn cannot supply all the oxygen the body tissues would like. Most of those body parts will continue to function normally at this level of 93 percent blood saturation with one notable exception. The retina of the eye demands more oxygen than any other organ. At 93 percent saturation, this little extension of the brain will begin to function somewhat below maximum, so night vision may be diminished. During night flight at 5,000 feet or above, pay close attention to instrument readings and maps as well as to ground details, because your vision may be slightly impaired.
10,000 Feet: Total atmospheric pressure is down to 523 mm H, about 70 percent of the sea-level pressure. Oxygen partial pressure to the lungs is about 100 mm, enough to produce only 90 percent saturation of the blood. Ninety percent saturation is the absolute minimum the brain can tolerate in a normal, healthy person. This is the highest altitude at which you can trust your own judgment, even though our discrimination will be somewhat impaired. Operate at this altitude with care and caution. Short durations of an hour or less are well tolerated, but longer periods of several hours at or above this altitude can produce significant effects, especially at night.
14,000 Feet: Your blood saturation will be down to 84 percent. If you continue at this height for any period of time you will become appreciably handicapped. Your vision will dim. Your hands may shake, and your thought, memory, and judgment will be seriously degraded. An objective observer likely would notice some or all of these symptoms after one or two hours at this altitude, but you would feel just fine, possibly better than normal due to the euphoric effects of oxygen deprivation.
16,000 Feet: This level is particularly meaningful to pilots in the western United States because it is close to the MEA across several areas of mountainous terrain. Operations at 16,000 feet without oxygen are dangerous because you will not notice your dramatic deterioration. Those who have survived such flights are living proof that the real impairment associated with this altitude is virtually undetectable by the victim. At 16,000 feet, your blood saturation is only 79 percent. You will be considerably handicapped. Depending on your temperament and other personal traits, you will be disoriented, belligerent, euphoric, or all three. ***Your judgment will be decidedly unreliable. This level of hypoxia is similar to serious intoxication***.

18,000 Feet: Here the oxygen partial pressure to the lungs is a mere 70 mm H, and the blood saturation is approximately 70 percent. At this altitude, without supplemental oxygen, you will be seriously impaired and incapable of functioning in any useful manner for more than a few minutes. You are likely to feel confident, comfortable and happy due to the euphoric response of oxygen deprivation***. Your time of useful consciousness (TUC) is about 30 minutes.*** After that, you will simply pass out.
20,000 Feet: If your altimeter shows 20,000 feet and you're not using supplemental oxygen, you probably won't ever see it. At this altitude, you are in the brink of collapse, if you're not already unconscious. Although extremely rare, there are documented instances of death from hypoxia at this altitude. ***TUC is 5 to 15 minutes.***
25,000 Feet: Due to complex physiological factors, blood saturation falls very rapidly above 22,000 feet. At 25,000 feet, your blood will have only a 37 percent load of oxygen, ***and you will be unconscious in 3 to 6 minutes***. During one air carrier decompression at 23,000 feet, the flight attendants had great difficulty even plugging their oxygen mass to the walk around bottles after only one to two minutes of exposure.
Above 25,000 Feet: Your TUC drops rapidly. ***At 30,000 feet, it is a mere two minutes.*** At 35,000 feet, it is 60 seconds, and at about 37,000 feet, it drops to 20 seconds. Further, above 25,000 feet and with a sudden decompression, you may suffer from aeroembolism or "the bends", a condition caused by nitrogen bubbling out of the blood and tissues. Pain is detected first in the joints, then in the chest and abdomen and along nerve trunks. Only increased ambient pressure (lower altitude) can reverse the process. Supplemental oxygen has no effect on this decompression sickness, but it is important to sustain consciousness so that you can quickly descend to a lower altitude. The Lancair pilot SCUBA diving before pressurized flight is particularly vulnerable.
Consider the pilots of King Air N777AJ who experienced a cracked laminate in the pilot's (left) windshield on February 2, 2007. The pilot's turned off the cabin pressurization at FL 270 and then donned the O2 masks only to find there was no O2 flow. Both crewmembers passed out. The aircraft was not on the autopilot. The pilot regained consciousness at a lower altitude. The aircraft was overstressed during the event and lost most of its horizontal tail. Fortunately for the crew they were able to land safely at Cape Girardeau Regional Airport.

TABLE 1-1. TIMES OF USEFUL CONSCIOUSNESS AT VARIOUS ALTITUDES

	Standard Ascent Rate	After Rapid Decompression
Altitude (Feet)	Time	Time
18,000	20 to 30 minutes	10 to 15 minutes
22,000	10 minutes	5 minutes
25,000	3 to 5 minutes	1.5 to 3.5 minutes
28,000	2.5 to 3 minutes	1.25 to 1.5 minutes
30,000	1 to 2 minutes	30 to 60 seconds
35,000	30 to 60 seconds	15 to 30 seconds
40,000	15 to 20 seconds	7 to 10 seconds
43,000	9 to 12 seconds	5 seconds
50,000	9 to 12 seconds	5 seconds

Smoking, fatigue and depressants (alcohol and other depressant drugs) reduce the oxygen diffusion rate to the blood so higher partial pressures (lower altitudes) are necessary for any given saturation level. A fatigued smoker with small residuals of alcohol from the previous evening could require a 50 percent increase in partial pressures to attain a given level of saturation. In the worst case, this individual could be mildly hypoxic at sea level and completely dysfunctional at 10,000 feet.

Operation of the Lancair Evolution

Operating the pressurized EVOLUTION above 10,000 feet requires the pilot be aware that a gradual loss of cabin pressure may not be recognized, if reference to the cabin pressure indicator is not maintained. The first indication may be the “popping” of ears and/or gradual onset of hypoxia. Include the cabin pressure instruments in your scan pattern. Always check the instruments when your ears tell you of a pressure change.

If cabin pressure loss is gradual, after checking the pressurization controls in proper positions:

Don oxygen mask, check flow (100%) inform passengers.

Inform ATC of the problem and request lower altitude.

Make normal descent, consistent with descent rate and airspeed limitations.

Consider terrain and level off at 2,000’ AGL or 10,000 MSL whichever is higher

If cabin pressure loss is rapid:

Don oxygen mask – check flow (100%), inform passengers.

Auto pilot off.

Turn 90 degrees from airway course, if flying airways.

Set transponder to code 7700.

Reduce power to minimum.

Configure aircraft for maximum sink rate.

Consider aircraft structure. If sound:

(1) Increase pitch down until reaching maximum allowable airspeed.

If aircraft structure has sustained damage:

(1) Reduce speed to lowest practical speed.

(2) Lower flaps and gear for low speed and high sink rate.

Physiology Quiz:

The time of useful consciousness (TUC) for a person is dependent on?
Smoking, fatigue and depressants usage
Cabin altitude, decompression rate
Both A and B
At FL 280 our cabin altitude in a Lancair EVOLUTION will be?
12,000’
8,000’
9,000’
We should test our O2 standby system for servicing and operation?
When we reach cruising altitude
On preflight
During the condition inspection
If we have a cabin decompression we should?
Advise ATC and wait for clearance to descend, set autopilot for descent, don O2 mask
Don O2 mask, check O2 flow “on”, declare an emergency with ATC, descend to lower altitude, check passengers
Declare emergency, descend to lower altitude, check O2 mask “on”
The Lancair EVOLUTION cabin pressure differential is?
4.5 psid
5 psi
6 psid

Weather

Pilots should be aware of and recognize the meteorological phenomena associated with high altitudes and the effects these phenomena have on flights. The following is reprinted from FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AND/OR MACH NUMBERS (MMO) GREATER THAN .75

A. The Atmosphere

The atmosphere is a mixture of gases in constant motion. It is composed of approximately 78% nitrogen, 21% oxygen, and 1% other gases. Water vapor is constantly being absorbed and released in the atmosphere, which causes changes in the atmosphere, which causes changes in weather. The three levels of the atmosphere where high-altitude flight may occur are the troposphere, which can extend from sea level to approximately FL 350 around the poles and up to FL 650 around the equator; the tropopause, a thin layer at the top of the troposphere that traps water vapor in its lower level; and the stratosphere, which extends from the tropopause to approximately 22 miles. The stratosphere is characterized by lack of moisture and a constant temperature of -55C, while the temperature in the troposphere decreases at a rate of 2°C per 1,000 feet. Condensation trails, or contrails, are common in the upper levels of the troposphere and the stratosphere. These cloud-like streamers that are generated in the wake of aircraft flying in clear, cold, humid air, form by water vapor from aircraft exhaust gases being added to the atmosphere causing saturation and supersaturation of the air. Contrails can also form aerodynamically by the pressure reduction around airfoils, engine nacelles, and propellers, cooling the air to saturation.

B. Atmospheric Density

Atmospheric density in the troposphere decreases 50% at 18,000 feet. This means that at FL 180, a given volume of air contains only one-half the oxygen molecules that it does at sea level. Because the human body requires a certain amount of oxygen for survival, aircraft that fly at high altitudes must be equipped with some means of creating an artificial atmosphere, such as cabin pressurization.

C. Winds

(1) The jet stream is a narrow band of high-altitude winds, near or in the tropopause, that results from large temperature contrasts over a short distance (typically along fronts) creating large pressure gradients aloft. The jet stream usually travels in an easterly direction between 50 and 200 kts. The speed of the jet stream is greater in the winter than in the summer months because of greater temperature differences. It generally drops more rapidly on the polar side than on the equatorial side. In the mid-latitudes, the polar front jet stream is found in association with the polar front. This jet stream has a variable path, sometimes flowing almost due North and South.

(2) Because of its meandering path the polar front jet stream is not found on most circulation charts. One almost permanent jet is a westerly jet found over the subtropics at 25 latitude and about 8 miles above the surface. Low-pressure systems usually form to the South of the jet stream and move northward until they become occluded lows, which move North of the jet stream. Horizontal windshear and turbulence are frequently found on the northern side of the jet stream.

D. Clear Air Turbulence (CAT)

Clear Air Turbulence CAT is a meteorological phenomenon associated with high-altitude winds. This high-level turbulence occurs where no clouds are present and can take place at any altitude (normally above 15,000 feet AGL), although it usually develops in or near the jet stream where there is a rapid change in temperature. Clear Air Turbulence is generally stronger on the polar side of the jet and is greatest during the winter months. Clear Air Turbulence can be caused by windshear, convective currents, mountain waves, strong low pressures aloft, or other obstructions to normal win flow. Clear Air Turbulence is difficult to forecast because it gives no visual warning of its presence and winds can carry it far from its point of origin.

E. Clouds and Thunderstorms

(1) Cirrus and cirriform clouds are high-altitude clouds that are composed of ice crystals. Cirrus clouds are found in stable air above 30,000 feet in patches or narrow bands. Cirriform clouds, such as the white clouds in long bands against a blue background known as cirrostratus clouds, generally indicate some type of system below. Cirrostratus clouds form in stable air as a result of shallow convective currents and also may produce light turbulence. Clouds with extensive vertical development indicate a deep layer of unstable air and contain moderate to heavy turbulence with icing. The bases of these clouds are found at altitudes associated with low to middle clouds, but their tops can extend up to 60,000 feet or more.

(2) Cumulonimbus clouds are thunderstorm clouds that present a particularly severe hazard to pilots and must be circumnavigated. Hazards associated with cumulonimbus clouds include embedded thunderstorms, severe or extreme turbulence, lightning, icing, and dangerously strong winds and updrafts. Many Lancair accidents have occurred because of pilots venturing into thunderstorms. It is easier to avoid convective weather activity with today's datalink weather displays. It is highly recommended you fly with such a system. FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AND/OR MACH NUMBERS (MMO) GREATER THAN .75

Icing

Icing at high altitudes is not as common or extreme as it can be at low altitudes. When it does occur, the rate of accumulation at high altitudes is generally slower than at low altitudes. Rime ice is generally more common at high altitudes than clear ice, although clear ice is possible. Despite the composition of cirrus clouds, severe icing is generally not a problem although it can occur. It is more common in tops of tall cumulus buildup, anvils and over mountainous terrain. FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AND/OR MACH NUMBERS (MMO) GREATER THAN .75

Since most all Lancairs lack any deicing capabilities, flight into known icing conditions is not recommended. The Lancair pilot must always consider the possibility of icing, even in the summer when flying above the freezing level.

NASA recommended ice avoidance strategies:

- Stratus clouds icing usually found in mid to low level clouds below 15,000’.
- Vertical extent of icing layer usually does not exceed 3,000 feet
- Change altitude by at least 3000’
- Cumulus clouds may carry lots of moisture high aloft with large droplet sizes encountered.
- Icing usually found below FL 270 and at temps between +2C to -20C
- Navigate around cumulus clouds when at or below freezing level

http://aircrafticing.grc.nasa.gov/courses/inflight_icing/main.html

Weather quiz:

50% of the atmosphere is below what altitude?
5000’
10,000’
18,000’
You can avoid icing in stratiform clouds by climbing or descending
3000’
6000’
9000’
Thunderstorms contain:
Hail
Moderate to severe turbulence
Lightning
All the above
Ambient temperature decreases at what rate?
2 degrees F per 10,000’
3 degrees C per 1,000’
2 degrees C per 1,000’

FLIGHT PLANNING AND NAVIGATION

The following is reprinted from FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AN D/OR MACH NUMBERS (MMO) GREATER THAN .75

Flight Planning

Careful flight planning is critical to safe high-altitude flight.

Consideration must be given to power settings, particularly on takeoff, climb, and descent to assure operation in accordance with the manufacturer's recommendations. Fuel management, weather briefings, the freezing level, and icing may affect the flight. Direction of flight, airplane performance charts, high speed winds aloft, and oxygen duration charts must also be considered. When possible, additional oxygen should be provided to allow for emergency situations. Breathing rates increase under stress and extra oxygen could be necessary.

Flight planning should take into consideration factors associated with altitudes that will be transited while climbing to or descending from the high altitudes (e.g., airspeed limitations below 10,000 feet MSL, airspace and minimum altitudes). Westward flights should generally be made away from the jet stream to avoid the strong headwind, and eastward flights should be made in the jet stream when possible to increase groundspeed. Groundspeed checks are particularly important in high-altitude flight. If fuel runs low because of headwinds or poor flight planning, a decision to fly to an alternate airport should be made as early as possible to allow time to preplan descents and advises ATC.

Knowledge of Aircraft

Complete familiarity with the aircraft systems and limitations is extremely important. For example, many high-altitude airplanes like the Evolution feed from only one fuel tank at a time. If this is the case, it is important to know the fuel consumption rate to know when to change tanks. This knowledge should be made part of the preflight planning and it's accurately confirmed regularly during the flight.

Descent Planning

Gradual descents from high altitudes should be planned in advance to prevent excessive engine cooling and provide for passenger comfort. The manufacturer's recommendations found in the Airplane Flight Manual should be complied with, especially regarding descent power settings to avoid stress on the engine. ATC does not always take aircraft type into consideration when issuing descent instructions. It is the pilot's responsibility to fly the airplane in the safest manner possible. Cabin rates of descent are particularly important and should generally not exceed 500 to 600 feet per minute. Before landing, cabin pressure should be equal to ambient pressure or inner ear injury can result. If delays occur enroute, descents should be adjusted accordingly.

Weather Charts

Before beginning a high-altitude flight, all weather charts should be consulted, including those designed for low levels. Although high-altitude flight may allow a pilot to overfly adverse weather, sometimes a low altitude visual path can be safer than high altitude in IFR conditions with imbedded thunderstorms. (My favorite weather site is (http://adds.awc-kc.noaa.gov/))

Wind shear

Wind shear is indicated by dashed lines on Tropopause Height Vertical Windshear charts. Horizontal wind changes of 40 knots within 150 NM, or vertical windshear of 6 knots or greater per 1,000 feet usually indicate moderate to severe turbulence and should be avoided. Pilot reports (PIREPs) are one of the best methods of receiving timely and accurate reports on icing and turbulence at high altitudes.

Navigation

Specific charts have been designed for flight at FL 180 and above. Enroute high-altitude charts delineate the jet route system, which consists of routes established from FL 180 up to and including FL 450. The VOR airways established below FL 180 found on low-altitude charts must not be used at FL 180 and above. High-altitude jet routes are an independent matrix of airways, and the pilot must have the appropriate enroute high altitude charts before transitioning to the flight levels.

Jet Routes

Jet routes in the United States are predicted solely on VOR or VORTAC navigation facilities, except in Alaska where some are based on L/MF navigation aids. All jet routes are identified by the letter “J” and followed by the airway number. Today. Except for congested airspace in the northeast and southwest… much of your flying can be GPS direct.

Reporting Points

Reporting points are designated for jet route systems and must be used by flights using the jet route unless otherwise advised by ATC. Flights above FL 450 may be conducted on a point to point basis, using the facilities depicted on the enroute high-altitude chart as navigational guidance. Random and fixed Area Navigation (RNAV) routes are also used for navigation at high altitudes and are based on area navigation capability between waypoints defined in terms of latitude/longitude coordinates, degree-distance fixes, or offsets from established routes or airways at a specified distance and direction. Radar monitoring by ATC is required on all random RNAV routes.

Point-to-Point Navigation

In addition to RNAV, many high-altitude airplanes are equipped with point-to-point navigation systems for high-altitude enroute flight. These include Global Positioning System. Further information about these and additional navigational systems are available in the Aeronautical Information Manual. It is important to note that navigation databases must be current to file and fly IFR.

Navaids

VOR, DME, and TACAN depicted on high-altitude charts are designated as class H navaids, signifying that their standard service volume is from 100 feet AGL up to and including 14,500 feet AGL at radial distances out to 40 NM; from 14,500 AGL up to and including 60,000 feet AGL at radial distances out to 100 NM; and from 18,000 feet AGL up to and including 45,000 feet AGL at radial distances out to 130 NM. Ranges of NDB service volumes are the same at all altitudes.

Aerodynamics and performance factors

Thin air at high altitudes has a significant impact on an airplane's flying characteristics because surface control effects, lift, drag, and horsepower are all functions of air density. Pilots who operate aircraft at high speed and high altitudes are concerned with the forces affecting aircraft performance caused by the interaction of air on the aircraft. With an understanding of these forces, the pilot will have a sound basis for predicting how the aircraft will respond to control inputs.

A. Reduced weight of air

The reduced weight of air moving over control surfaces at high altitudes decreases their effectiveness. As the airplane approaches it absolute altitude, the controls become sluggish, attitude is difficult to maintain making altitude and heading difficult to maintain. For this reason, most Lancairs are equipped with an autopilot.

B. Determined weight of air

The internal combustion engine requires a given weight of air to produce a specified horsepower. For a given decrease of air density, horsepower decreases at a higher rate, which is approximately 1.3 times that of the corresponding decrease in air density.

C. Maintaining level flight

For an airplane to maintain level flight, drag and thrust must be equal. Because density is always greatest at sea level, the velocity at altitude given the same angle of attack will be greater than at sea level, although the indicated air speed (IAS) will not change. Therefore, an airplane's TAS increases with altitude while its IAS remains constant. In addition, an airplane's rate of climb will decrease with altitude.

D. Controllability Factors

(1) Static stability is the inherent flight characteristic of an aircraft to return to equilibrium after being disturbed by an unbalanced force or movement.

(2) Controllability is the ability of an aircraft to respond positively to control surface displacement, and to achieve the desired condition of flight.

(3) At high-flight altitudes, aircraft stability and control may be greatly reduced. Thus, while high-altitude flight may result in high TAS, calibrated airspeed is much slower because of reduced air density. This reduction in density means that the angle of attack must be increased to maintain the same coefficient of lift with increased altitude. Consequently, aircraft operating at high altitudes simultaneously experience problems associated with slow-speed flight such as Dutch roll, adverse yaw, and stall. In addition, the reduced air density reduces aerodynamic damping, overall stability, and control of the aircraft in flight.

(a) Dutch roll is a coupled oscillation in roll and yaw that becomes objectionable when roll, or lateral stability is reduced in comparison with yaw or directional stability.

(b) Adverse yaw is a phenomenon in which the airplane heading changes in a direction opposite to that commanded by a roll control input. It is the result of unequal lift and drag characteristics of the down-going and up-going wings.

(4) Supersonic flow over the wing is responsible for:

(a) Formation of shock waves on the wing, which results in drag rise.

(b) Aft shift in the center of lift resulting in a nose-down pitching moment called Mach Tuck.

(c) Airflow separation behind the shock waves resulting in Mach buffet.

(5) In general, this discussion has been confined to normal level, unaccelerated 1.0 G-flight. When turning or maneuvering about the pitch axis, however, acceleration of G-forces can occur while maintaining a constant speed. As G-forces increase, both the aircraft's aerodynamic weight and angle of attack increase. The margin over low-speed staff buffet decreases as well as the margin below Mach buffet because of the increased velocity of the air over the wing resulting from the higher angle of attack. This, in effect, could lower the aerodynamic ceiling for a given gross weight. Increased G-loading can also occur in non-maneuvering flight because of atmospheric turbulence. Pilots flying at high altitudes in areas where turbulence may be expected must carefully consider acceptable safety margins necessary to accommodate the sudden and unexpected vertical accelerations that may be encountered with little or no warning. How wide is the safety margin between low-speed and high-speed buffet boundaries for an altitude and weight in a 30-degree bank? The safety margin in airspeed spread diminishes

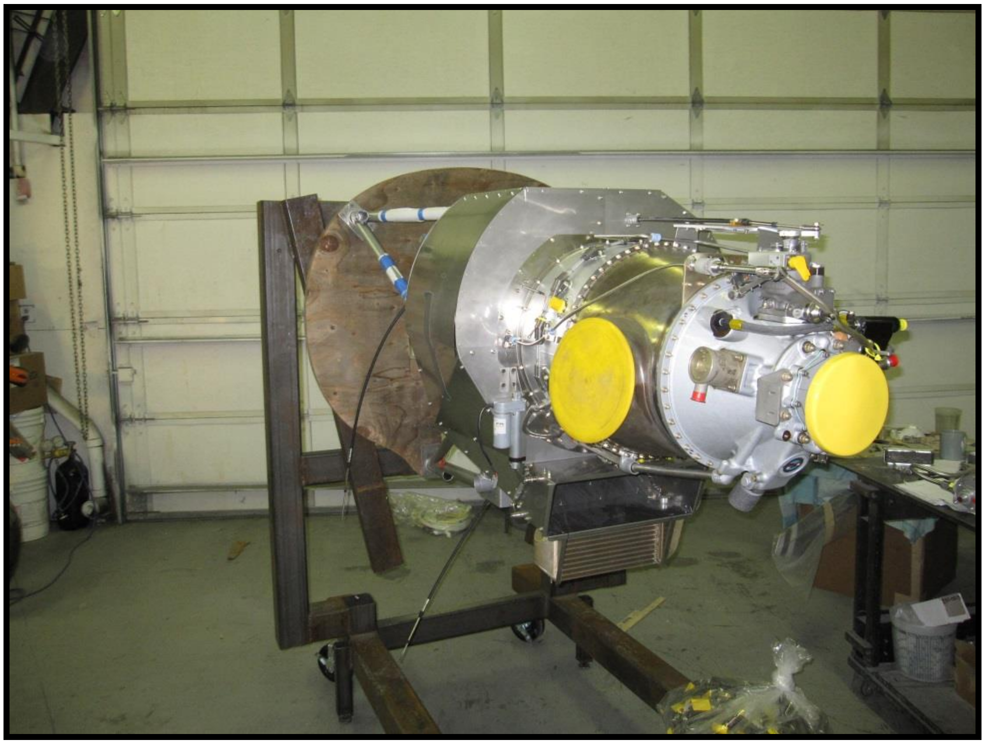
rapidly as the aircraft climbs and leaves little room for safety in the event of an air turbulence encounter or accident thunderstorm penetration. The above material is reprinted from FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AN D/OR MACH NUMBERS (MMO) GREATER THAN .75

EVOLUTION AIRCRAFT SYSTEMS

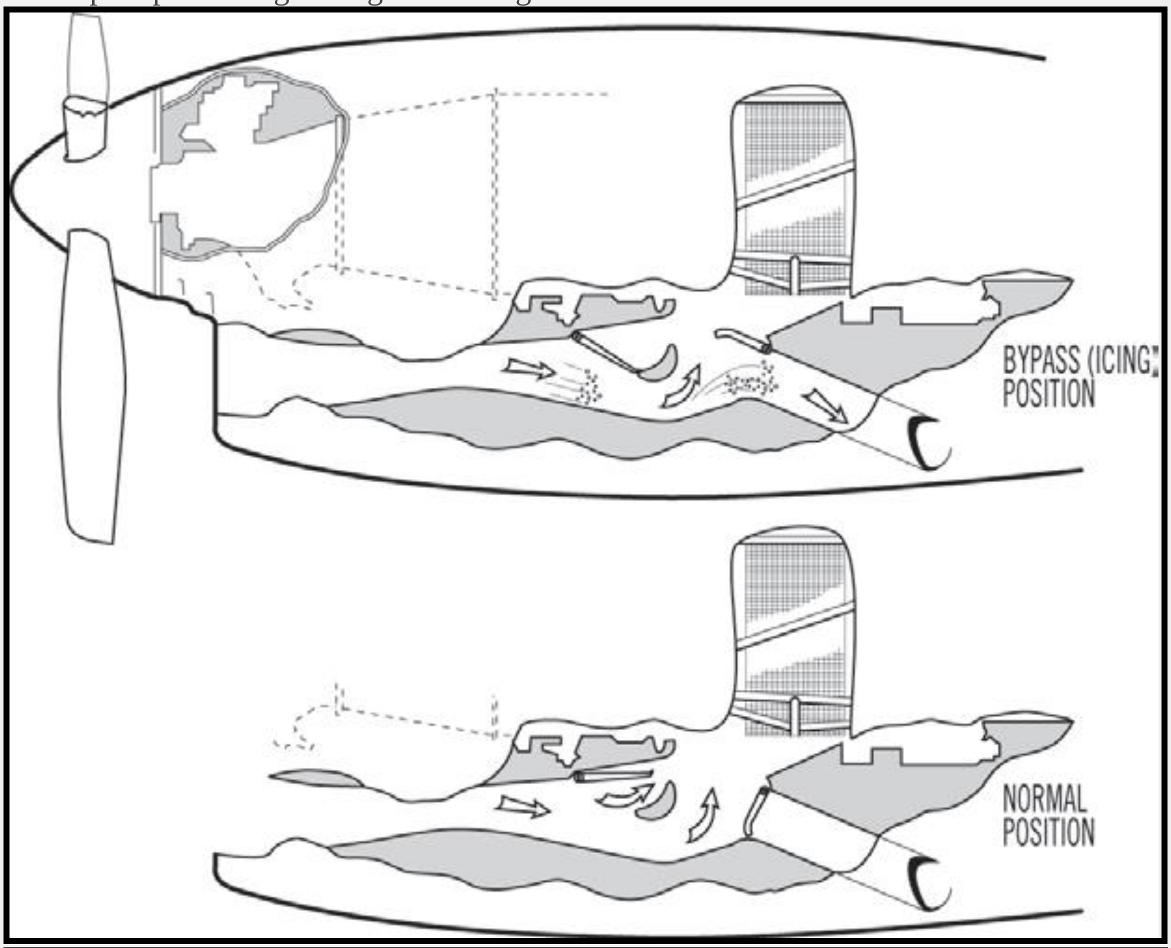
The Lancair EVOLUTION is a high performance, four-seat, amateur built aircraft capable of 300 KTAS at FL 180 and higher. It is normally powered by a 750 shp Pratt & Whitney Canada PT-6A-135A. The engine turns a four blade constant speed Hartzell HC-E4N-3N/D8292B fully feathering and reversing propeller. The aircraft features a composite airframe of predominately carbon fiber in an epoxy resin matrix. The wings have electro mechanically actuated full slotted fowler flaps and mechanically actuated high aspect ratio ailerons. The elevator and rudder have centerline bearings. The elevator is push rod actuated; a stainless steel cable actuates the rudder. The tricycle retractable landing gear is hydraulically actuated. The nose gear is a self centering free swiveling unit and has an oleo strut for dampening. The trailing link main gear struts are made of welded steel tubing. The main wheel brakes have their own independent system and are hydraulically actuated.

POWERPLANT

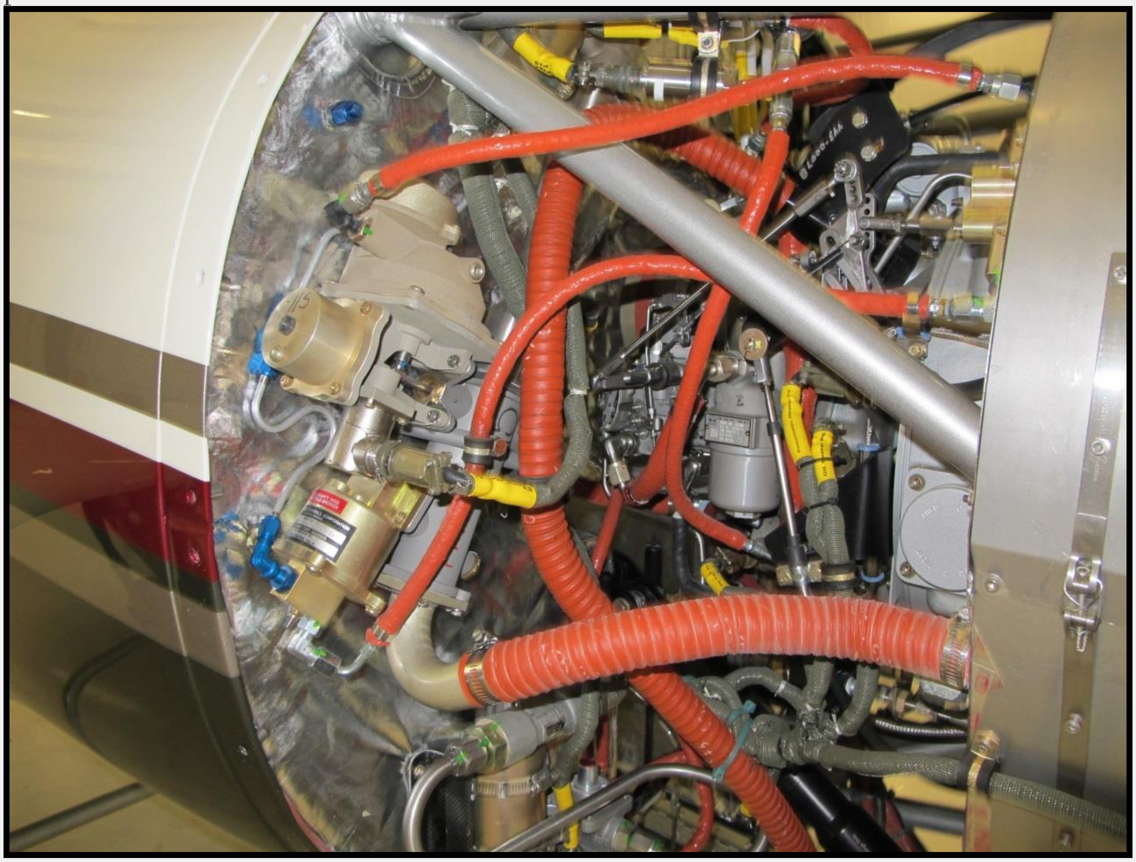
Pratt & Whitney Canada PT6A-135A

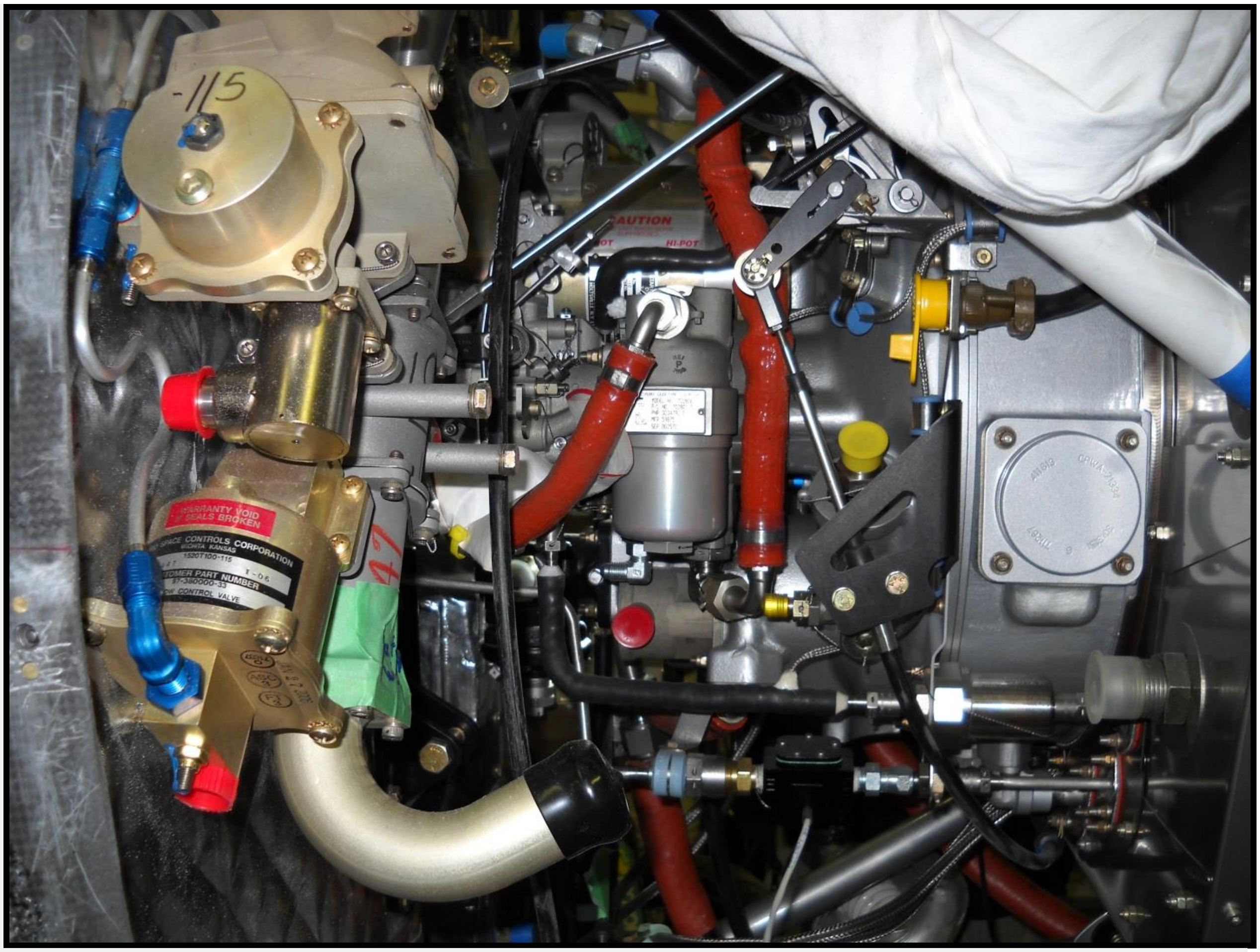


The Pratt & Whitney Canada PT 6A-135A turboprop engine is a reverse flow annular design turboprop engine. The intake air enters at the rear of the engine via the lower cowl intake and engine mounted stainless steel plenum. The plenum is equipped with an electrically operated ice door that when opened by the pilot diverts ice chunks and ingested foreign objects out of the intake path preventing damage to the engine.



At the entrance to the compressor the incoming air turns 180 degrees and goes forward through x stages of compression. Bleed air from x compressor is used to pressurize the cabin via the flow pack mounted on the firewall.





There are 3 stages of axial compressor wheels and one centrifugal compressor section and a single stage turbine section. The engine speed (Ng) is measured at the xxx position and at full power is operating at xx,xxxx rpm. There is a forward gear box connected to the power turbine that turns the propeller. Mounted on the forward gearbox is the propeller governor, propeller tach and secondary prop tach. Maximum propeller speed is 1900 rpm. The single stage compressor turbine is connected via a drive shaft to the compressor. An accessory gearbox on the rear of the engine powers the starter generator, fuel pump, oil pump and air conditioning compressor.

The PT6A is a two-shaft engine with a multi-stage compressor driven by a single-stage compressor turbine and an independent shaft coupling the power turbine to the propeller through an epicyclic concentric reduction gearbox.

The PT6A family of engines embodies three series of models with increasing power levels, referred to as PT6A ‘Small’, ‘Medium’ and ‘Large.’ The increased power levels are achieved through the increase of compressor air flow and increased number of power turbine stages. Most recent models enjoy the advantage of additional advanced technologies in materials, turbine cooling and aerodynamic design. The -135A has one power turbine wheel and the -42 has two power turbine wheels.

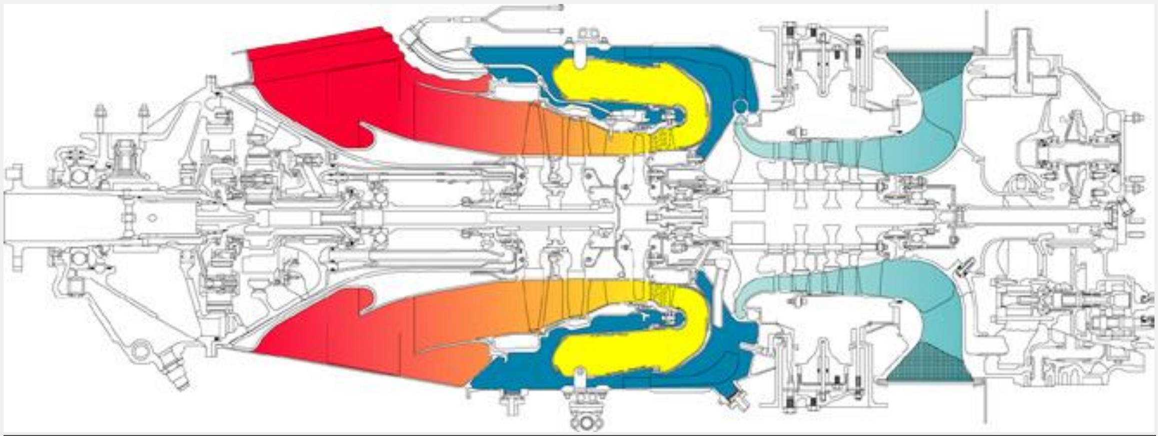
Multi- stage axial and single-stage centrifugal compressor

Reverse flow, radial inlet with screen for FOD (Foreign Object Damage) protection

Large PT6A models incorporate 4-stage axial and 1-stage centrifugal compressors

Small and Medium PT6A models incorporate 3-stage axial and 1-stage centrifugal compressors

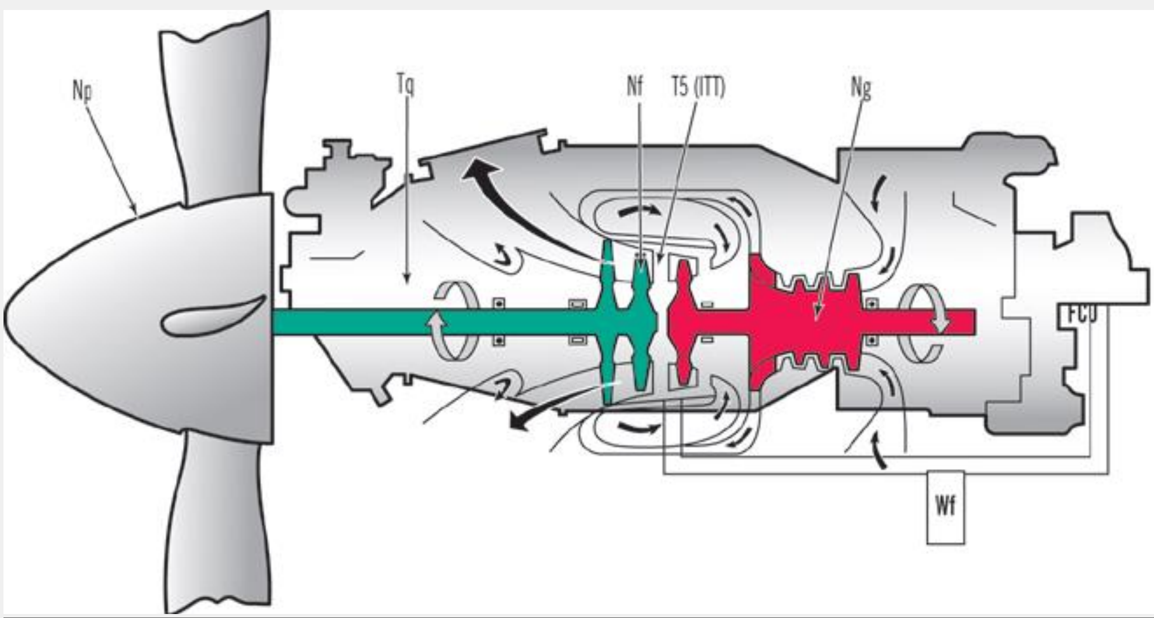
Reverse flow
combustor



Low emissions, high stability, easy starting, durable

Single-stage compressor turbine

Cooled vanes in some models to maintain high durability

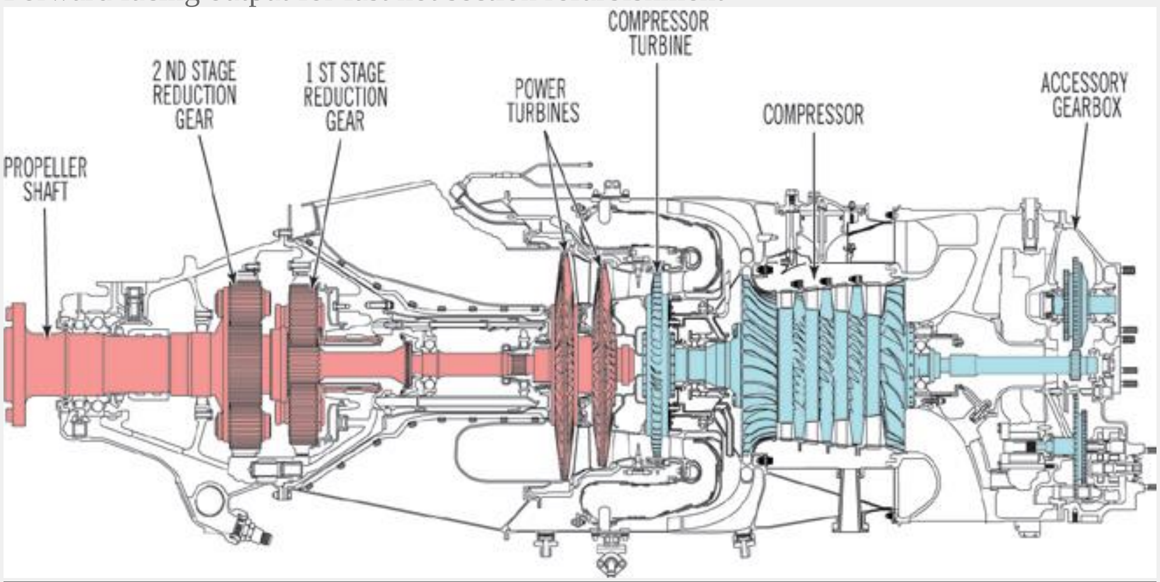


Independent ‘free’ power turbine with shrouded blades

Large PT6A models incorporate 2-stage axial turbine

Small and Medium PT6A models incorporate 1-stage axial turbine

Forward facing output for fast hot section refurbishment

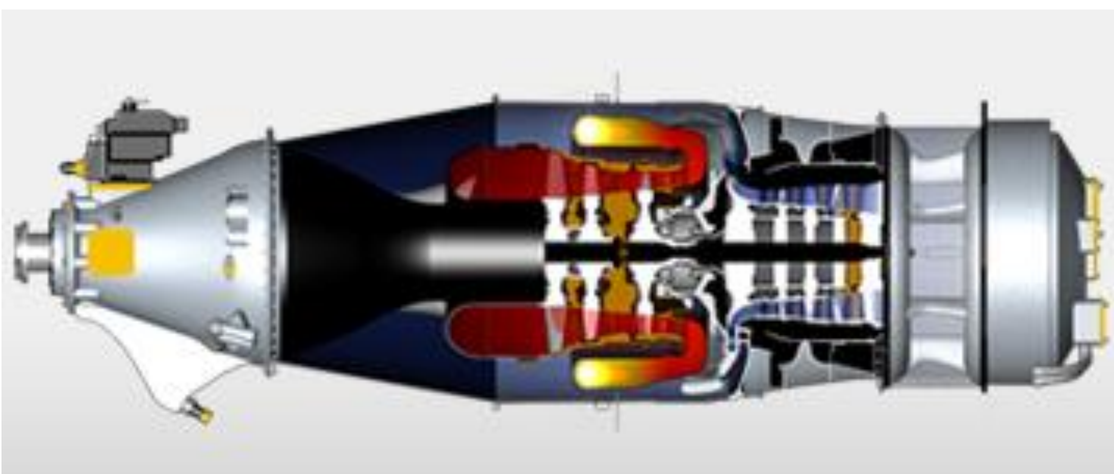


Epicyclic speed reduction gearbox

Enables compact installation

Output speed optimized for highest power and low propeller noise

1,700 to 2,200 rpm output speed

.. 

At full power of 1900 rpm; 101,6% NG, 2080 foot pounds of torque the PW&C PT6A-135A develops 750 shaft horsepower. The engine may be operated at maximum power in the climb to cruise altitude. Maximum recommended cruise power setting is 1900 rpm and 805*C ITT generating 700 shp. A dual igniter provides ignition source for engine starting. An electric fuel pump is installed.

The engine is provided with a high-pressure oil system of 12-quart capacity. The oil filler cap is on the backside of the engine. Turbine engine oil is added as needed. PW&C says that regular oil changes are not necessary as is standard on piston aircraft—this is because oil does not interact with combustion byproducts. Oil quality should, however be monitored for contamination. Do not mix turbine oil brands. Check oil level within ten minutes of shutdown.

DO NOT MIX DIFFERENT VISCOSITIES OR SPECIFICATIONS OF OIL AS THEIR CHEMICAL STRUCTURE CAN MAKE THEM INCOMPATIBLE.

The following oils are approved by PW&C

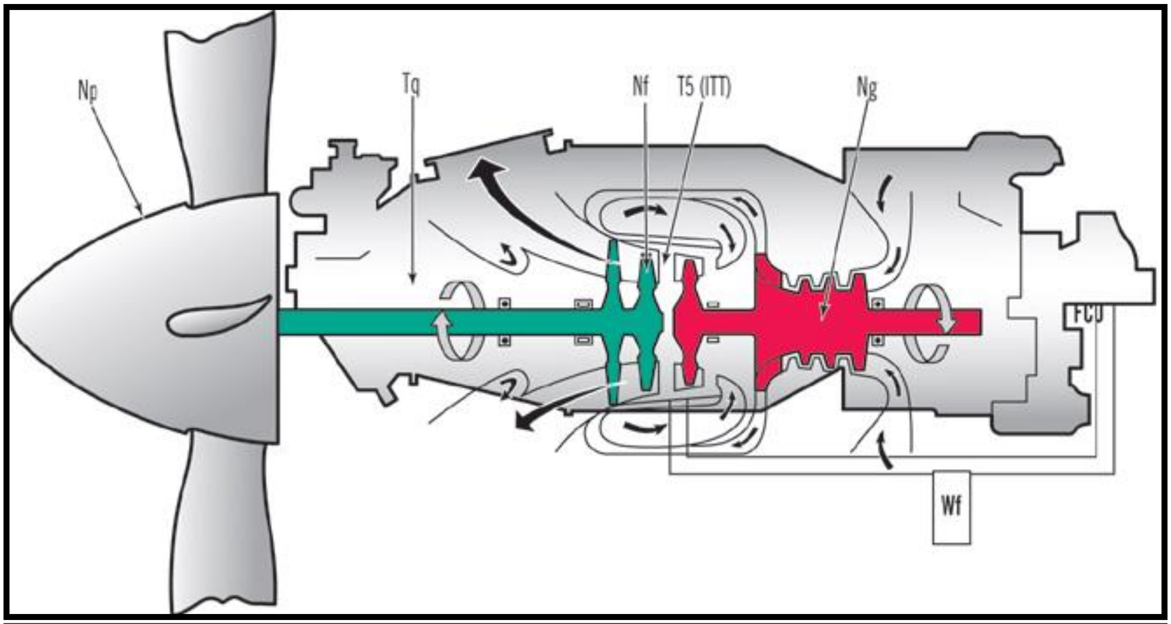
Table 1 (7.5 centistokes)
Aeroshell Turbine Oil 750
Royco Turbine Oil 750
Castrol 98
Exxon Turbine Oil 274
BP Turbine Oil 274

Table 2 (5 centistokes)
Turbonuycoil 35 M
Aeroshell Turbine Oil 500
Royal Turbine Oil 500
Mobil Jet Oil II
Castrol 5000
Exxon Turbine Oils 2380
BP Turbine Oil 2380
Turbonycoil 525-2A
Turbonycoil 600

Tasble 3/ Gen 3 Oils
*Mobil Jet Oil 254
*Aeroshell Turbine Oil 560
* Royco Turbine Oil 560

*Third Generation or HTS (High Thermal Stability) Mil –PRF-23699F are approved. See PW&C Service Bulletin No. 1001R24 for more information. Change to these oils only after overhaul or when installing a new engine.

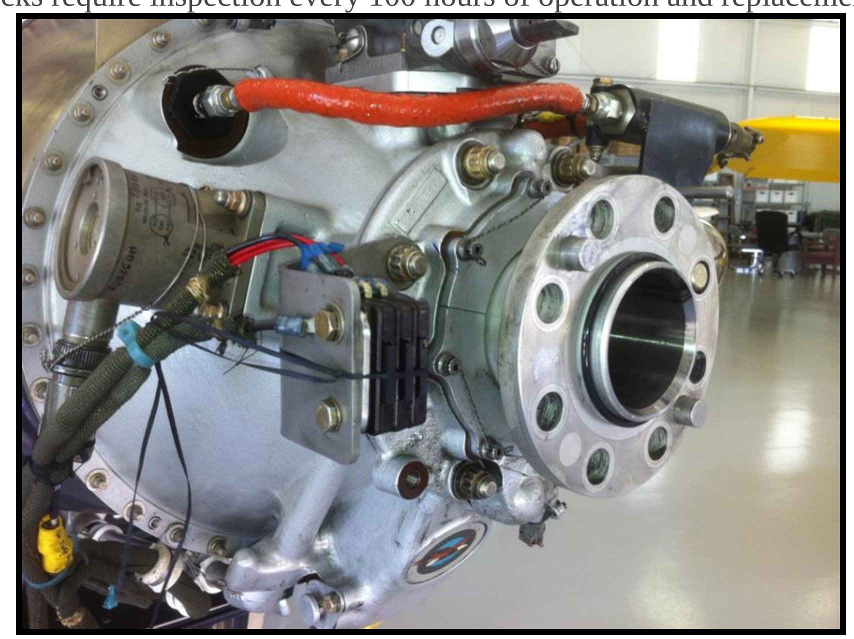
Change oil by attrition. Check oil filter at 50 hour intervals for carbon deposits



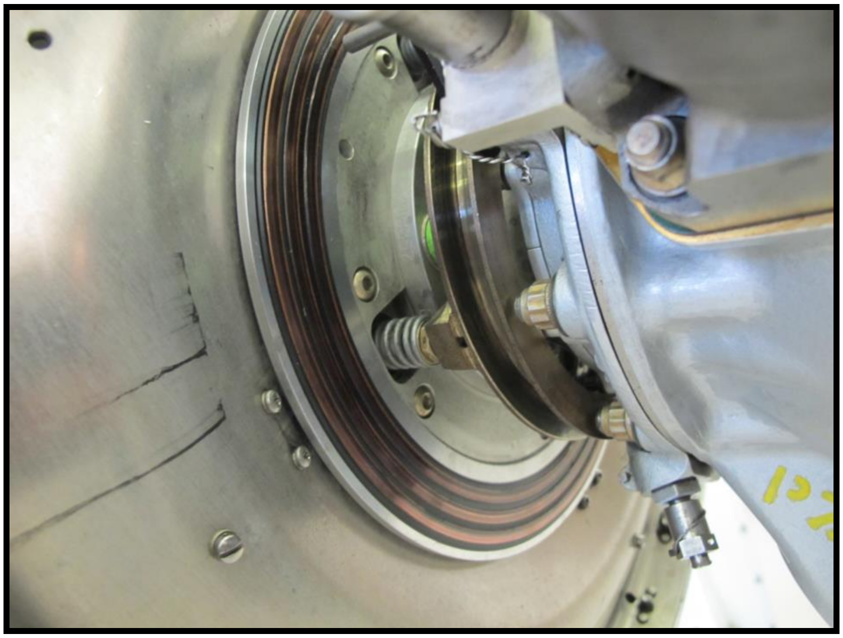
PROPELLER

The engine drives a four bladed Hartzell constant speed propeller (other propellers may be used). A governor, controlled by mechanical linkage from the cockpit, maintains the selected rpm, regardless of varying airspeeds or flight loads. The governor controls rpm by regulating oil pressure to the propeller hub. Propeller high pitch (low rpm) is obtained by propeller governor boosted oil pressure working against the centrifugal twisting moment of the blades and a spring. <u>Loss of oil pressure will cause the prop to go to feather</u>. The propeller should be cycled occasionally, especially during cold conditions, to maintain warm oil in the hub. The propeller is fully feathering. It is also capable of reverse or "beta" for assisting in stopping or taxiing. [redacted]

A deice ring and block assembly provide electrical power to the heated boots on the propeller. The carbon blocks require inspection every 100 hours of operation and replacement as necessary.

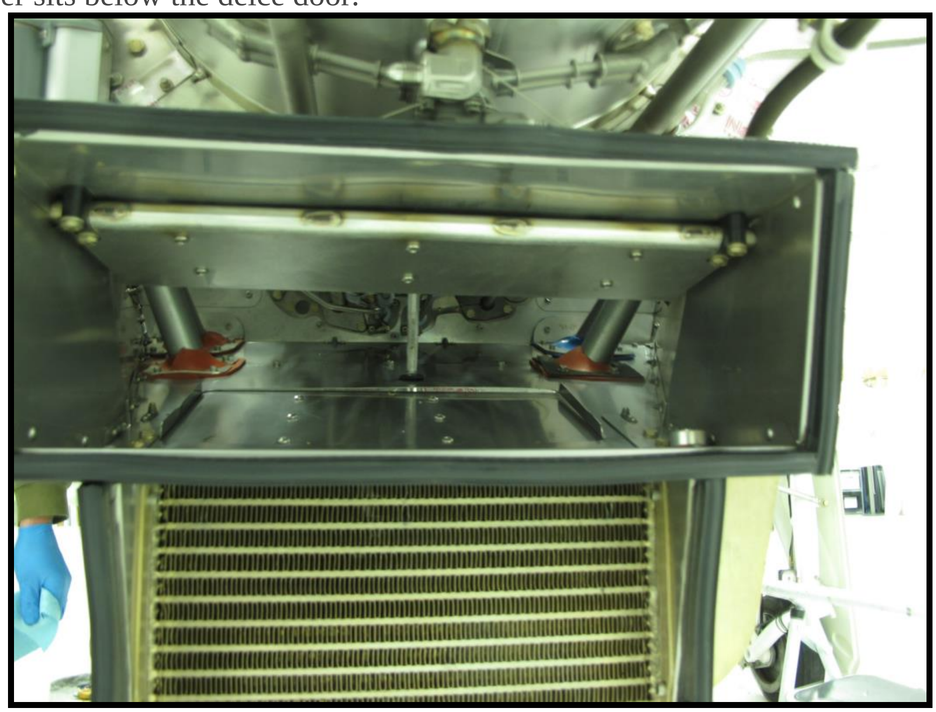


Deice Block



Slip Ring

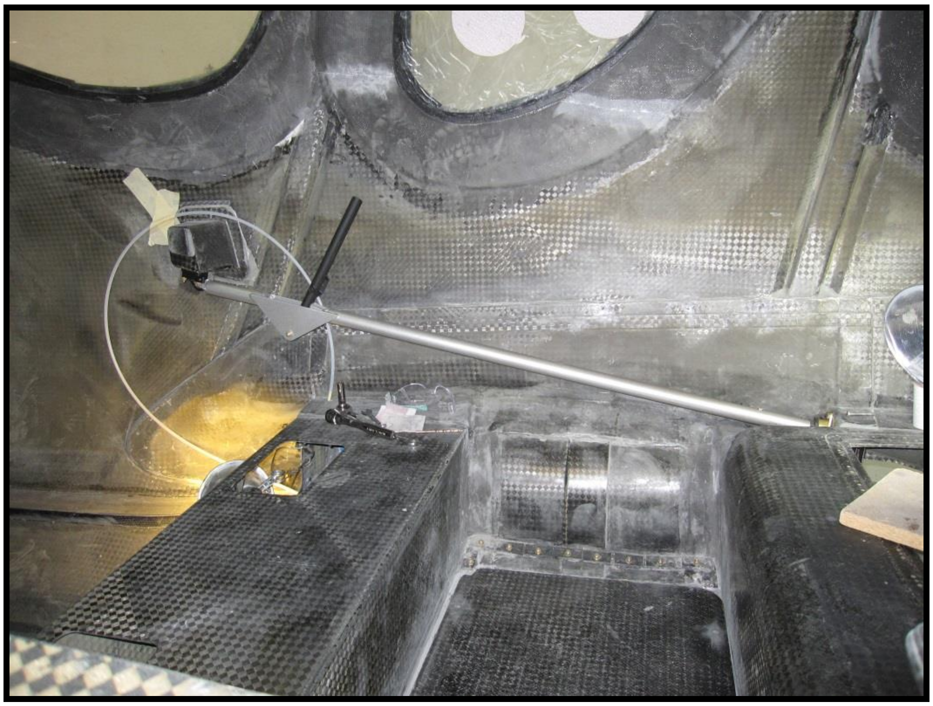
A deice door allows heavy material such as ice or debris to exit vial an electrically controlled door int e hbiottom of the plenum. This door should be closed for start and shut down but open for ground operations and takeoff and landing to reduce the risk of foreign object damage (FOD). The oil cooler sits below the deice door.



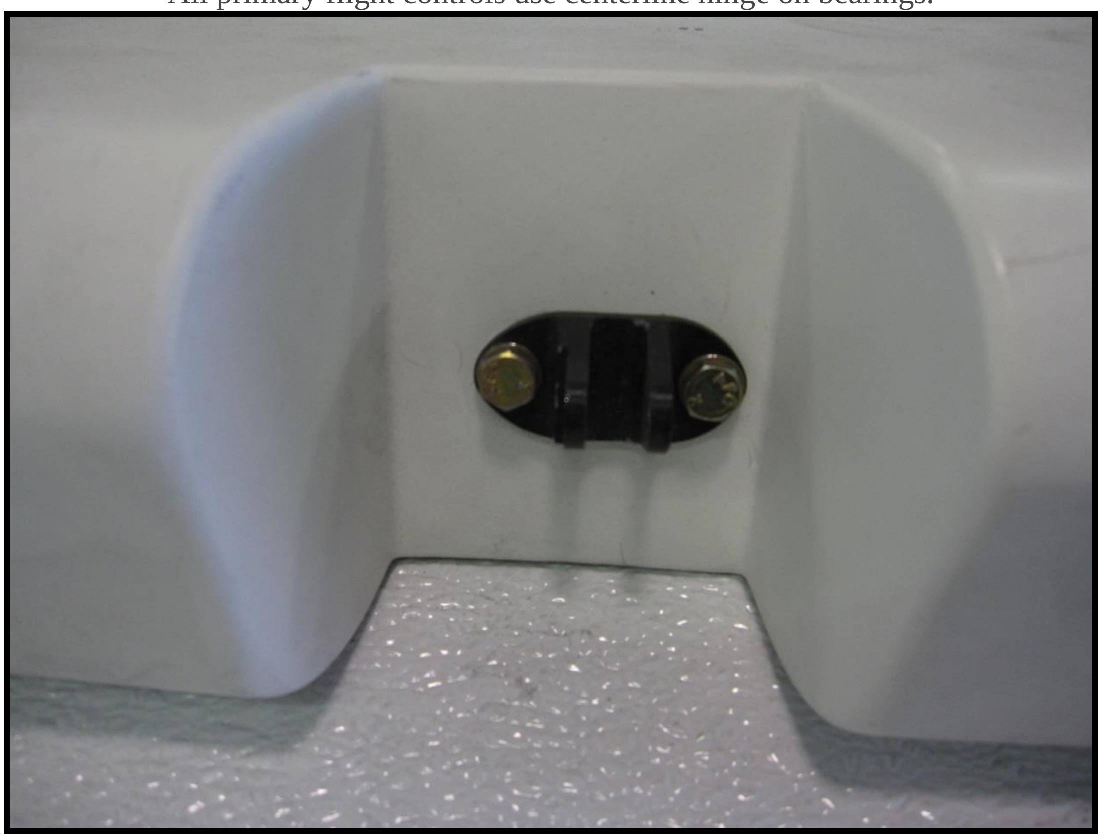
Deice Door

FLIGHT & POWER CONTROLS

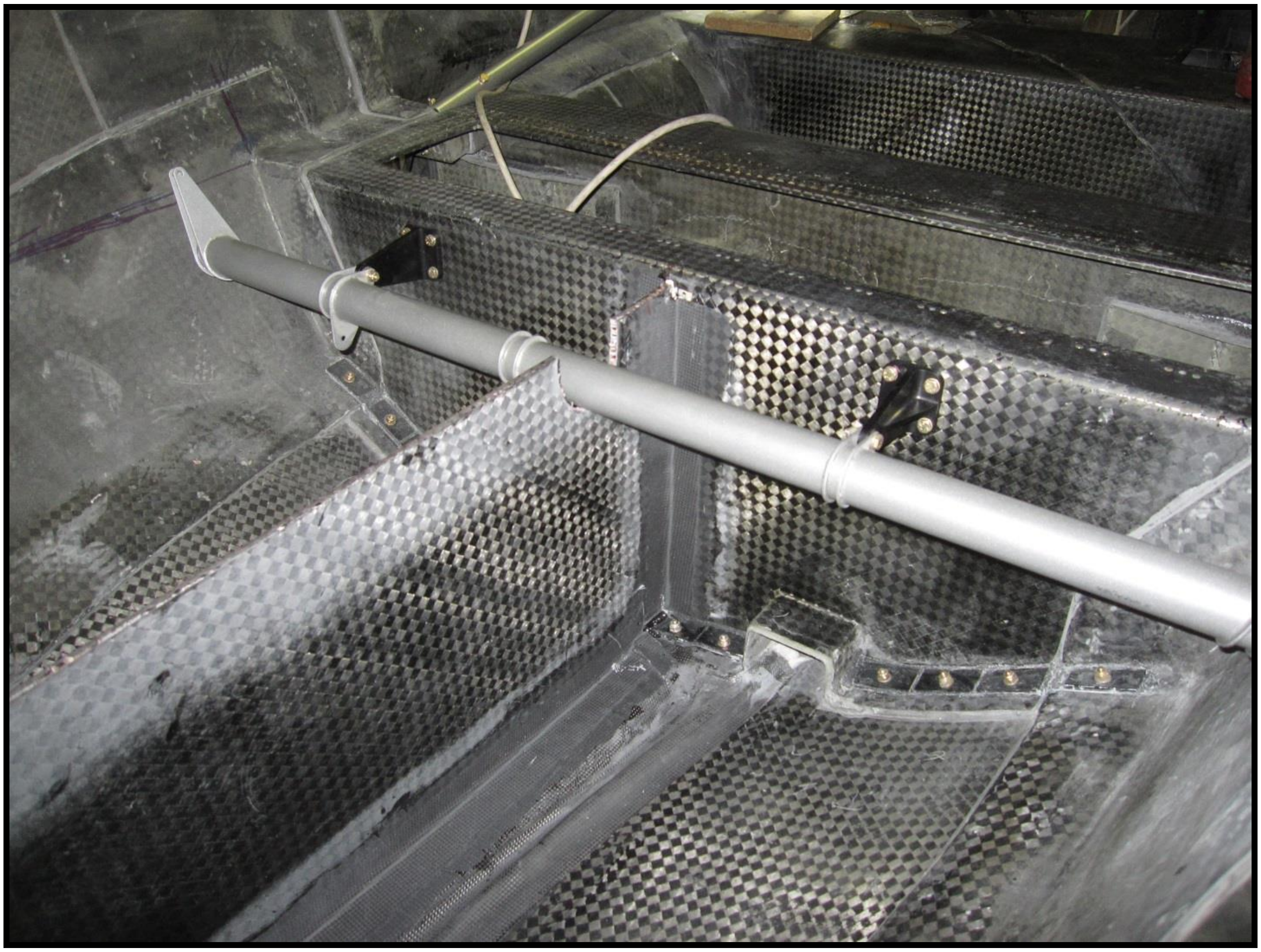
The primary flight controls are the ailerons, rudder, and elevator. These control surfaces are operated from either front seat by interconnected side stick controls and rudder pedals. On the EVOLUTION the controls run through the pressure bulkheads to the non pressurized side of the fuselage.



All primary flight controls use centerline hinge on bearings.

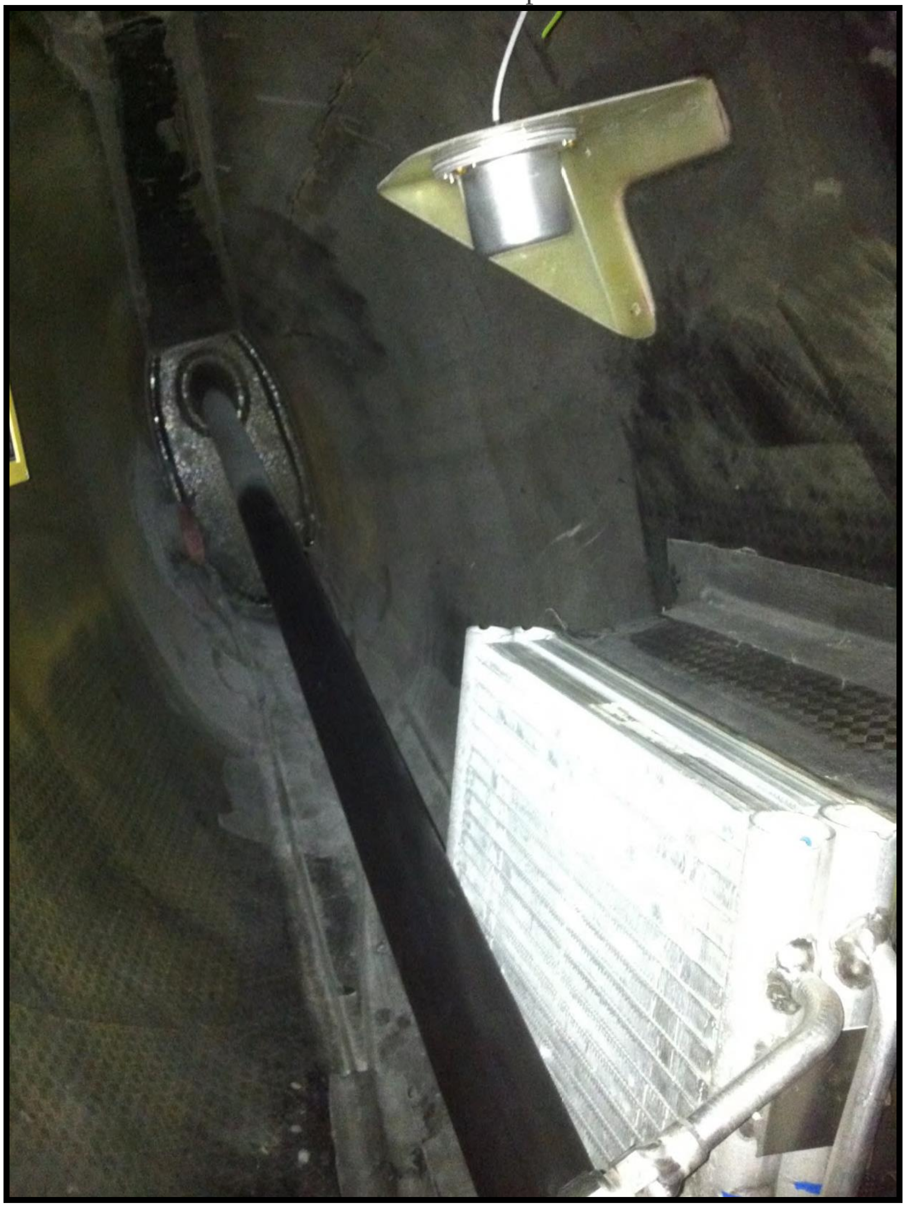



Elevator Hinges

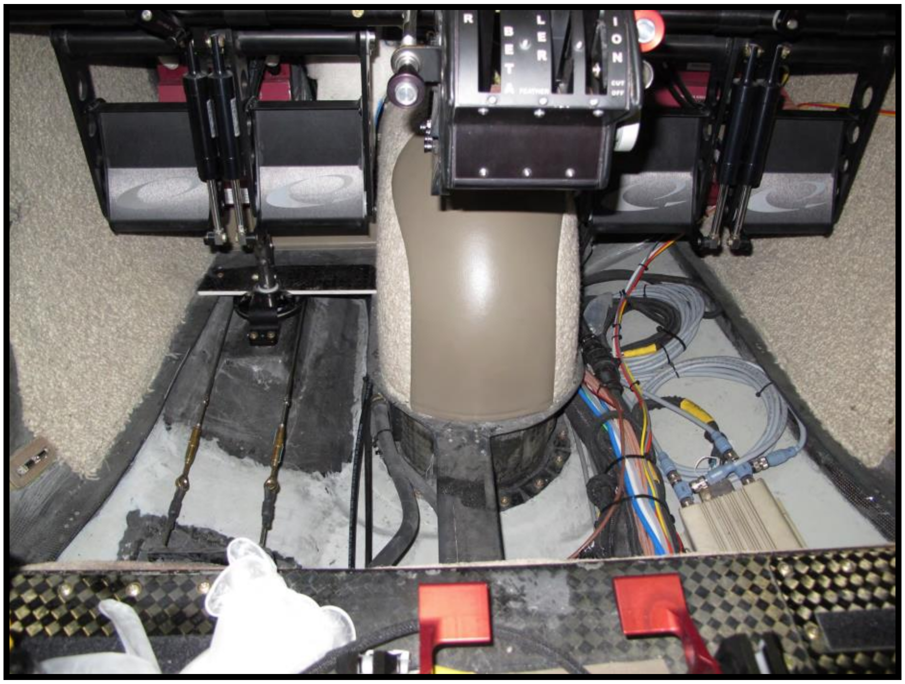


Elevator Cross Tube

The ailerons and elevator are push rod actuated.



Elevator Pushrod in Empennage



Rudder Cables

Both side stick controls have positive grip handles and should have a radio transmit button mounted on them. CWS and trim buttons are mounted on the grips, as well.


Control Stick

The rudder pedals actuate the rudder with stainless steel cables. The wheel brakes are actuated by applying pressure on the top of the rudder pedals. Do not rest your feet above the bottom of the rudder pedal on landing lest you blow a tire.

Copilot Rudder Pedals

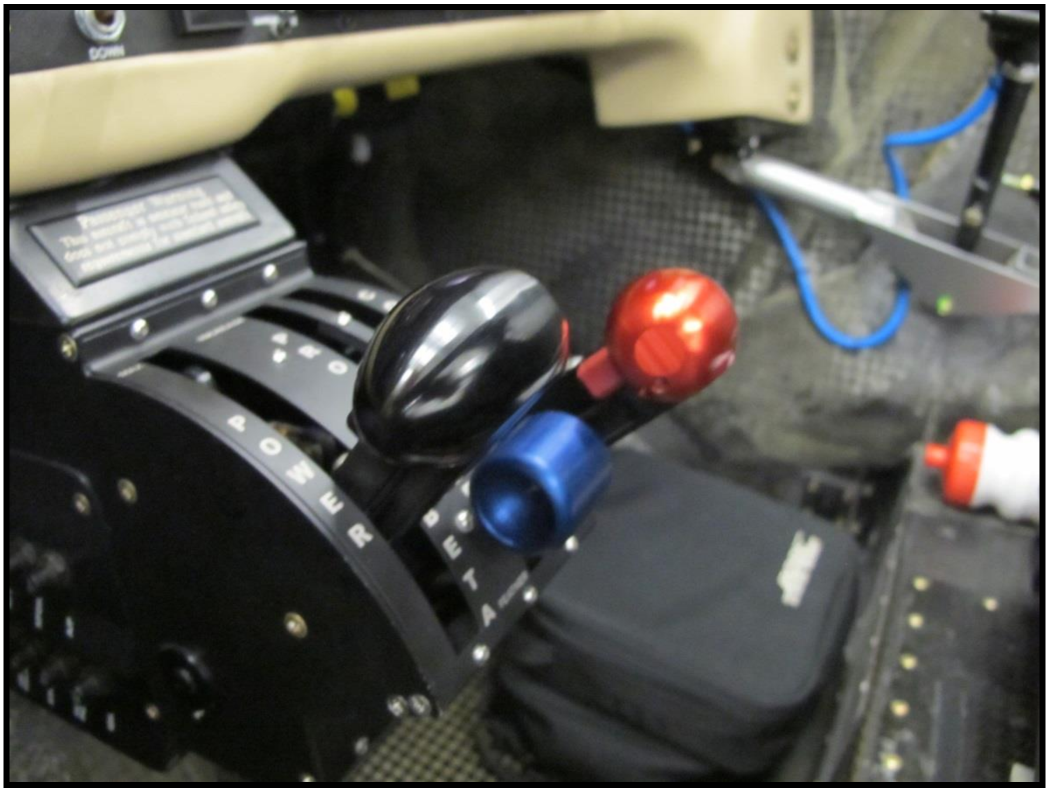
The secondary flight controls are the wing flaps.

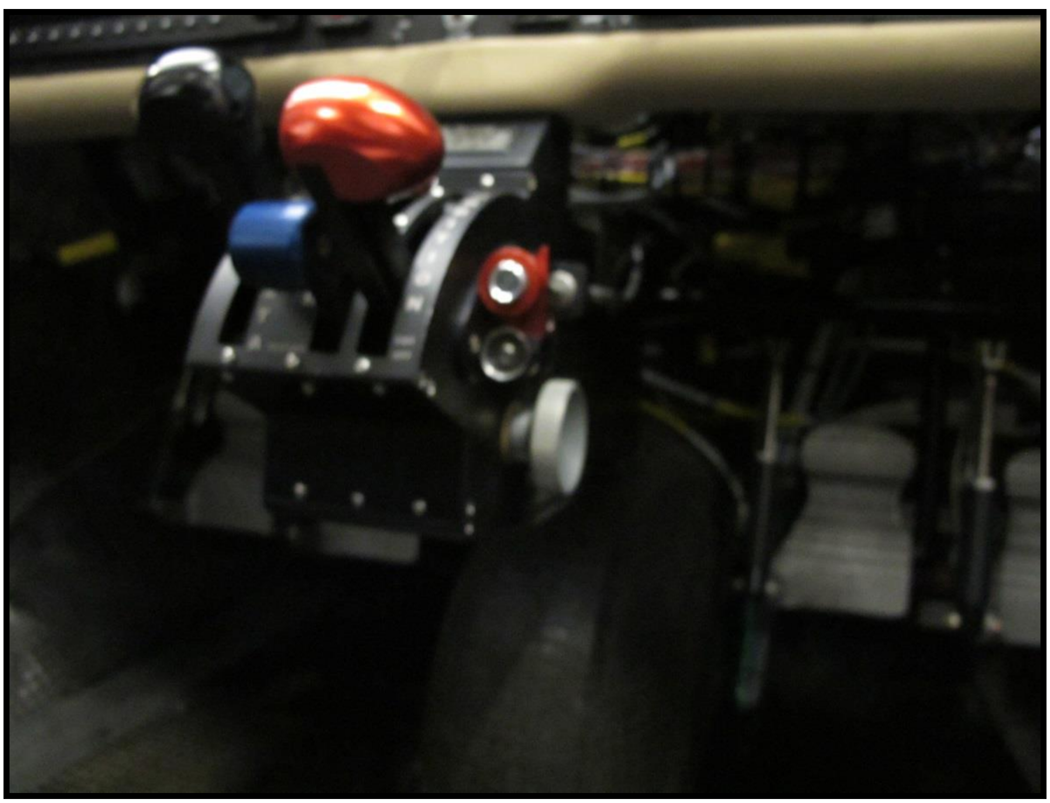
The electrically driven fowler flaps extend from aileron to fuselage on each wing.

On earlier Evos the flaps are operated by an electric flap switch mounted above the power lever quadrant and are selectable to any setting between zero and forty six degrees. On newer Evos the flaps switch is a three postion switch Up, Approach and Down. The electric flap motor is located in the non pressurized bay under the passenger seats.

Flap Motor

The engine power controls are located on the instrument sub panel between the pilot stations and consist of the PCL or power control lever, propeller control and condition lever. There is also a standby power lever that directly meters fuel to the engine in the event of a fuel control failure or PCL disconnect.





Power Quadrant

Elevator Trim (electric)

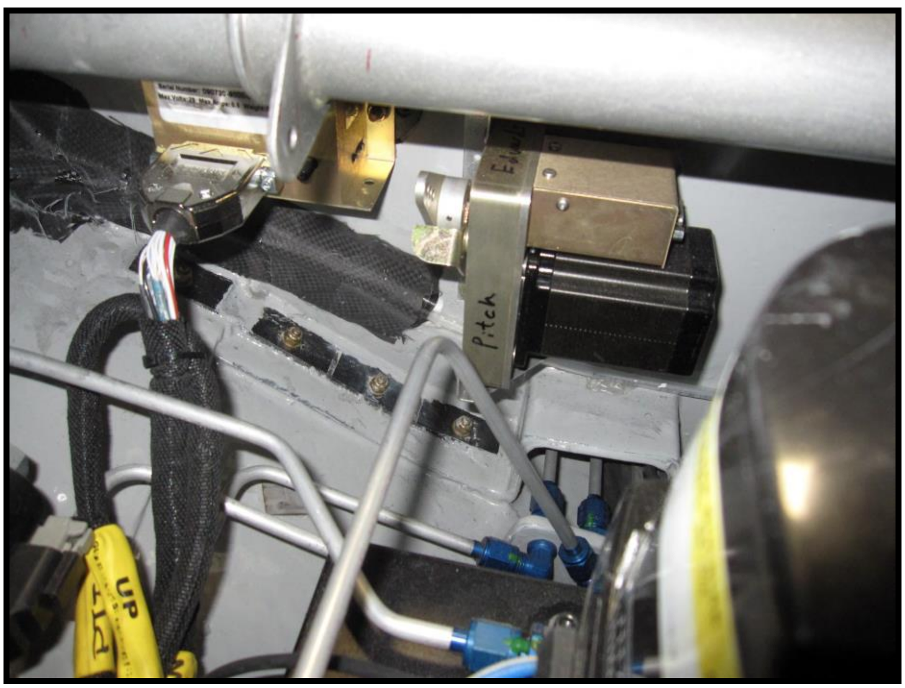
The elevator trim system is manually controlled by the “hat” switch on the stick and by the autotrim feature on the Trutrak autopilot.

Rudder Trim

Aileron trim

Trim Switches. Label Switches!

Tru Trak AP Controller



AP Pitch Servo (right) and Pitch AutoTrim (left)


Stall Strips on Wing Leading Edge

LANDING GEAR

The landing gear system is electrically controlled and hydraulically operated. Main landing gear is made of welded 4130 steel tube.Wheels and tires are 18-4.4 6 or 10 ply. The nose gear has a 5.00 x 5 6 ply wheel and tire.

Hydraulically operated Cleveland disc brakes are standard.

If gear are not down and locked an aural warning “LANDING GEAR” will activate indicating you are below 100 KIAS with the gear “UP”

Based on my use MLG tires last on average 230 hours and 123 landings, unless you flat spot a tire by using too much brake pressure on landing and skid the tire. Remember, the mains are 100 psi tires and you have no antiskid so it is very easy to flat spot or blow a tire with too aggressive braking!

The nose gear is a free swivel conventional air/oleo strut with internal viscous shimmy dampening. Any shimmy of the nose gear is cause for an immediate inspection of the nose strut! Differential braking is used for directional control on the ground until the rudder becomes effective.

A two-position electric landing gear switch is located above the PFD EFIS. The landing gear position indicating system consists of three green lights that illuminate when all three gear are down and locked. A yellow hydraulic pump light illuminates to indicate the hydraulic pump is operating. A red light on the panel indicates an unsafe down wheel. Correct tire pressures are 80-100 psi for the mains and 45-55 psi for the nose tire.

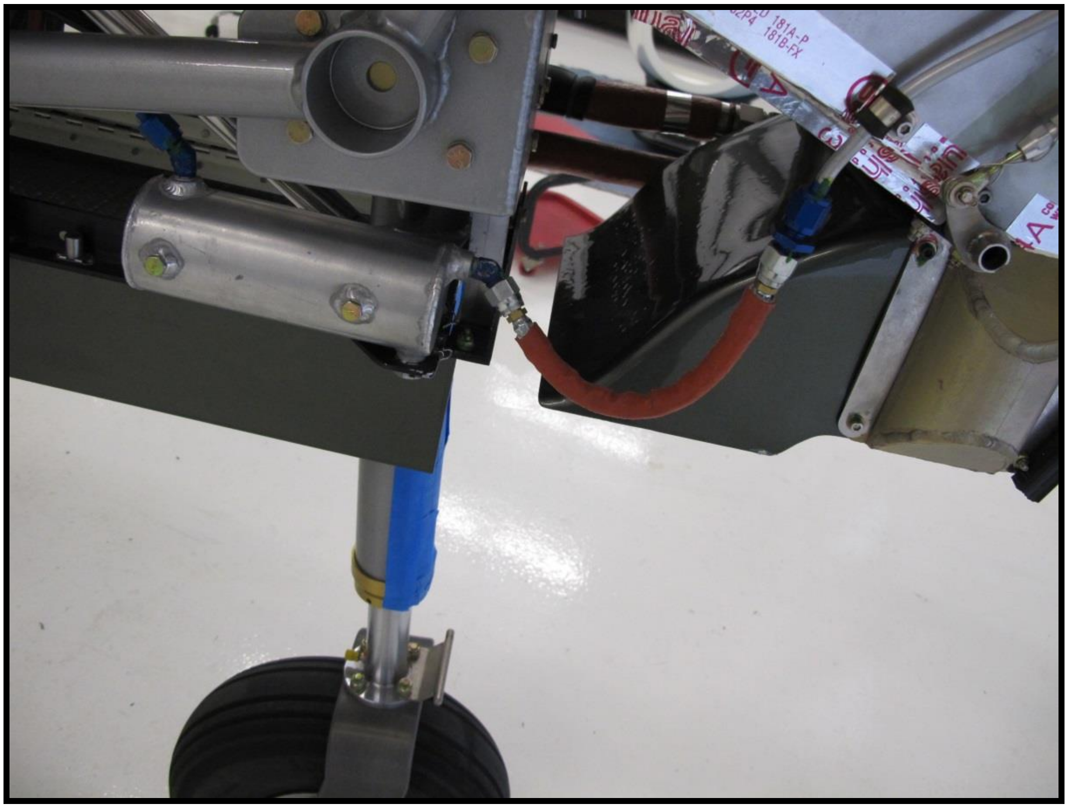
Landing Gear Switch and Indicator

An airspeed switch mounted on the pitot tube line prevents gear retraction below 75 kts. For landing gear retract tests on jacks you must blow into the pitot tube to get enough "airspeed" to disengage the airspeed safety switch. Don't overdo it and damage your pitot system. A balloon will also do the trick. The main gear and nose gear is retracted into the wings via hydraulic actuators, and the nose gear also retracts aft.

The mains and the nose gear are held up by hydraulic pressure. The mains and nose have mechanical down locks in the hydraulic actuating cylinders and a 110 psi gas shock strut provides a positive down/lock for the nose gear. There is no "uplock " on the mains. During condition inspection check operation of the mechanical downlock inflight.

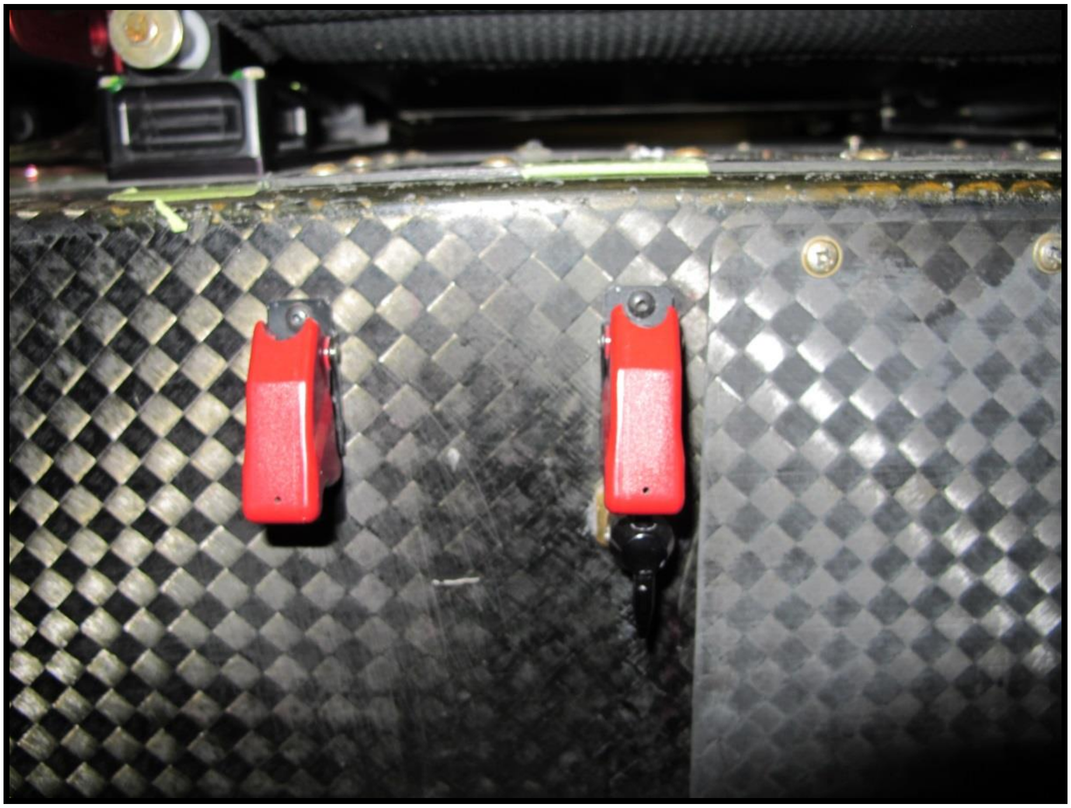
Airspeeds for the landing gear are:

Landing Gear Operating speed	VLO 150 KIAS
Landing Gear Extended Speed	VLE 165 KIAS

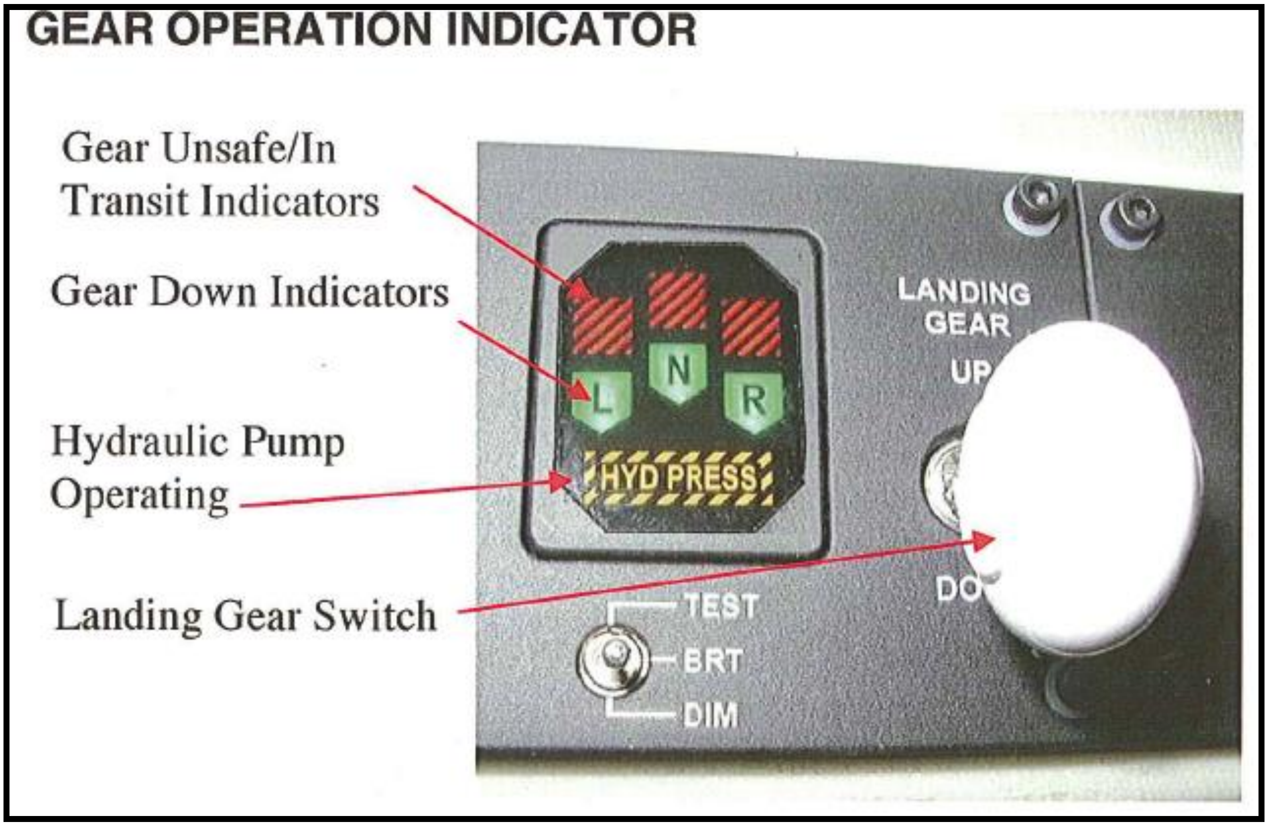


Nose Gear

The gear is extended in the emergency mode via a manually operated valve below the pilot seat that allows the landing gear to extend via gravity to a down and locked position.



Emergency Landing Gear Hydraulic Valve



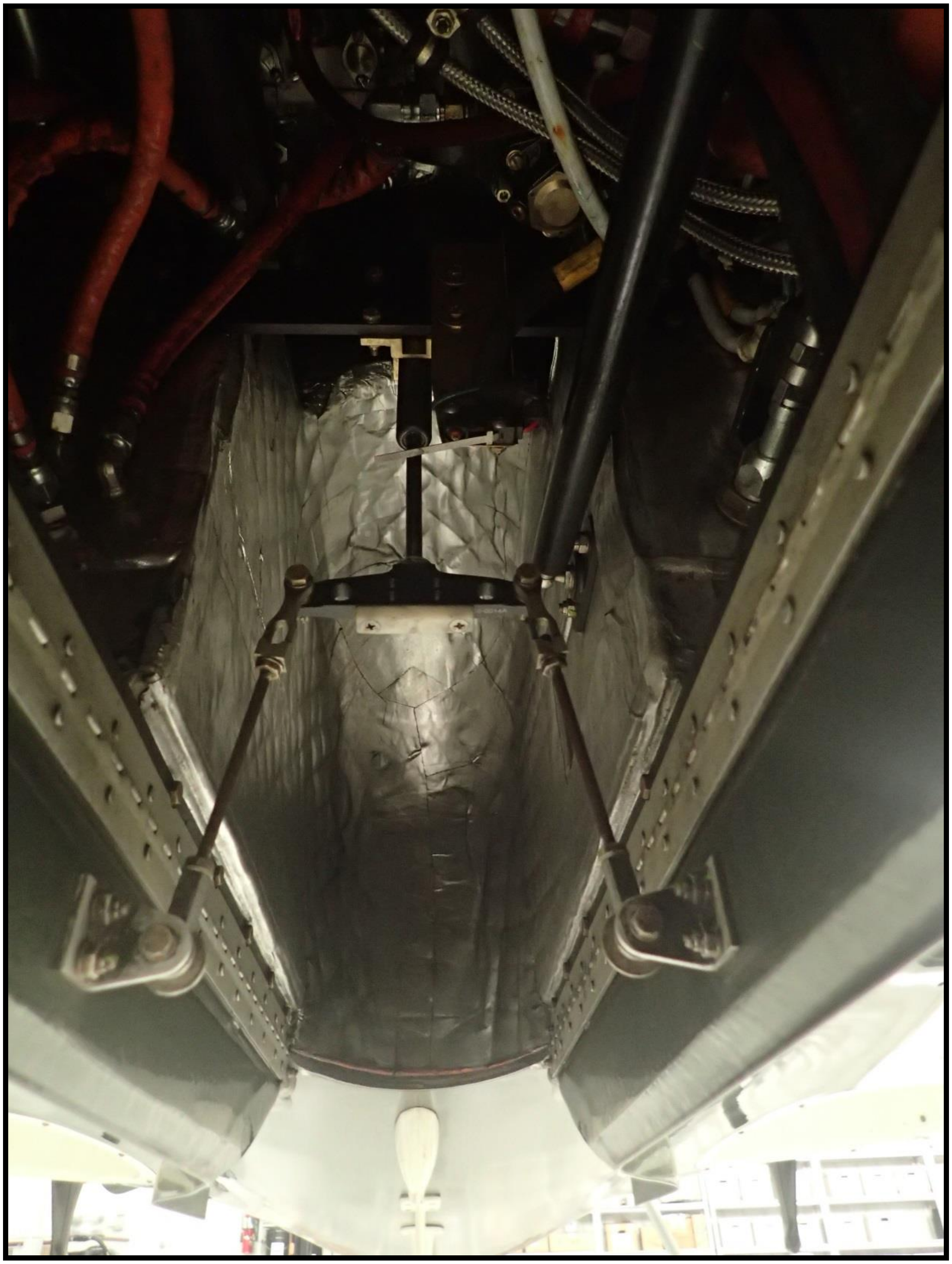
Landing Gear Indicator

Left main landing gear

Co-pilot adjustable rudder pedals

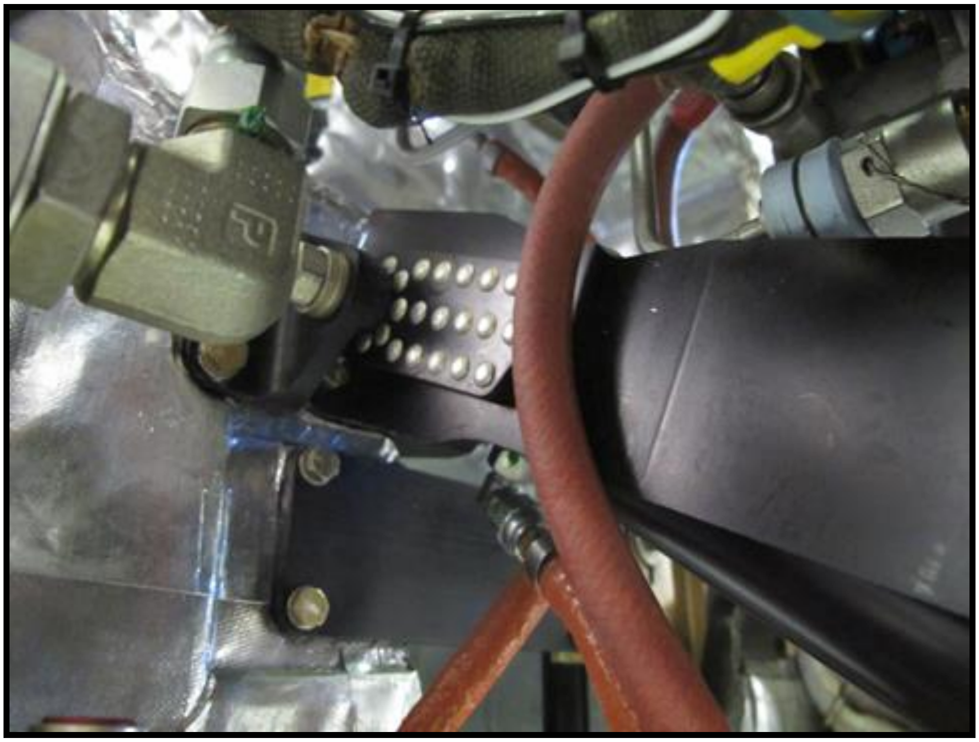
Main landing gear trunnion attach fitting

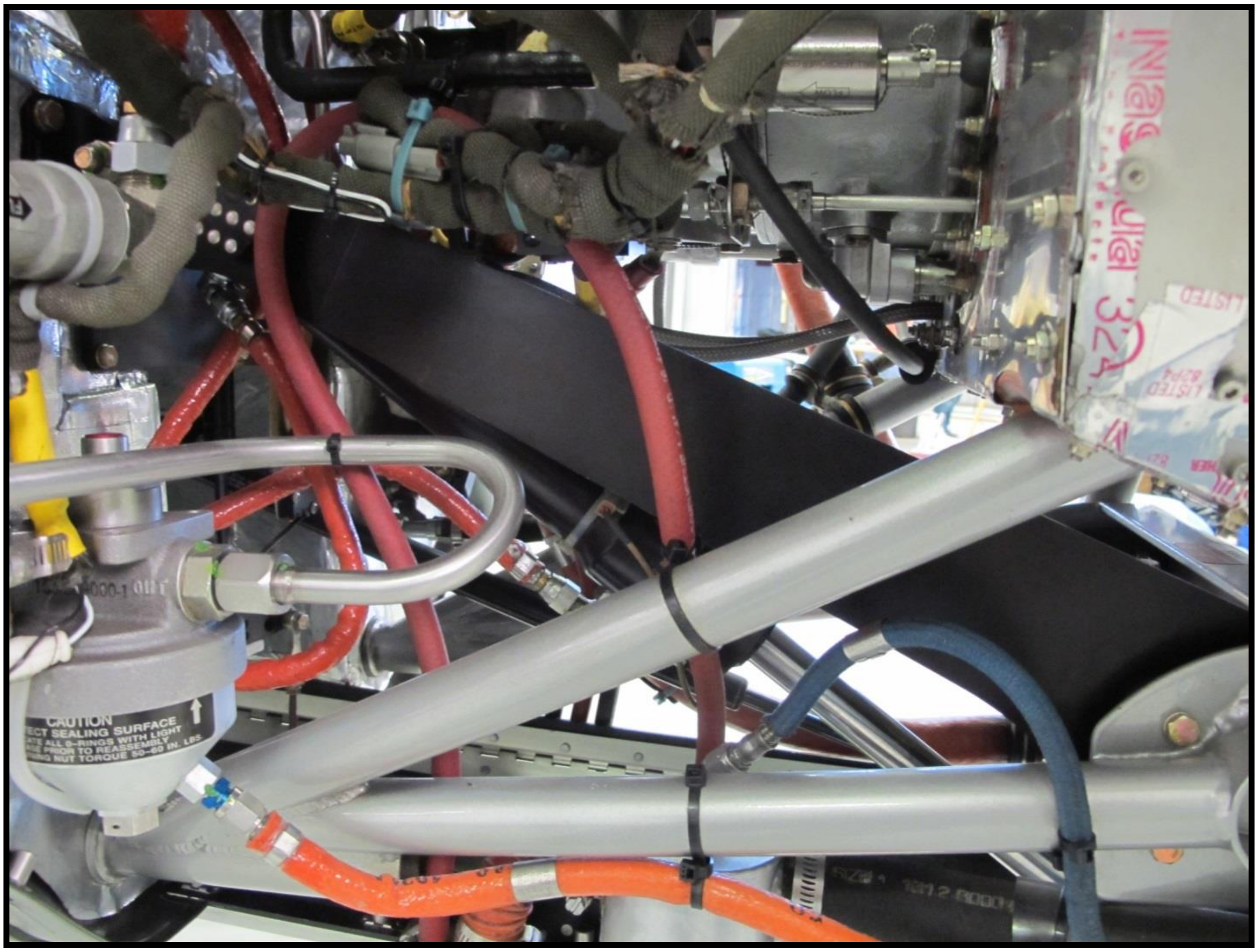
Main landing gear door pushrod attached to landing gear and door



Nose gear tunnel with doors extended

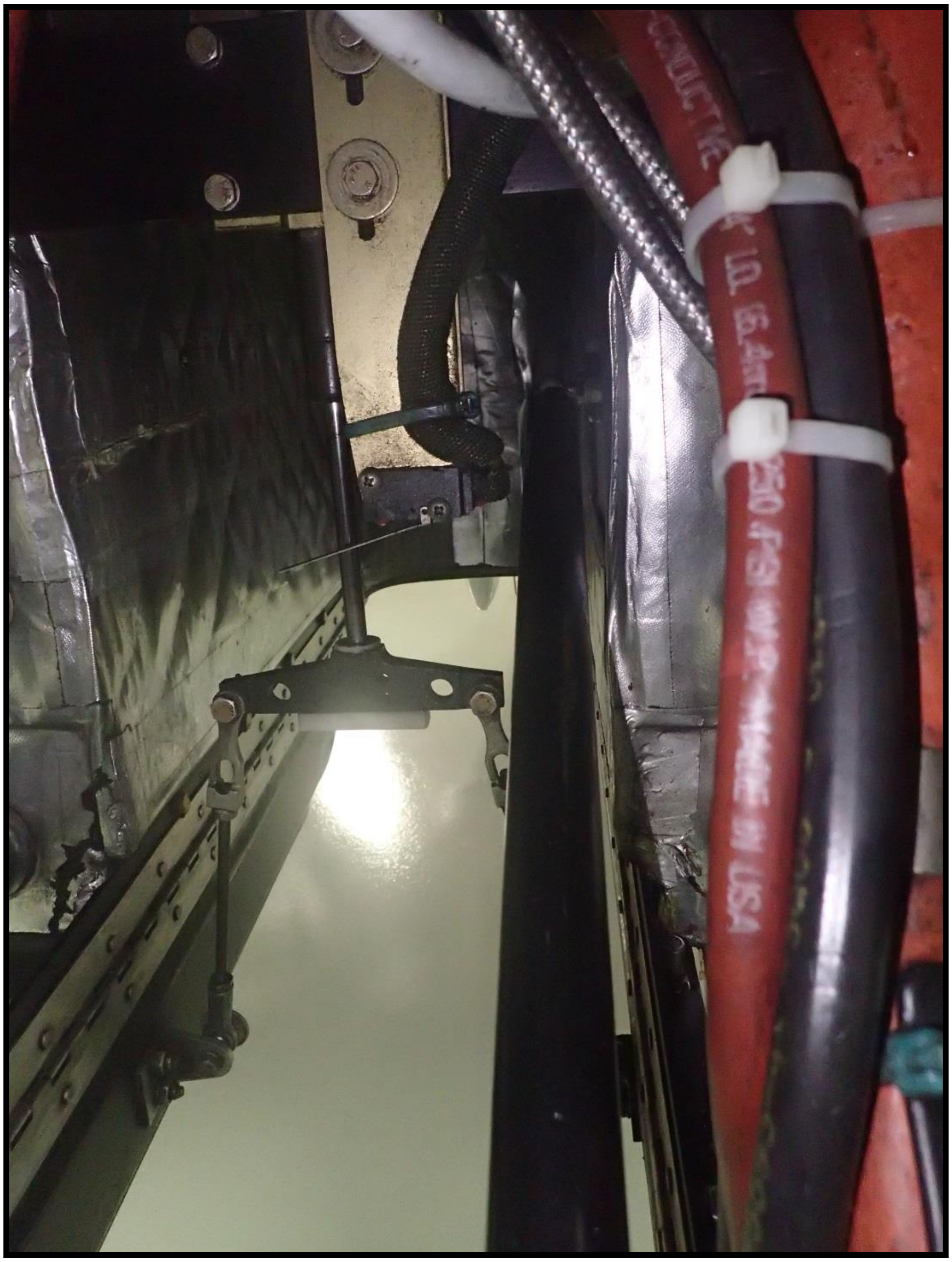
Nose gear strut and wheel and tire assembly


Nose gear strap (Service Bulletin)



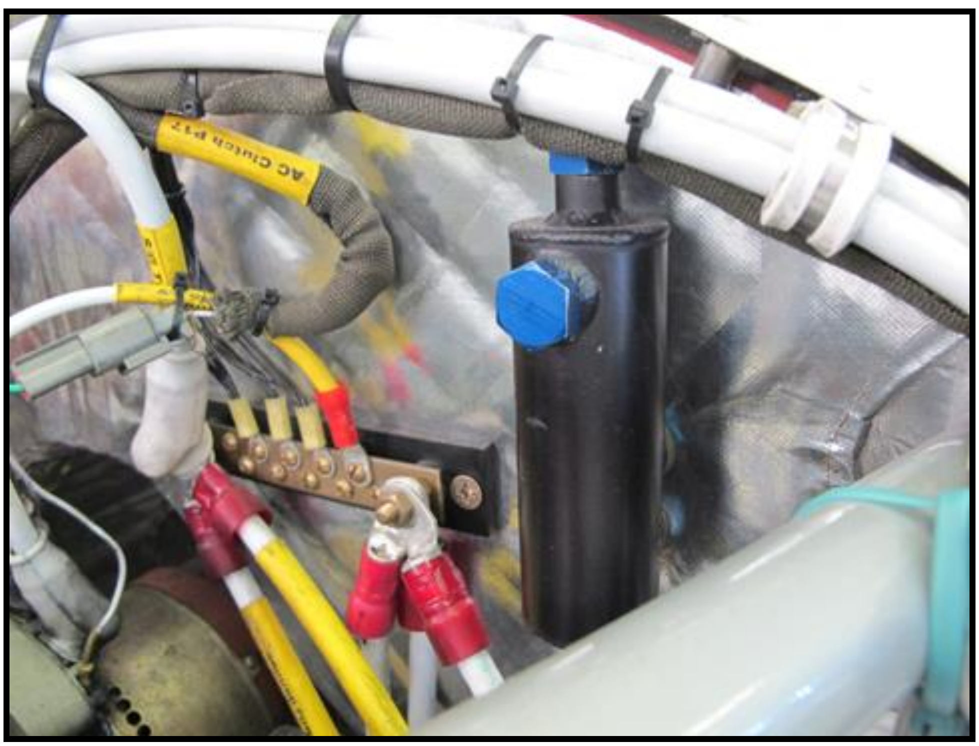
Nose gear strap (right side view)

Nose gear gas strut



Nose gear door pushrods

Checking brake pads for wear thickness with a Cleveland “no go” guage (green)



Brake reservoir on firewall


Nose wheel and tire

Nose gear actuator (top) and gas strut (bottom)


Main landing gear hydraulic actuator with Bimba switch

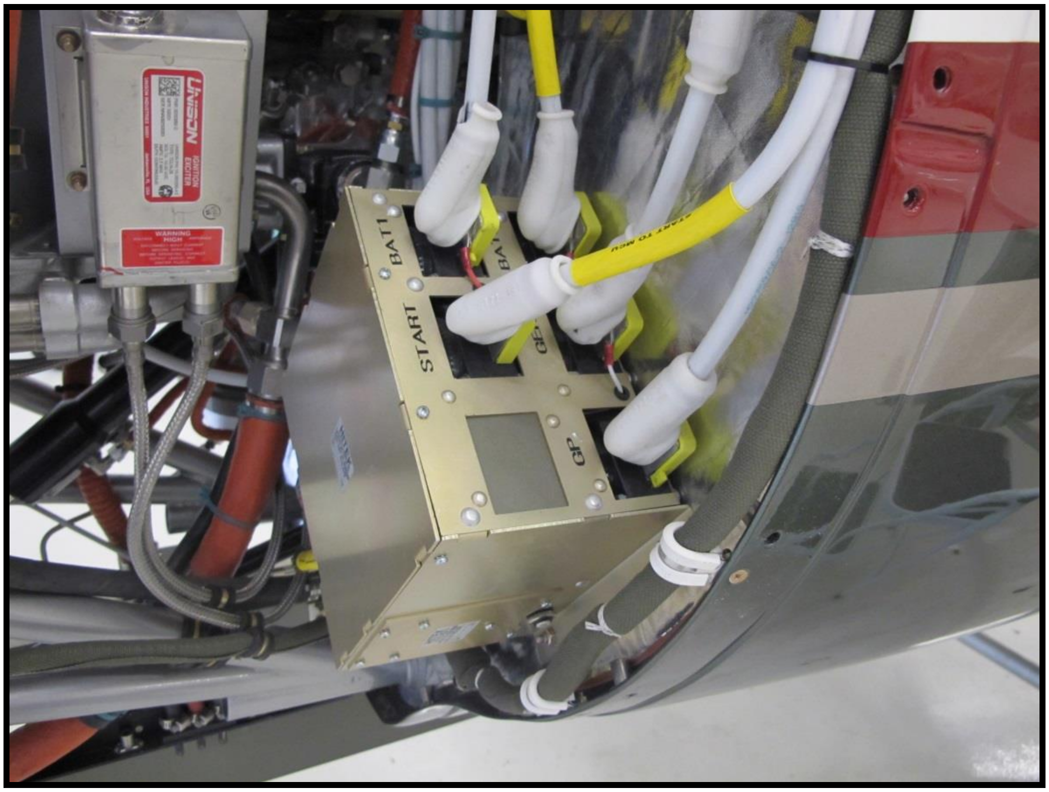
Cleveland wheel and brake assy.

Garmin G1000 Instrument Panel


Main landing gear hydraulic actuator

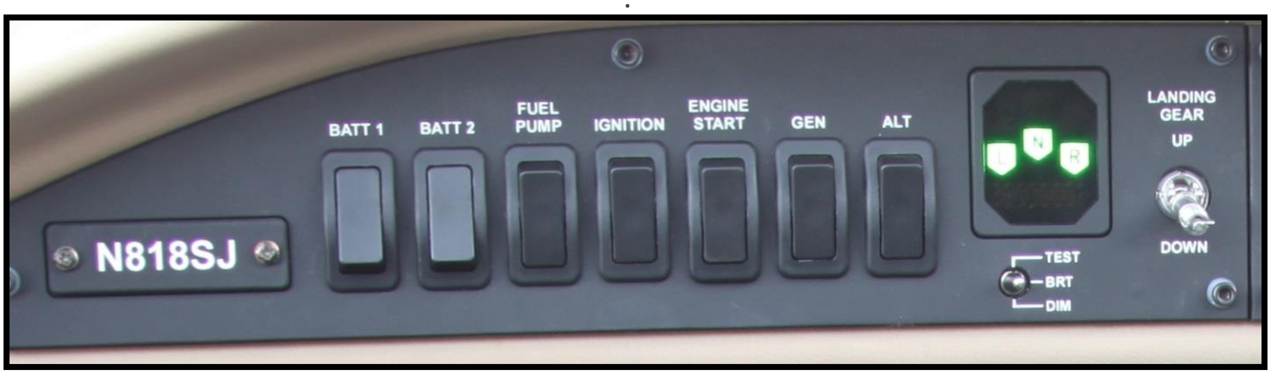
ELECTRICAL

In general, the airplane’s circuitry is dual – wire with ground return. A Master Control Unit (MCU) controls power to the system with relays. It is located on the port side firewall. Below it is the external power receptacle.



Master Control Unit (MCU)

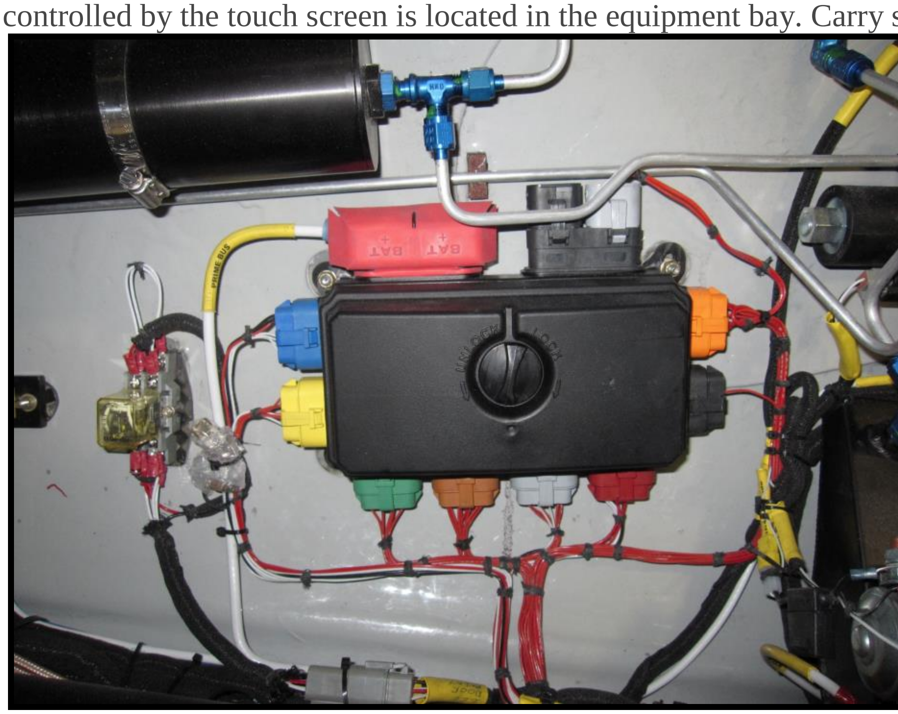
.



The battery, generator, and the start switches are located on the left brow panel The circuit breakers are located in the circuit breaker box between the pilot and copilot seat or under the power quadrant.

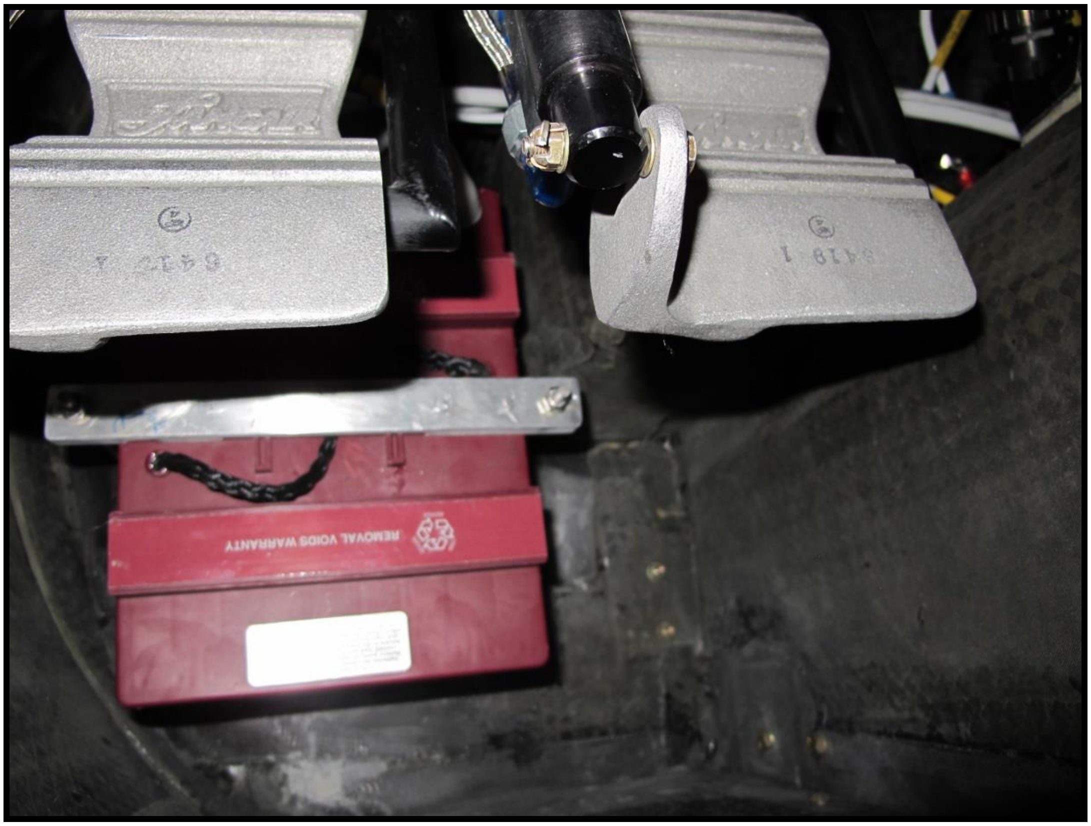
Circuit Breaker Panel

A fuse panel controlled by the touch screen is located in the equipment bay. Carry spare fuses!

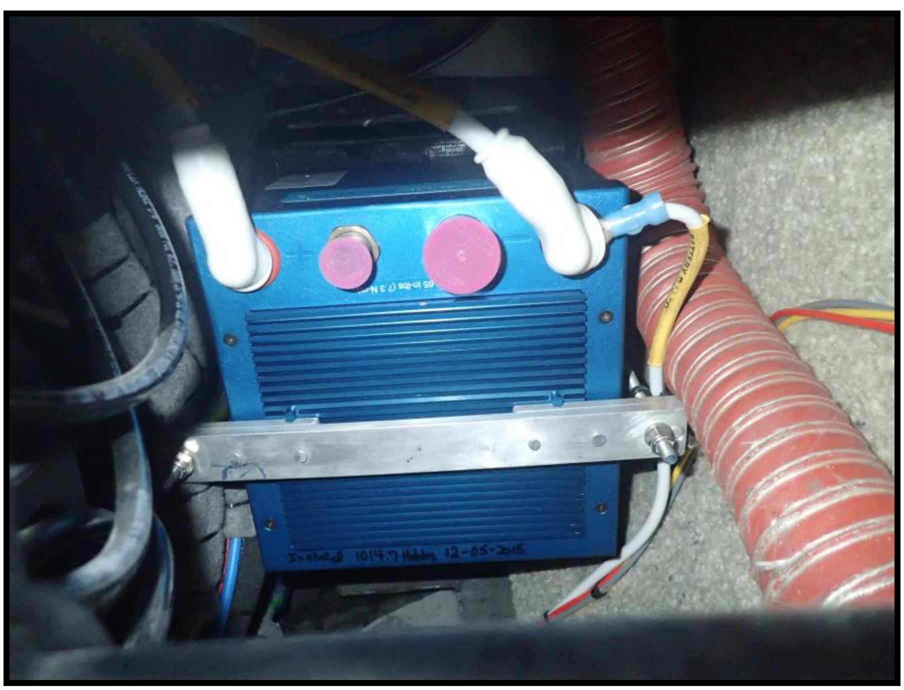


Fuse Panel

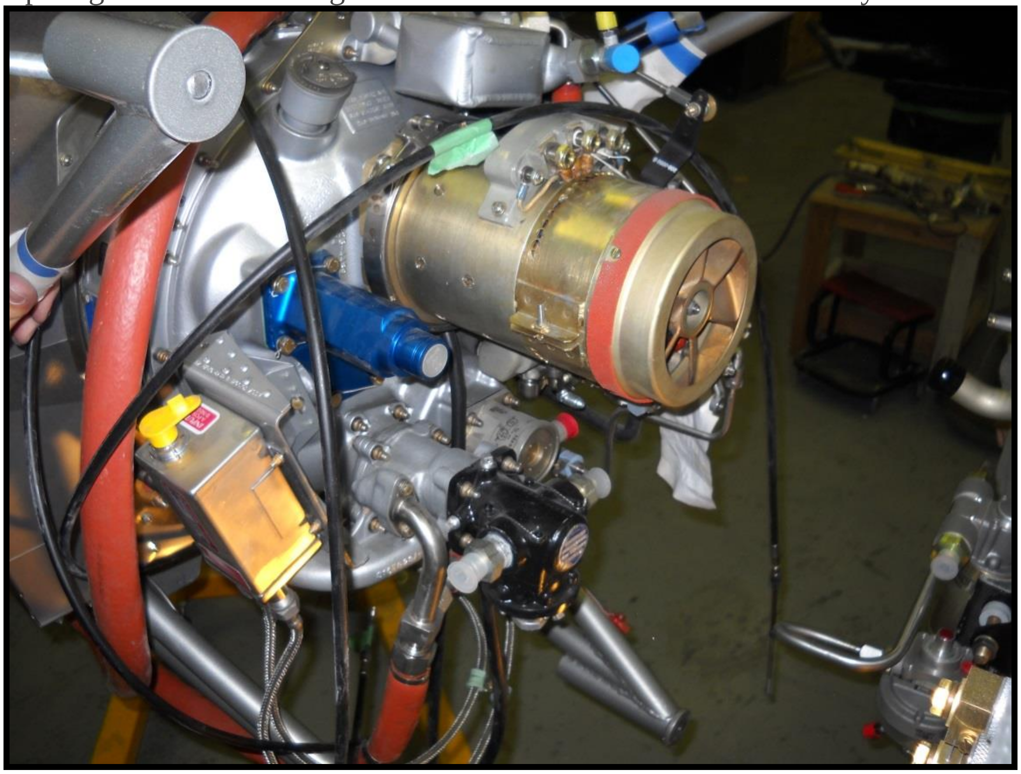
The standard battery installation is two 24 -volt batteries located on the cabin side of the firewall.



Or, you may have Mid Continent lithium batteries saving 35 pounds per battery.



A 300 ampere gear driven starter generator is mounted on the rear accessory case of the engine.

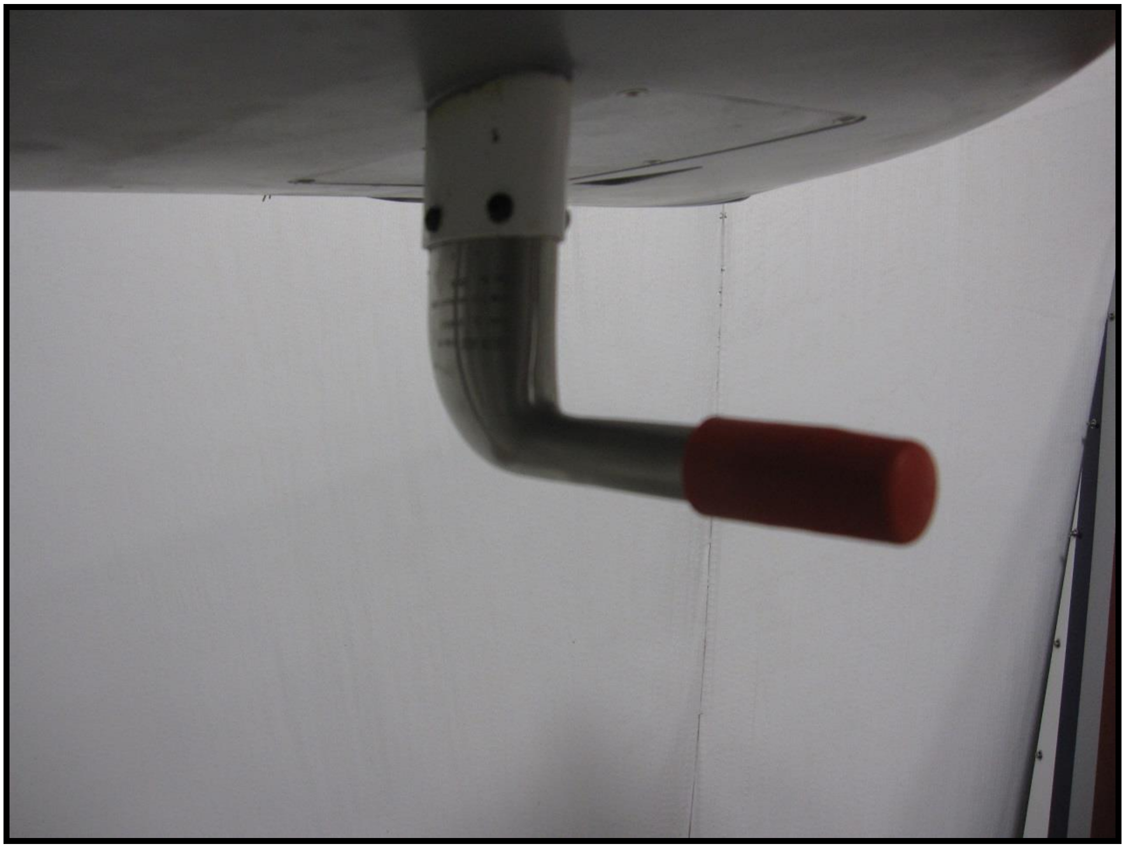


Starter Generator (gold)

A transistorized voltage regulator adjusts alternator output to the required load of 28 volts. The engine starter is located on the engine accessory case (aft right side). To energize the starter circuit, hold start switch in the START position. There is a 30 second limit on starter operation. An ammeter/ load meter is displayed on the EFIS.

PITOT STATIC

The aircraft has one electrically heated pitot tube mounted on the outboard left wing underside. The pitot heat switch is located on overhead panel on early aircraft and should be "on" from takeoff to landing. Two unheated static sources are mounted on the aft fuselage. A static drain is not usually installed.

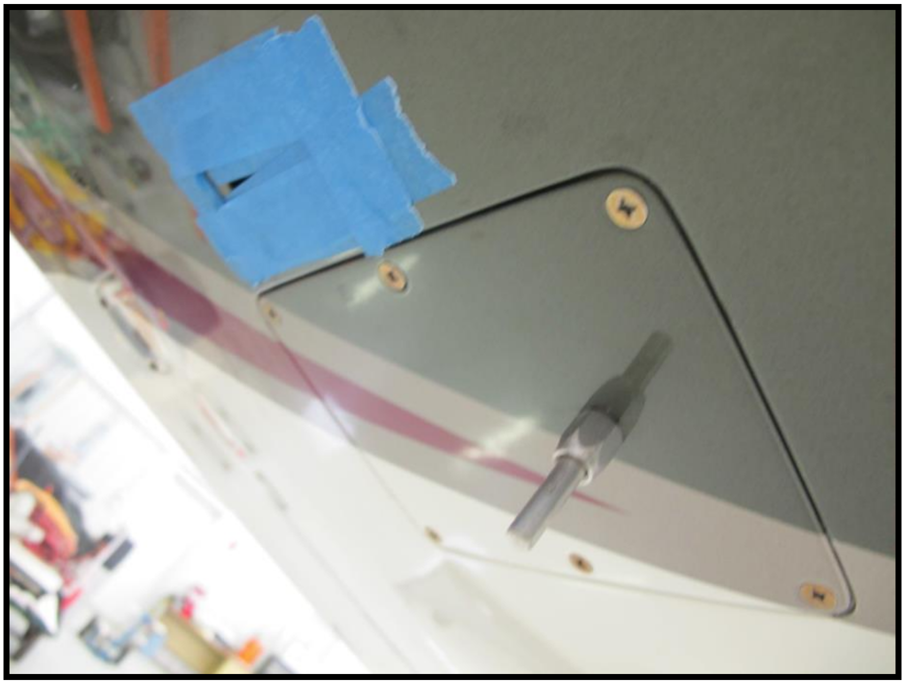


Pitot mast

FUEL SYSTEM

Fuel bays

The aircraft has two wet wing fuel tanks and they run from the wheel well to the outboard end of each wing. The fuel capacity is 172 gallons. The tanks are vented to the outside atmosphere by ports on the bottom of the wingtips.

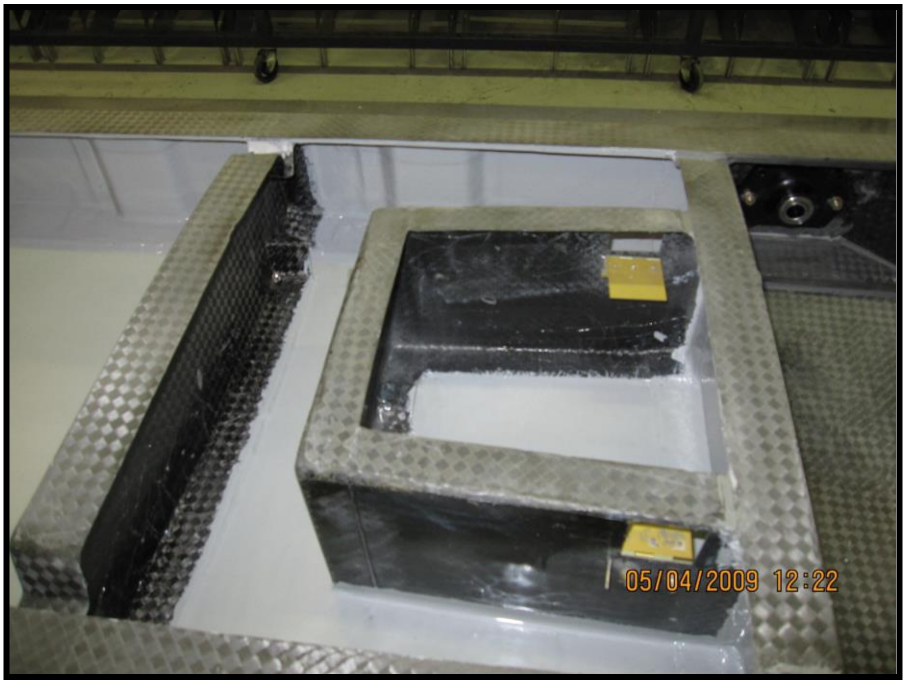


Temperature Probe

Each fuel cell has flush type filler caps mounted above the cell. There is one low point drain on each wing. **The drains should be sumped before flight to remove and water or debis from the fuel cells. The engine does not tolertate any water or contaminants!**

Feul Tank Drain

Fuel runs into a baffle tank on the inboard end of the cell. It has a one way flapper valve that keeps fuel from running outboard in unbalanced flight. Generally, two gallons is unusable per wing. If you fly in an unbalanced condition (wing low and ball out to the side) for too long the fuel will migrate outboard and you can cause a loss of fuel flow due to the baffle tank not being resupplied by the wing tank fuel.



Baffle Tank (shown upside down with gold flapper valves)

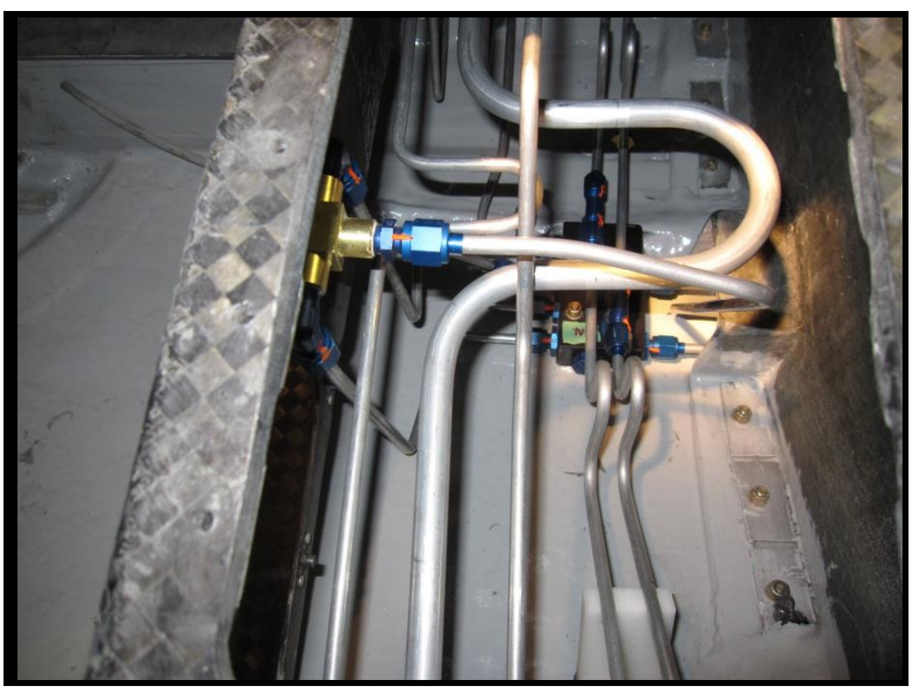
The fuel quantity probe installs from the wheel well and runs the length of the wing. It is a capacitance probe.

Fuel Probe

The fuel flows from the wing through fuel lines in the leading inboard edge to the fuselage and under the pilot's and co-pilot's seats to a selector valve.

Fuel Lines in Wing

The fuel selector valve is located on the floor between the pilot seats and has a LEFT, RIGHT and OFF position. Fuel will not flow if the pilot selects an intermediate position. The pilot must select the respective tank and switch tanks often in flight in order to maintain a balanced wing fuel weight. Staying balanced within ten gallons is recommended.

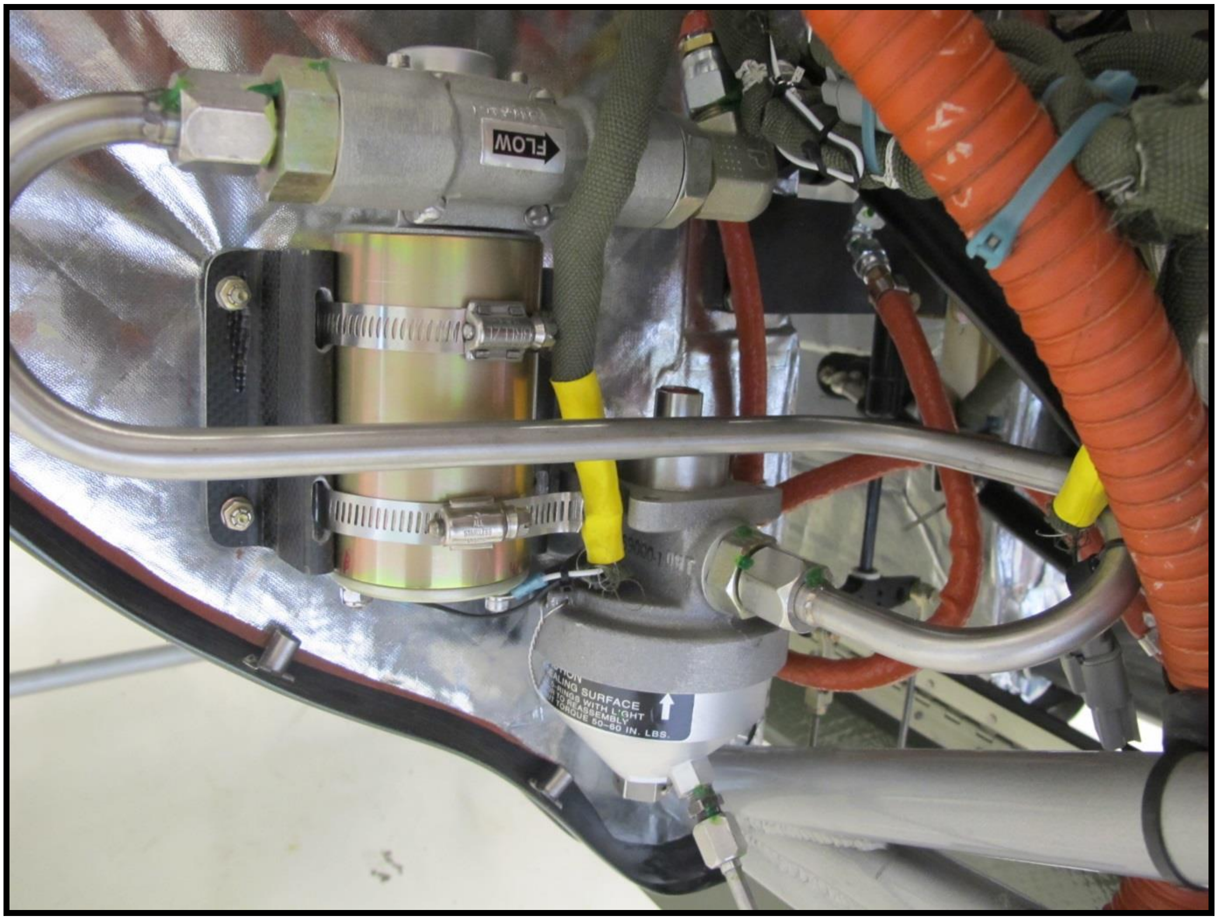


Fuel Lines in Cabin

Fuel and hydraulic lines under pilots seats

Fuel Selector Valve

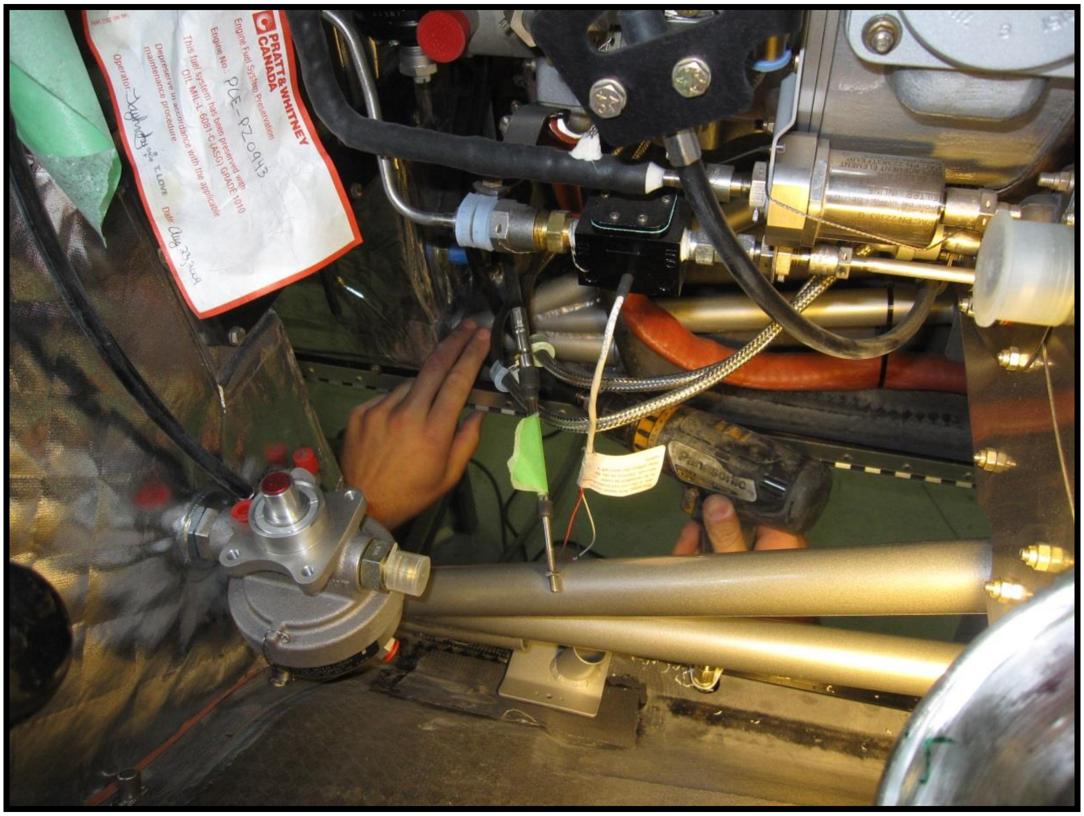
Fuel flows from the selector valve to the fuel filter on the forward lower right side of the firewall and thence to the electric boost pump also located on the lower right firewall.



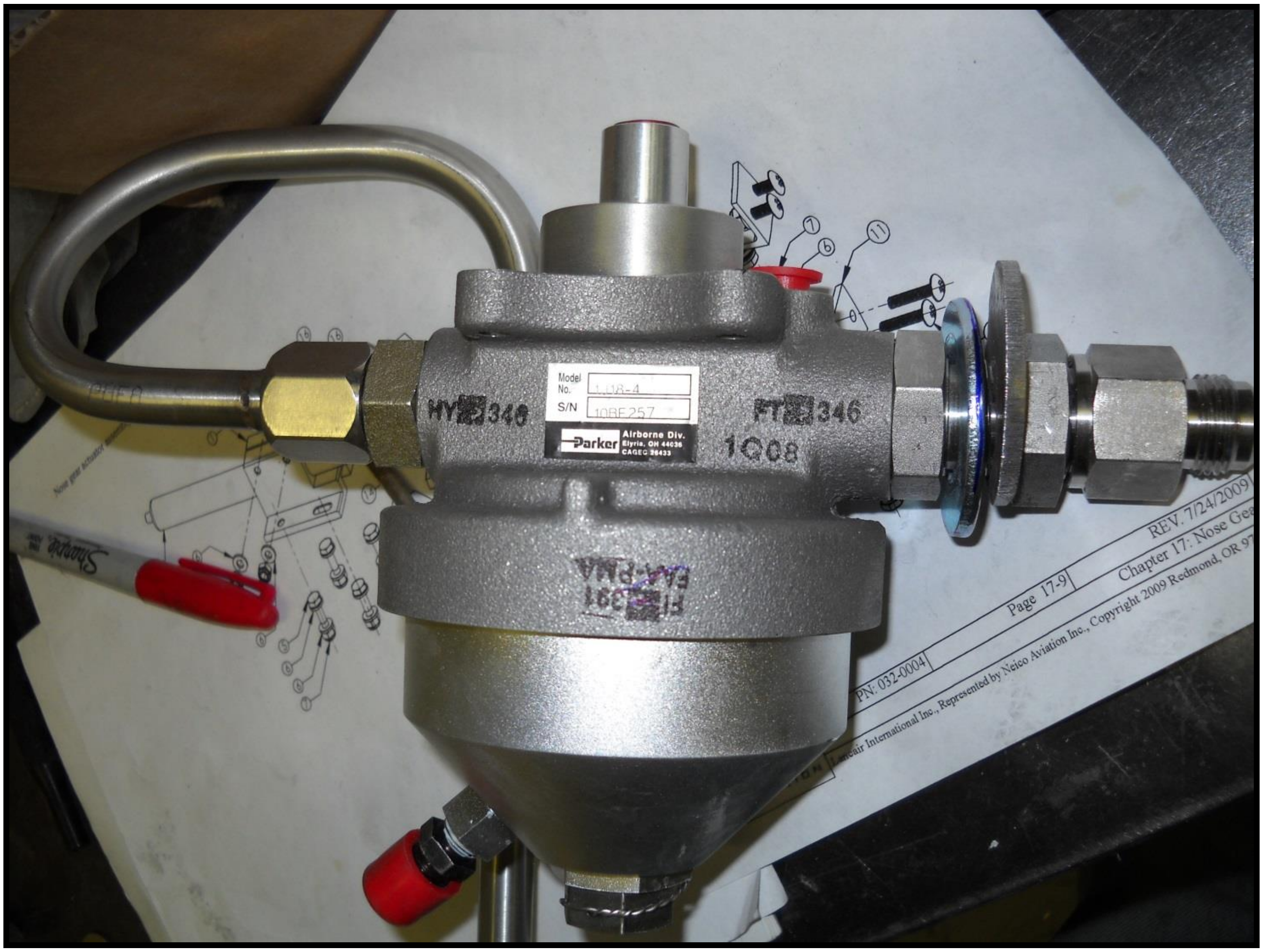
Electric boost pump (top left) and gascolator (fuel filter)

Electric Fuel Boost Pump

The fuel pump should be run continuously from start to shutdown. It is very important to NOT shutdown the engine with the pump "off"—otherwise damage to the pump may occur over time. The fuel control has an hour limit on running without positive fuel pressure coming into the fuel control. Excessive operation without a fuel pump oerating will damage the fuel control and lead to an expensive repair. **The airframe filter/ sump should be drained often to keep water and debris out of the engine**. Annually, it should be disassembled, cleaned and reassembled per the manufacturer's procedures. * see EPS RECOMMENDATION REGARDING DUAL FUEL PUMP INSTALLATIONS)

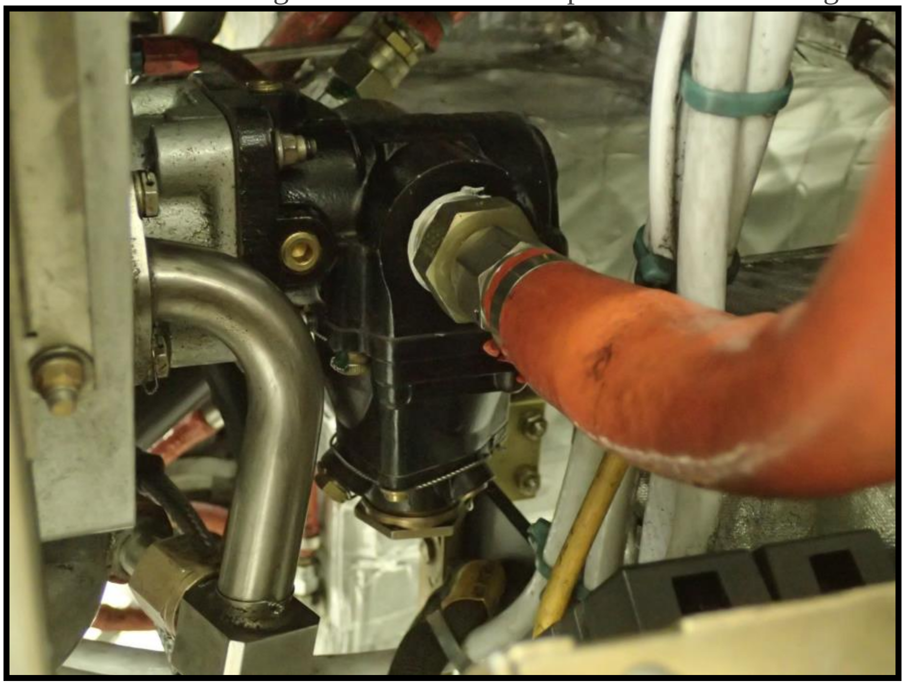


Fuel filter (lower left)



Fuel filter (gascolator)

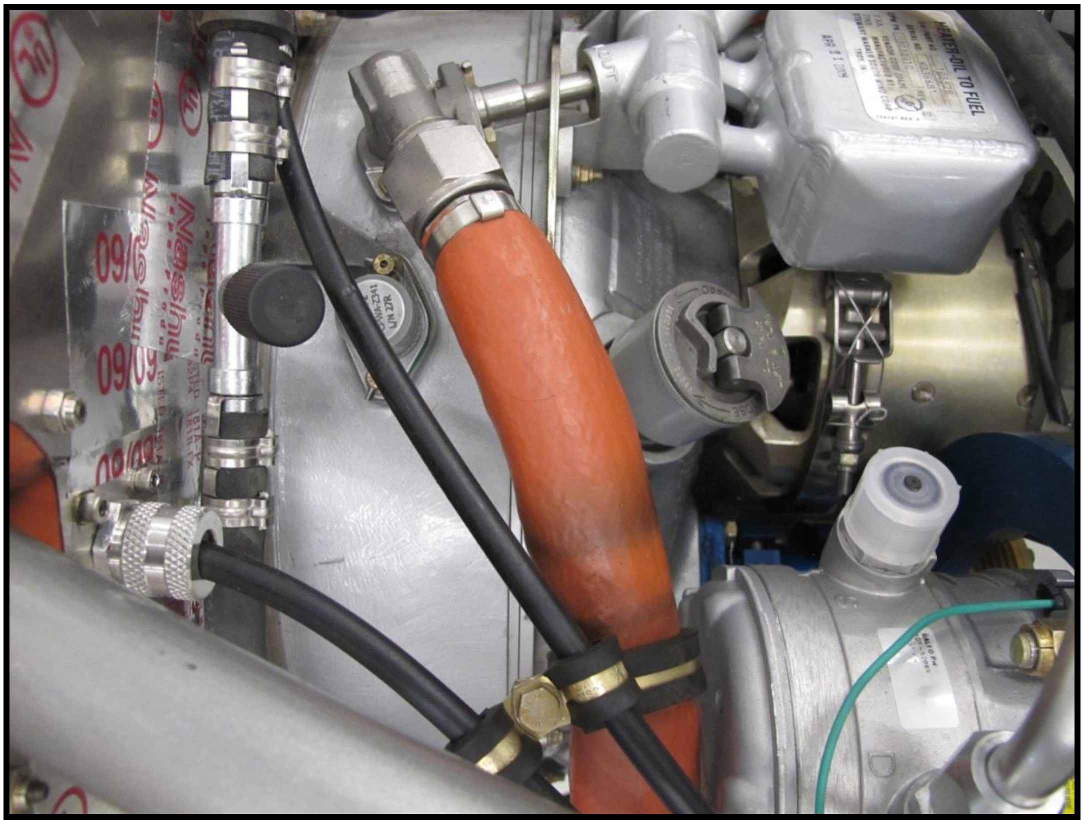
Gascolator Being Disassembled for Inspection and Cleaning



Mechanical Engine Drive Fuel Pump on Engine Accessory Pad

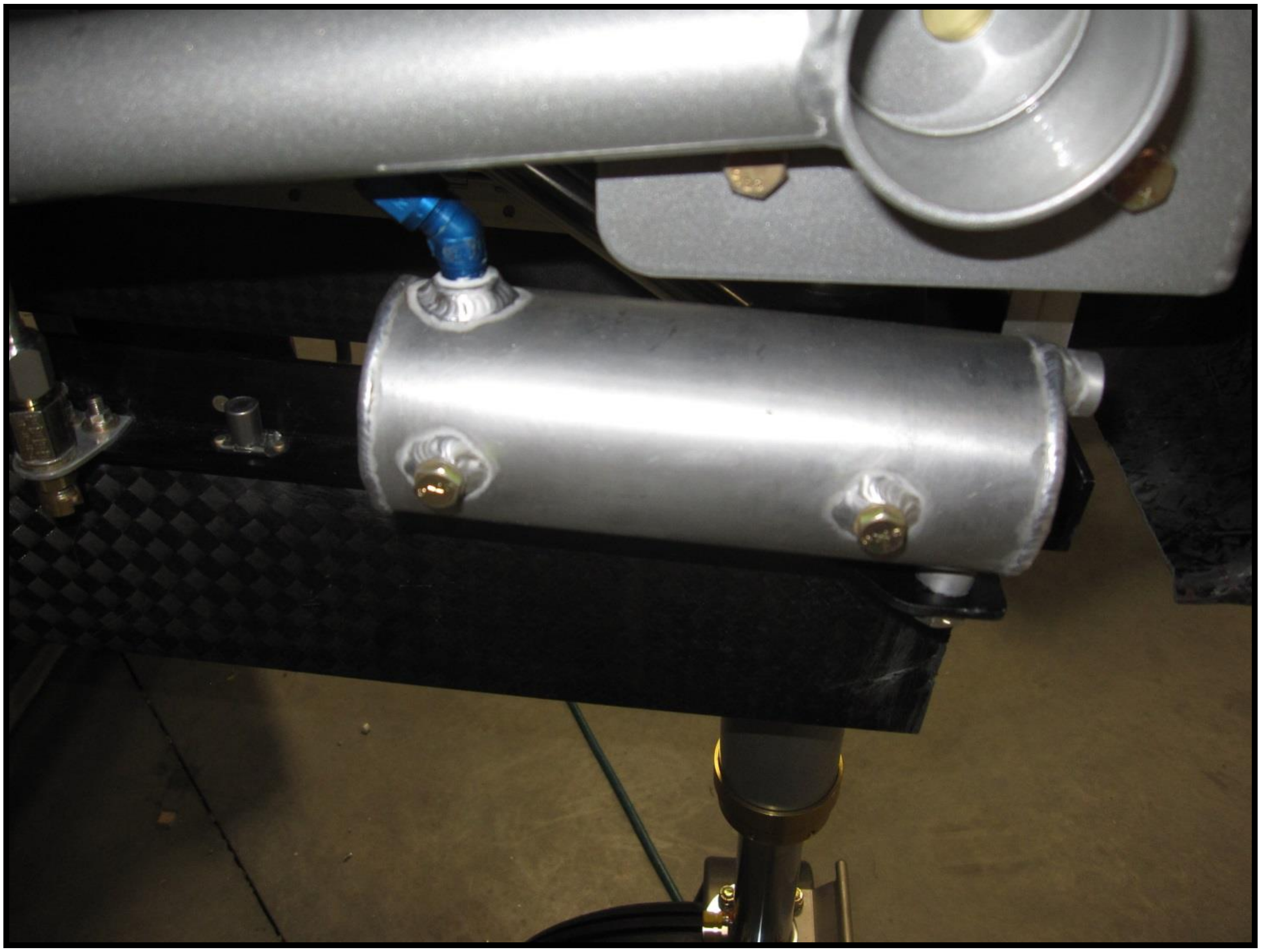
Fuel flows from the filter to the engine driven fuel pump on the accessory pad of the engine through the engine / oil heat exchanger, warming fuel and cooling the oil, thence to the fuel manifold and fuel nozzles where it goes into the burner can. Excess fuel returns to the fuel tank selected via a return fuel line. Fuel left in the manifold line is “dumped” on engine shutdown to the EPA can located on the nose gear door support. This can should be drained prior to each flight to prevent fuel from being discharged onto the ground.

Oil / Fuel heat exchanger



Oil / Fuel heat exchanger (top right)

.



EPA Can

HYDRAULIC

A 2000 psi hydraulic system operates the landing gear. The electrically powered hydraulic pump "power pack" is mounted in the port aft side equipment bay and is accessed through a removable panel. A reservoir is attached to the pump.

The Evolution hydraulic system consists of the following components: hydraulic pump, check valve, thermal relief valves (2), pressure relief valves (1), reservoir, accumulator, manifold blocks (2), solenoids (2), counter balance valve, pressure switch, dump valve, hydraulic circuit breaker, locking actuators (3), micro switches (6).

The system drives the landing gear utilizing a one way hydraulic pump which pressurizes an accumulator through a one way check valve. The accumulator is of sufficient volume to actuate the gear up or down. The hydraulic pump re-pressurizes the accumulator and augments flow for the transition of the landing gear. Once system pressure is reached, a pressure switch turns off power to a solenoid which de-activates the hydraulic pump. The solenoid can also be de-activated by the **HYD PUMP** circuit breaker.

The hydraulic pump located under the pilot side baggage floorboard contains one pressure relief valve and one thermal relief valve. In the event that the pressure switch does not de-activate the pump and sufficient pressure is reached, a pressure relief valve will bypass the pump and return fluid to the reservoir. Continuous operation of the pump should be avoided as this can result in excess heat and damage to the pump.

The hydraulic system is also protected from thermal damage with two thermal relief valves. These relief valves are set higher than the normal pressure relief valves. One valve is located in the hydraulic pump and protects corresponding portion of the hydraulic circuit. The other relief valve protects the accumulator and the corresponding portion of hydraulic circuit.

Two solenoids, one counterbalance valve, and pressure switch are mounted in a manifold connected the hydraulic pump. The solenoids control the flow of fluid to retract and extend circuits. When the solenoid is activated, fluid flows from the accumulator/pump to the corresponding retract or extend side. Alternatively, the opposite solenoid is de-activated allowing fluid to return back to the reservoir.

The counterbalance valve allows free flow on the retract circuit and a restriction of flow of fluid to return to the reservoir preventing cavitation of the hydraulic pump; cavitation is due in part to gravity pulling the gear down faster than the pump can generate flow (accumulator also helps to maintain pressure and reduce cavitation). The counterbalance valve also maintains the gear in the retract position when power is turned off to the solenoids, i.e. complete in-flight electrical failure.

Once the fluid passes the rear manifold, the fluid is directed to the second manifold located underneath the pilot's seat. This manifold directs fluid to the three locking actuators. Additionally, the dump valve is connected to this manifold which allows for retract and extend circuits to both be returned to the reservoir.

The locking actuators are locked in the down position positively by 8 ball bearings. A differential pressure in excess of 50 psi must be applied to the retract circuit before a piston retracts in each actuator allowing the 8 ball bearings to retract. Once the ball bearings retract, the actuator is free to move. No pressure is required to lock the actuator once fully extended as the piston is supplemented with a spring. A magnetic ring is connected to the locking piston which activates a reed switch mounted on the external body of the locking actuator cylinder. These micro switches control the green lights on the gear panel. Three additional micro switches are mounted in the gear well and are activated by the gear doors. These micro switches control the red transition lights in the gear panel.

Failure Modes of Hydraulic System Components and Indications

Hydraulic pump: **HYD PUMP** light will not illuminate; no pump noise. Gear will retract or extend by accumulator. Subsequent retractions or extensions may not continue to completion. Additionally accumulator with extinguish reserve volume. Attention should be paid on each retraction and extension to insure pump is running and recharging accumulator. Pump cycling: leak in system. Dump valve, Solenoids, and actuators, are three most common culprits in that order.

Accumulator: Hydraulic pump will retract or extend gear. Significant more time will be required for cycle to complete.

Pressure switch: Gear will either not activate or continue to run depending on failure.

Check valve: Pump will spin backwards and bleed off all hydraulic pressure

Solenoids: Both off (power *off/loss* of power): Gear will continue to stay retracted if counter balance is properly adjusted or drop out of wheel well if not; gear continues to stay down and locked in down position. Both on (failure of gear switch): Gear will drive down slowly and lock *(Need* to *check, but theoretically should)*

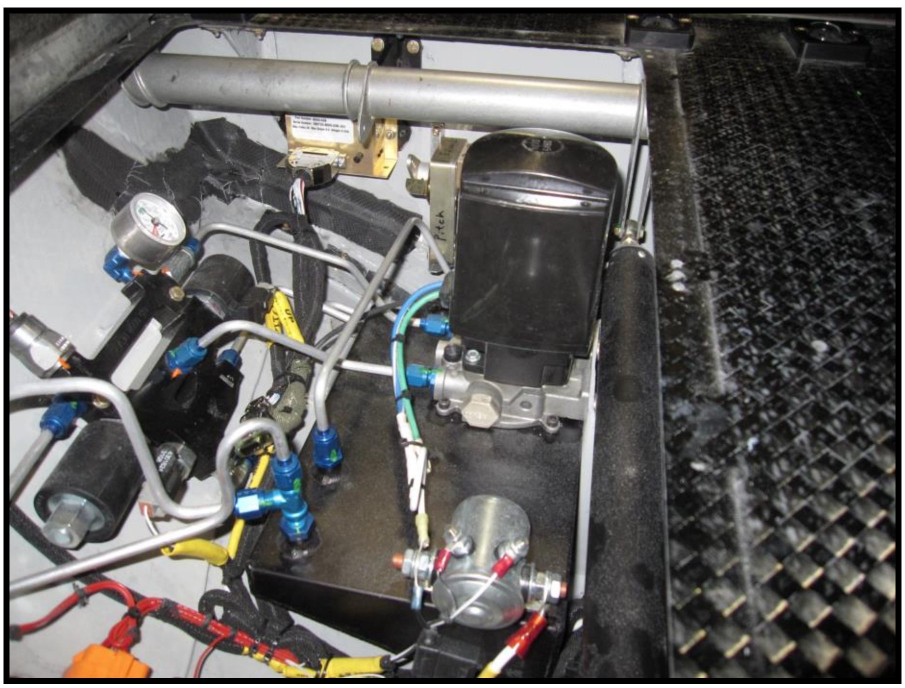
Emergency procedure: Hydraulic System

Select Gear Down. If gear does not extend and lock complete following:

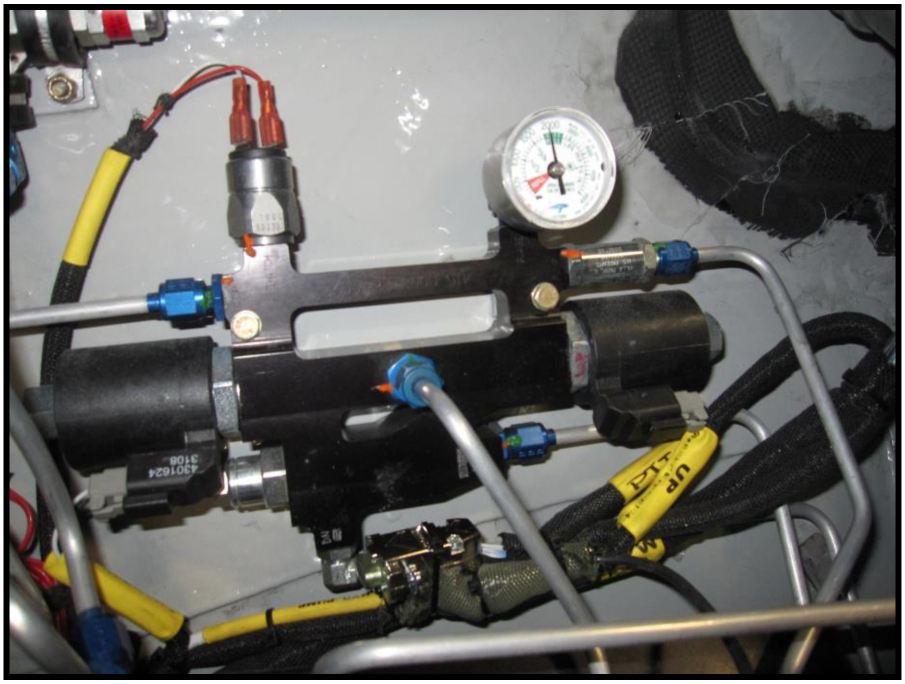
Pull **HYD PUMP** circuit breaker

Rotate dump valve to horizontal position

Yaw tail with rudder as necessary to attain 3 green lights

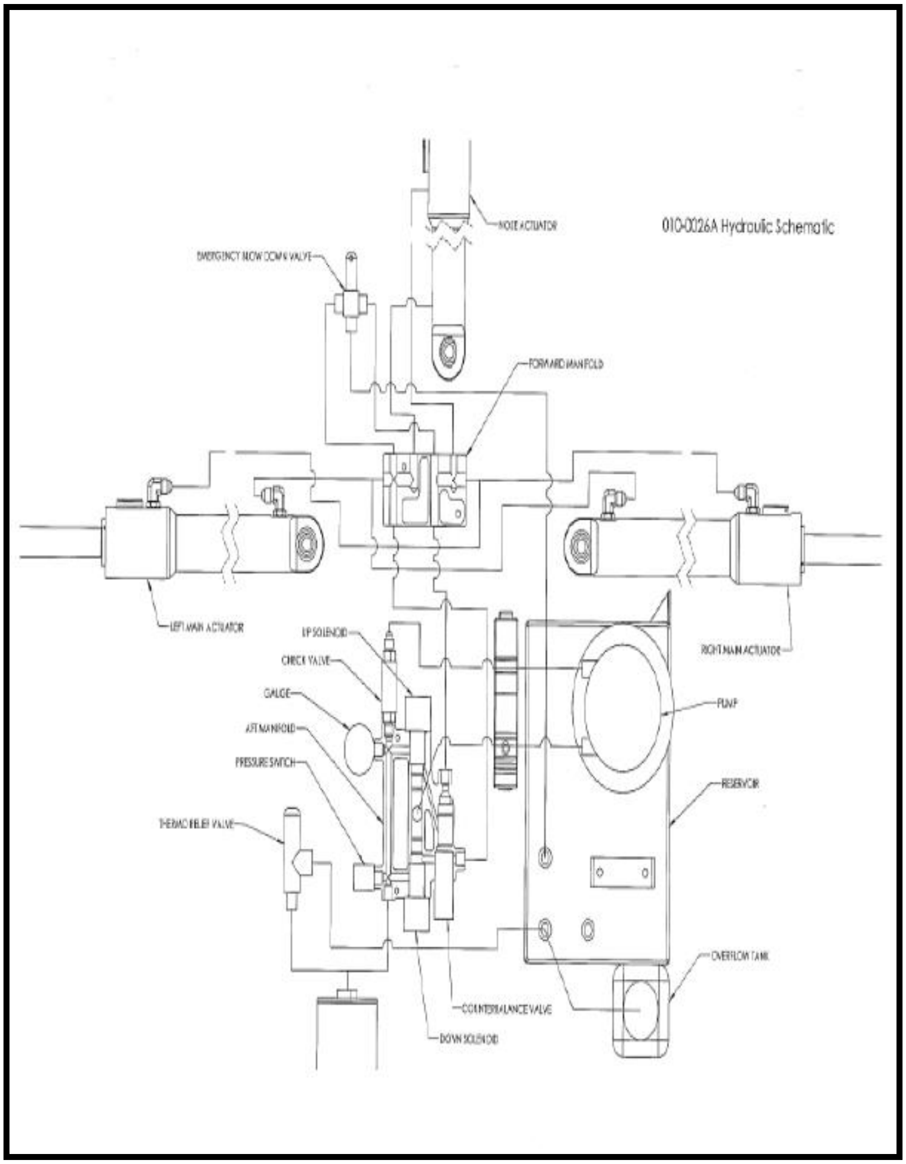


Hydraulic pump, motor and reservoir



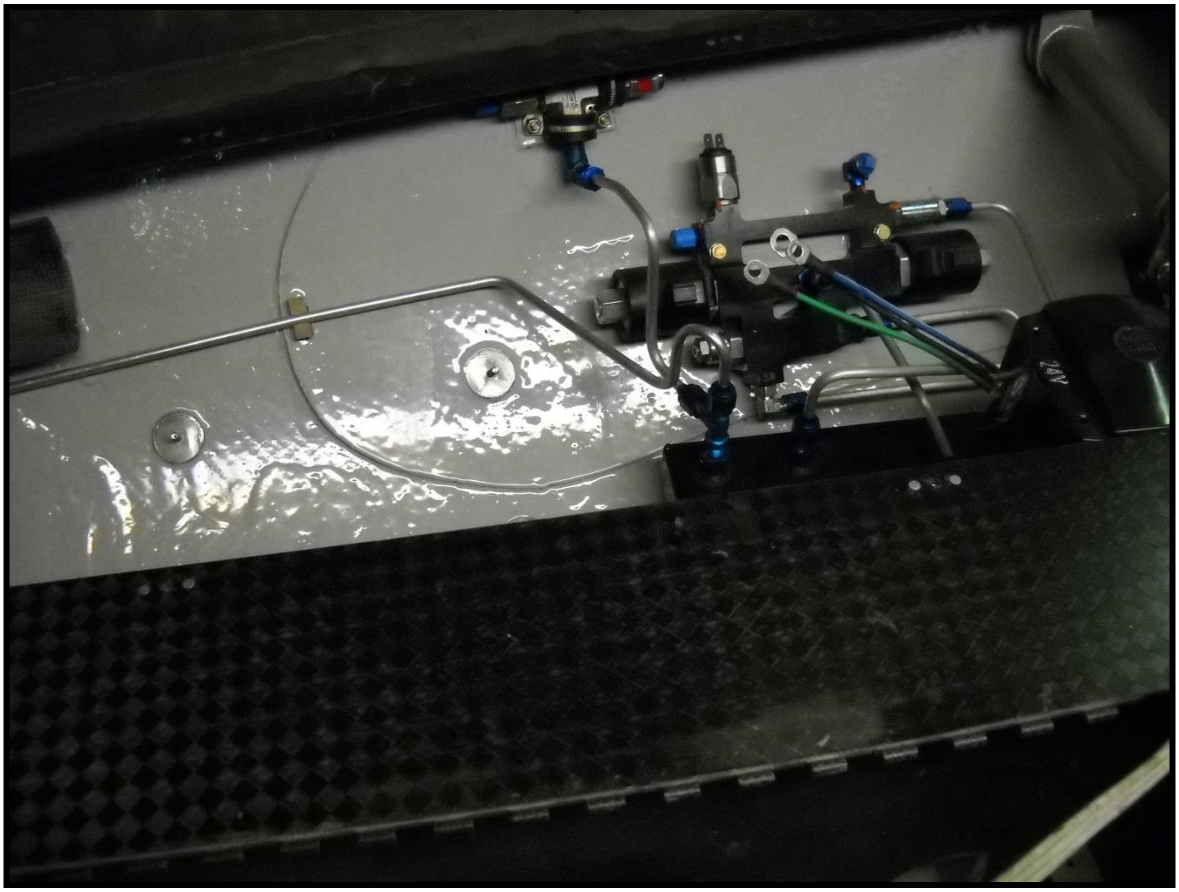
Hydraulic manifold

A schematic outlines the operation of the hydraulic system.

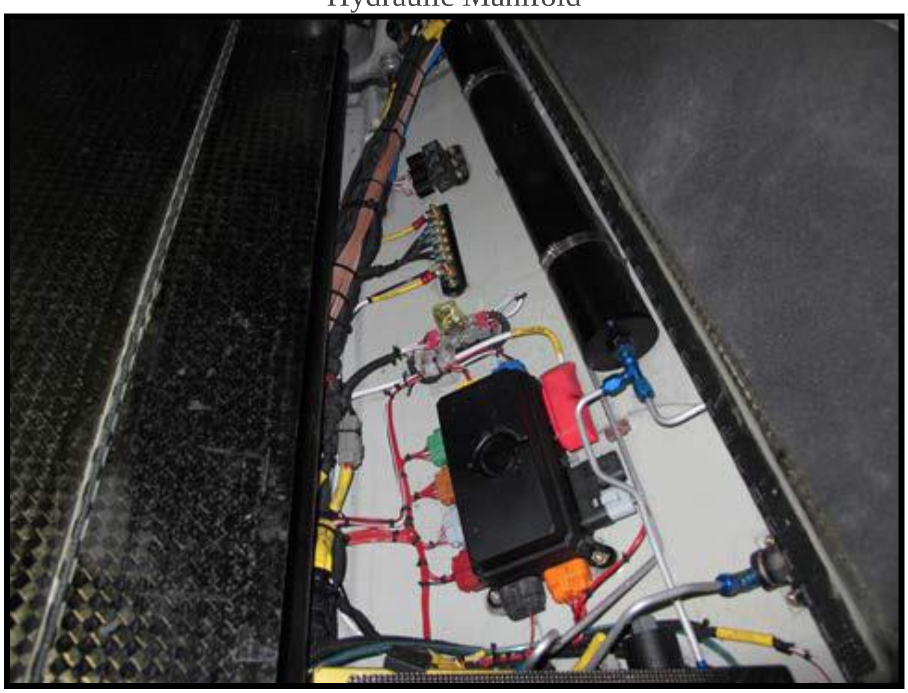

010-0026A Hydraulic Schematic
NOSE ACTUATOR
EMERGENCY BLOW DOWN VALVE
FORWARD MANIFOLD
LEFT MAIN ACTUATOR
RIGHT MAIN ACTUATOR
UP SOLENOID
CHECK VALVE
GAUGE
AFT MANIFOLD
PRESSURE SWITCH
THERMO RELIEF VALVE
PUMP
RESERVOIR
OVERFLOW TANK
COUNTERBALANCE VALVE
DOWN SOLENOID

The system is powered through a 35A circuit breaker located on the panel.

A manifold directs hydraulic pressure to the respective landing gear. Service the reservoir with MIL H 5606 hydraulic fluid. With the landing gear down the reservoir should be filled to within an inch of the filler neck.



Hydraulic Manifold


Equipment Bay with Hydraulic Pump, Reservoir, and Accumulator

An accumulator acts as a “shock absorber” in the system.

Accumulator

A secondary manifold under the pilot seat allows for emergency gear operation.

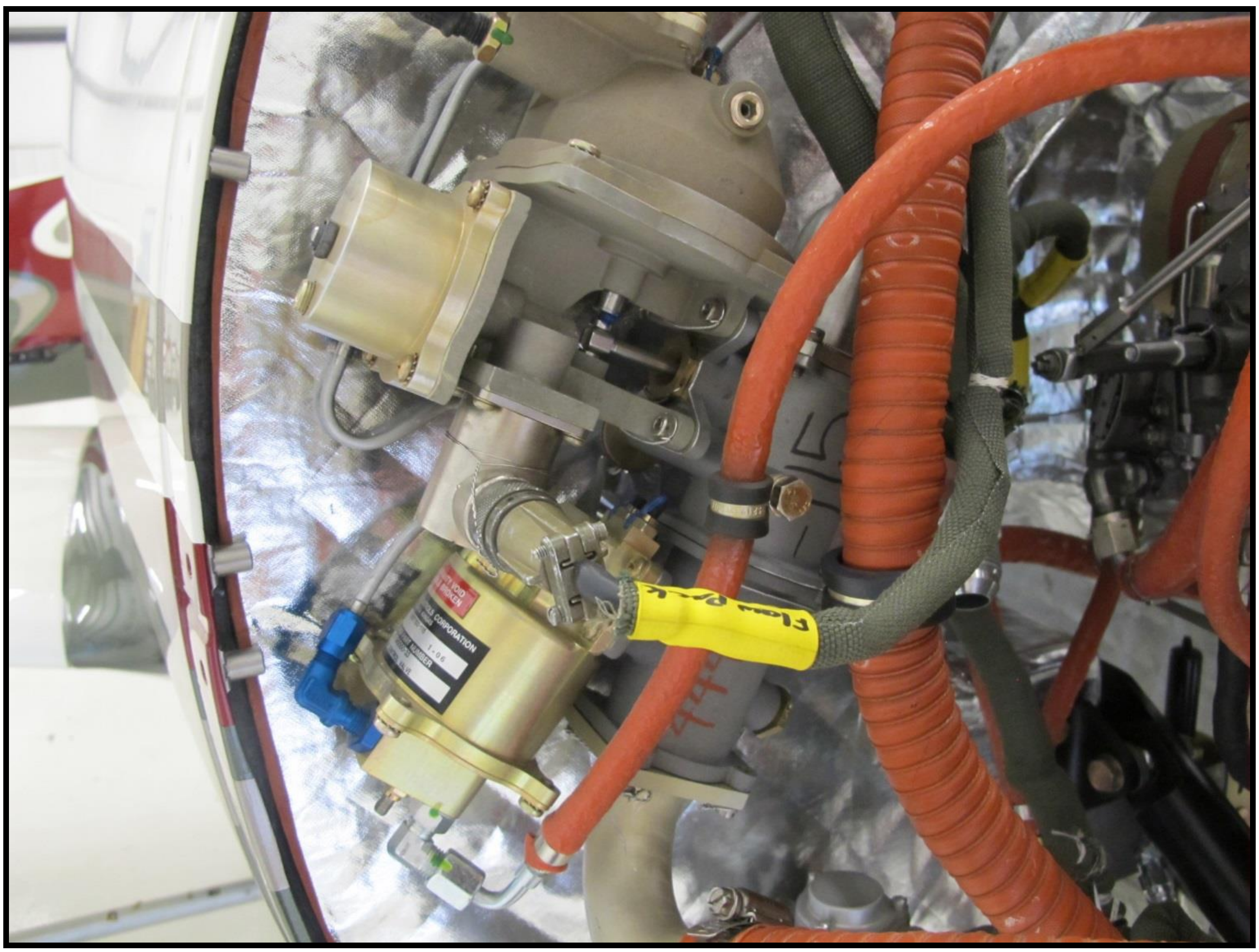
PRESSURIZATION

The Lancair EVOLUTION aircraft has a determined maximum pressure differential of 6.5 PSID which is the maximum differential between cabin and ambient altitudes that the pressurized section of the aircraft can support. Cabin pressurization is obtained by the compression of air in the aircraft cabin to maintain a cabin altitude lower (higher pressure) than the actual flight altitude (lower pressure). At FL 280 and 6.5 psid the cabin altitude is maintained at 8,000' MSL.

The cabin altitude can be selected and is monitored by the Maritz ECS screen, which indicates the pressure difference between the cabin and ambient altitudes. The rate of change between those two pressures is automatically controlled. In addition, a bleed air switch mounted overhead or on the panel energizes the flow pack allowing bleed air into the cabin. The doors seals must be energized and inflated to allow the cabin to pressurize.

Engine "bleed air" is taken from the compressor stage of the engine and routed through an intercooler on the right side of the lower engine cowl before it goes to the "flow pack" on the forward side of the fire wall. The purpose of the flow pack is to reduce pressure and temperature.

NACA duct with intercooler on right side lower engine cowling

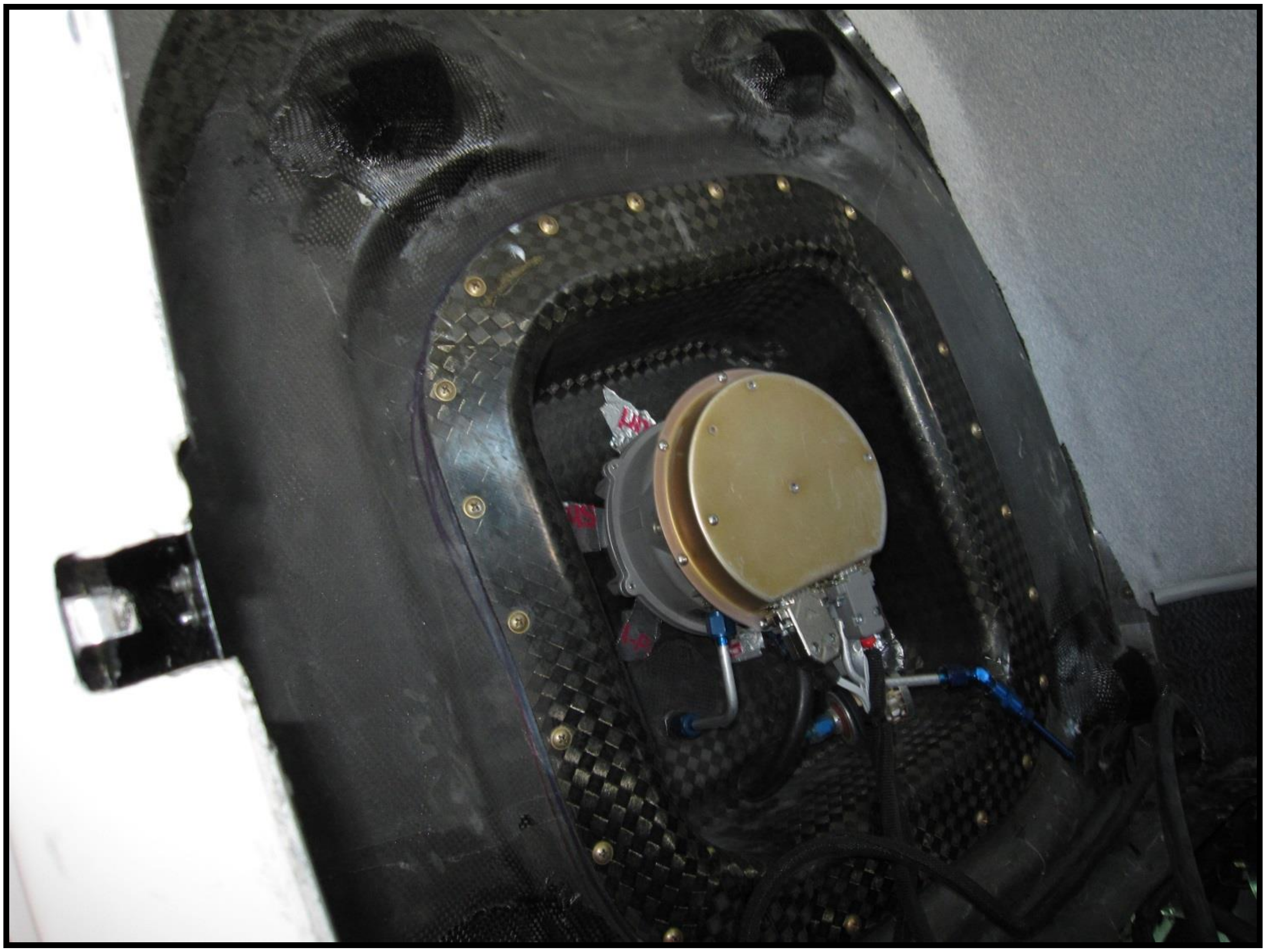


Flow Pack

The bleed air is routed through the firewall from the flow pack to the air-conditioning evaporator on the inside of the firewall. There the bleed air is further cooled and conditioned by the air conditioning system that is mixed in the evaporator plenum.

Evaporator

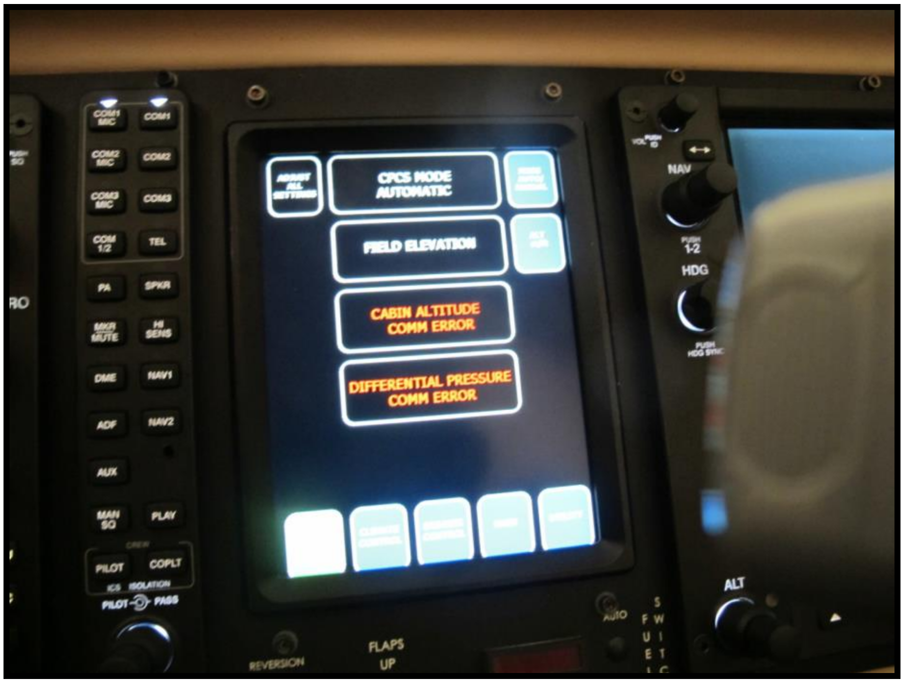
The Radiant Technologies (nee Maritz) touch screen controller on the instrument panel cockpit selects temperature. Additionally, a switch on the overhead panel selects an overboard dump of all cabin air for unpressurized flight. The flow of bleed air into the cabin is regulated by an outflow valve that keeps the pressure constant by releasing excess pressure from the cabin into the atmosphere. The outflow valve is located on the aft pressure bulkhead.



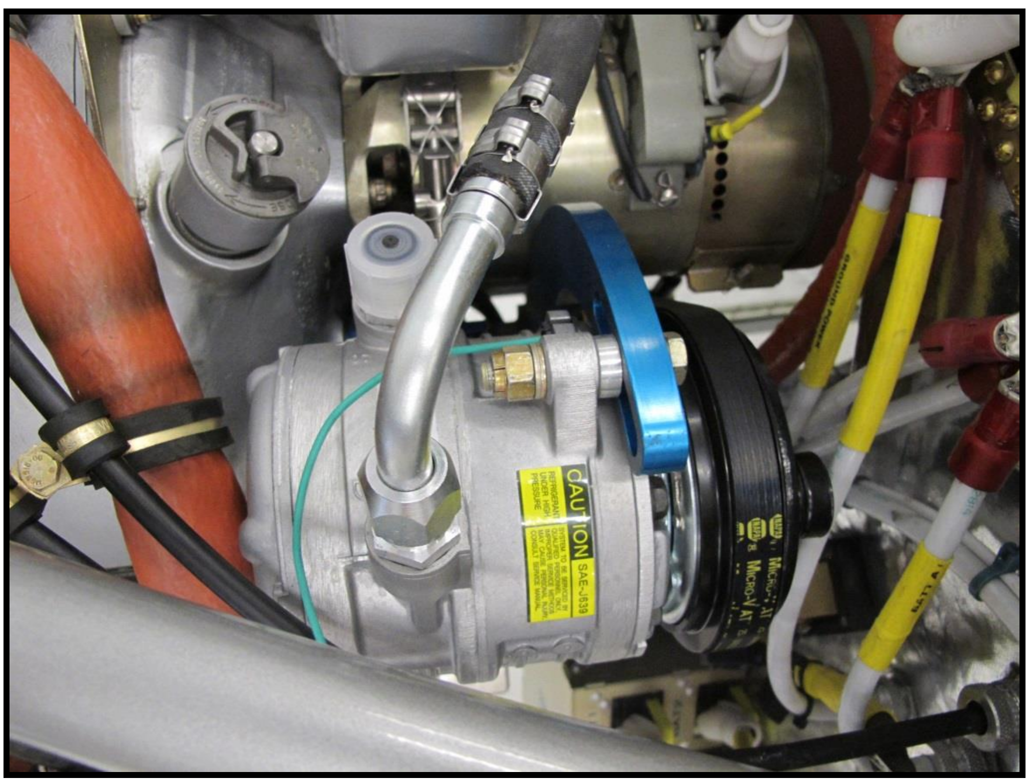
Outflow Valve (Dukes)

AIR CONDITIONING

Air Conditioning is a necessary standard feature on the aircraft. It is an aft bay mounted condenser Lancair system. The AC system is a closed loop system—constantly moving refrigerant through the lines and components using outside air to cool the refrigerant which in turn cools the cabin air but is warmed up by it in return. The air conditioning and pressurization is controlled by the Radiant Technologies/ Maritz touchscreen.



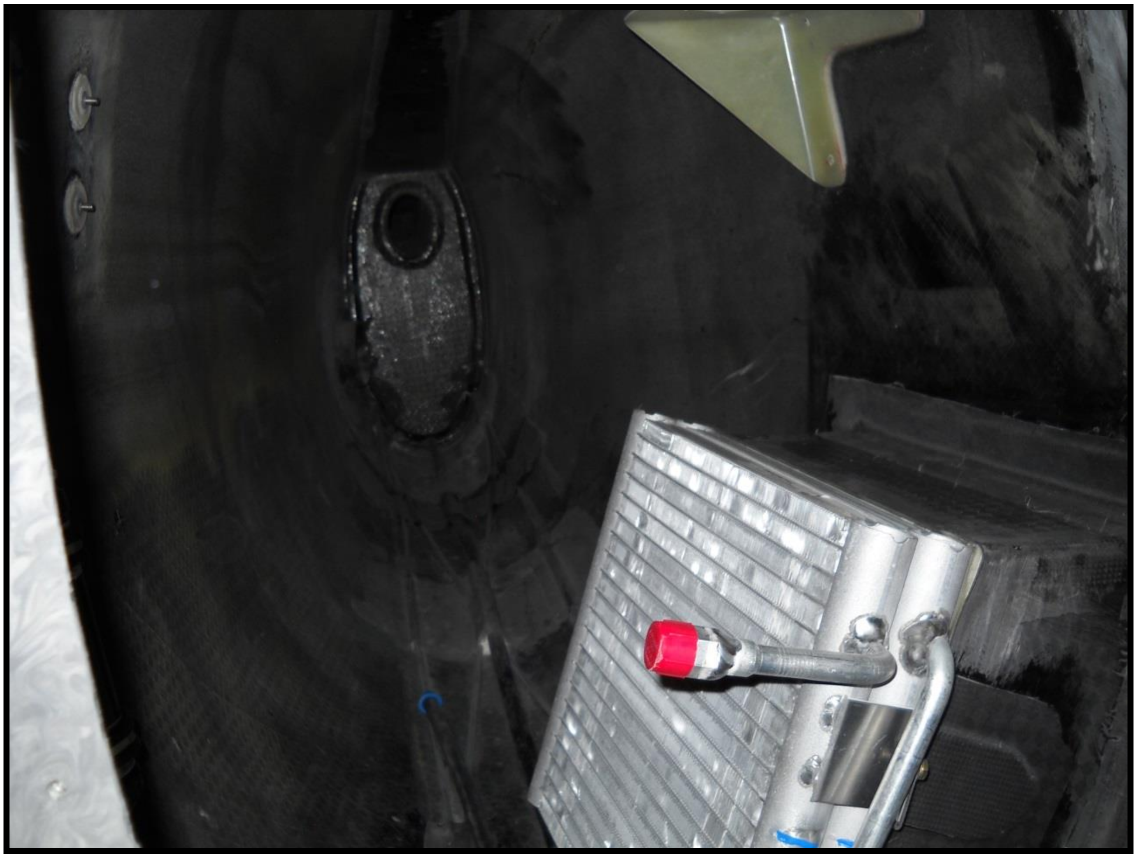
The compressor is mounted on an accessory drive on the left aft side of the engine and is belt driven—it compresses the Freon and moves the refrigerant through the system.



AC Compressor

The condenser is mounted on the left side of the empennage aft of the aft pressure bulkhead. Air enters the condenser on the left side of the empennage through a screen and flows through the condenser cooling the Freon refrigerant.

Air exits the condenser plenum and then travels aft in the empennage exiting the aircraft via a vent on the right hand side forward of the rudder. The Freon then continues on to the evaporator. The evaporator is mounted on the cabin side of the firewall and is integrated with the pressurization system—cooling the bleed air and the cabin. Warmed refrigerant then returns to the compressor beginning its cycle over again. A refrigerant supply and return hose connects the compressor to the rest of the system.



Condenser (mounted behind aft pressure bulkhead)

Air Exit

HIGH-ALTITUDE SYSTEMS AND EQUIPMENT

Several systems and equipment are unique to aircraft that fly at high altitudes, and pilots should be familiar with their operation before using them. Before any flight, a pilot should be familiar with all the systems on the aircraft to be flown.

Oxygen

Most high-altitude airplanes come equipped with some type of installed oxygen installation. The Evolution comes standard with a bottle mounted under the pilot floorboard and a remote switch to activate the system in the event of an emergency. Later aircraft may have a larger bottle located elsewhere and a panel mounted guage and switch. Ensure you have enough O2 for the proposed operation and have the bottle turned on before flight if it is remotely mounted.

Oxygen Guage and Switch

The following is reprinted from FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AN D/OR MACH NUMBERS (MMO) GREATER THAN .75

If the airplane does not have a fixed installation, portable oxygen equipment must be readily accessible during flight. **For flights in pressurized aircraft above FL250 a 10 minute supply of supplemental O2 must be made available to each occupant in the event is necessitated by loss of cabin pressurization (14 CFR 91.211)**.The portable equipment usually consists of a container, regulator, mask outlet, and pressure gauge. A typical 22 cubic-foot portable container will allow four people enough oxygen to last approximately 1.5 hours at 1,800-2,200 pounds per square inch (PSI). The container should be fastened securely in the aircraft before flight. When the ambient temperature surrounding an oxygen cylinder decreases, pressure within that cylinder will decrease because pressure varies directly with temperature if the volume of a gas remains constant. Therefore, if a drop in indicated pressure on a supplemental oxygen cylinder is noted, there is no reason to suspect depletion of the oxygen supply, which has simply been compacted due to storage of the containers in an unheated area of the aircraft. High-pressure oxygen containers should be marked with the PSI tolerance (i.e. 1,800 PSI) before filling the container to that pressure. To assure safety, oxygen system periodic inspection and servicing should be done at FAA certified stations found at some fixed base operations and terminal complexes.

Special FAA regulations apply to pilots and aircraft that fly at high altitudes. Although 14 CFR section 61.31(g) applies only to pilots who fly pressurized airplanes with a service ceiling or maximum operating altitude above 25,000 feet MSL, whichever is lower, this training is recommended for all pilots who fly at altitudes above 10,000 feet MSL.

(1) A service ceiling is the maximum height above MSL at which an airplane can maintain a rate of climb of 100 feet per minute under normal conditions.

(2) All pressurized aircraft have a specified maximum operating altitude above which operation is not permitted. This maximum operating altitude is determined by flight, structural, powerplant, functional, or equipment characteristics. An airplane's maximum operating altitude is limited to 25,000 feet or lower, unless certain airworthiness standards are met.

(3) Maximum operating altitudes and service ceilings are specified in the Aircraft Flight Manual (AFM).

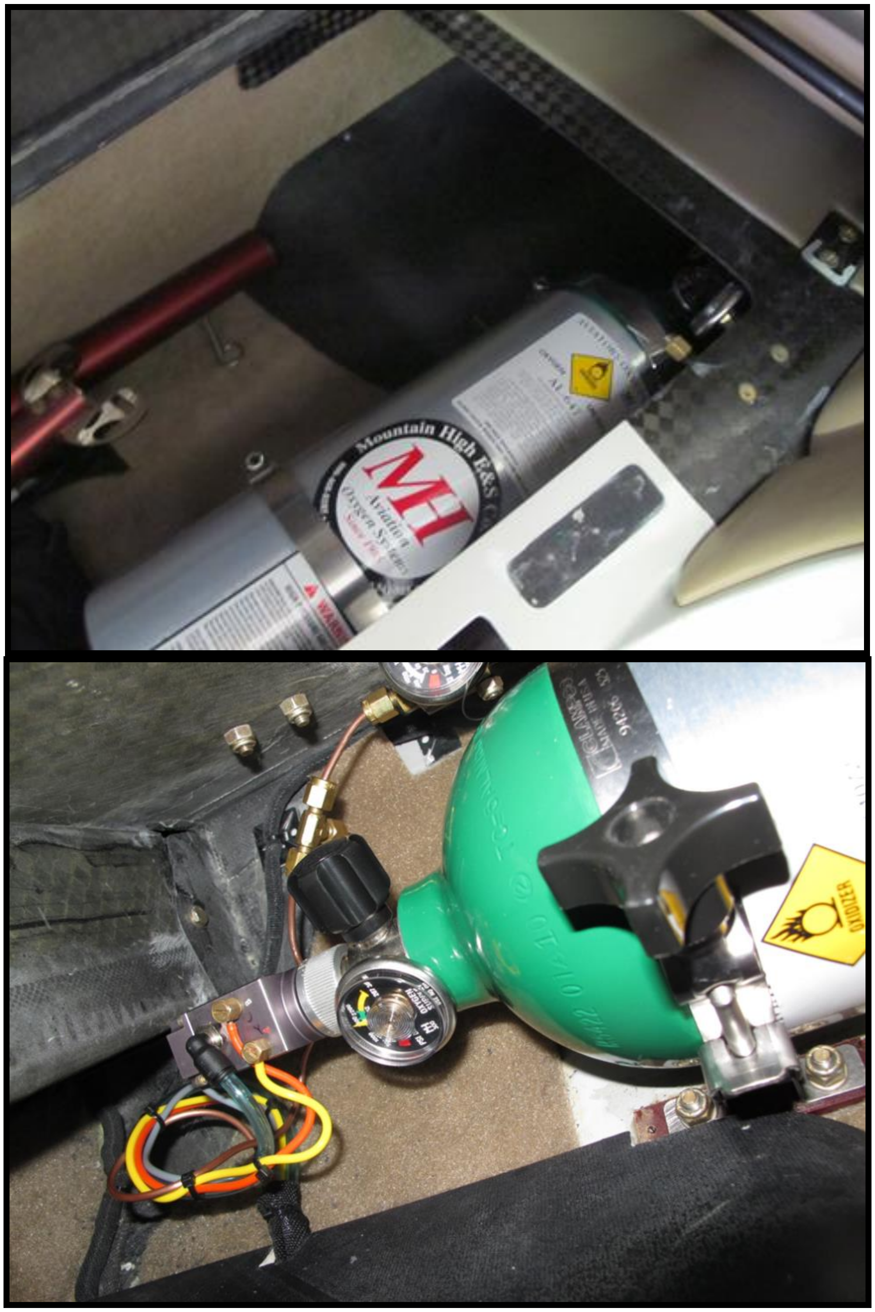
a. Airspace. Pilots of high-altitude aircraft are subject to two principle types of airspace at altitudes above 10,000 feet MSL. These are the Class E Airspace which extends from the surface up to FL 180, and the Class A Airspace, which extends from FL 180 to FL 600.

b. Federal Aviation Regulations. In addition to the training required by 14 CFR section 61.31(g), pilots of high-altitude aircraft should be familiar with 14 CFR section 91.211 that applies specifically to flight at high altitudes.

(1) Title 14 CFR section 91.215 requires that all aircraft operating within the continental U.S. at and above 10,000 feet MSL be equipped with an operable transponder with Mode C capability (unless operating at or below 2,500 feet above ground level (AGL). (Now those aircraft must also have ADS-B out, as well).

(2) Title 14 CFR section 91.211(a) requires that the minimum flightcrew on U.S. registered civil aircraft be provided with, and use supplemental oxygen at cabin pressure altitudes above 12,500 feet MSL up to and including 14,000 feet MSL for that portion of the flight that is at those altitudes for more than 30 minutes. The required minimum flightcrew must be provided with and use supplemental oxygen at all times when operating an aircraft above 14,000 feet MSL. At cabin pressure altitudes above 15,000 feet MSL, all occupants of the aircraft must be provided with supplemental oxygen.

(3) Title 14 CFR section 91.211(b) requires pressurized aircraft to have at least a 10-minute additional supply of supplemental oxygen for each occupant at flight altitudes above FL 250 in the event of a decompression. (FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AND/OR MACH NUMBERS (MMO) GREATER THAN .75)



Oxygen Bottle and Regualtor Installed in Aft Bay

Regulator and Masks

Regulators and masks work on continuous flow, diluter demand, or on pressure demand systems. The continuous flow system supplies oxygen at a rate that may either be controlled by the user or controlled automatically on some regulators. The mask is designed so the oxygen can be diluted with ambient air by allowing the user to exhale around the face piece, and comes with a rebreather bag which allows the individual to reuse part of the exhaled oxygen. The pilot's mask sometimes allows greater oxygen flow than passenger's masks. Although certified up to 41,000 feet, very careful attention to system capabilities is required when using continuous flow oxygen systems above 25,000 feet. The above is reprinted from FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AN D/OR MACH NUMBERS (MMO) GREATER THAN .75

The “soft” mask supplied with the Evolution kit is not recommended by LOBO. The Mountain High blue hard mask shown here is preferred.

Diluter Demand and Pressure Demand Systems

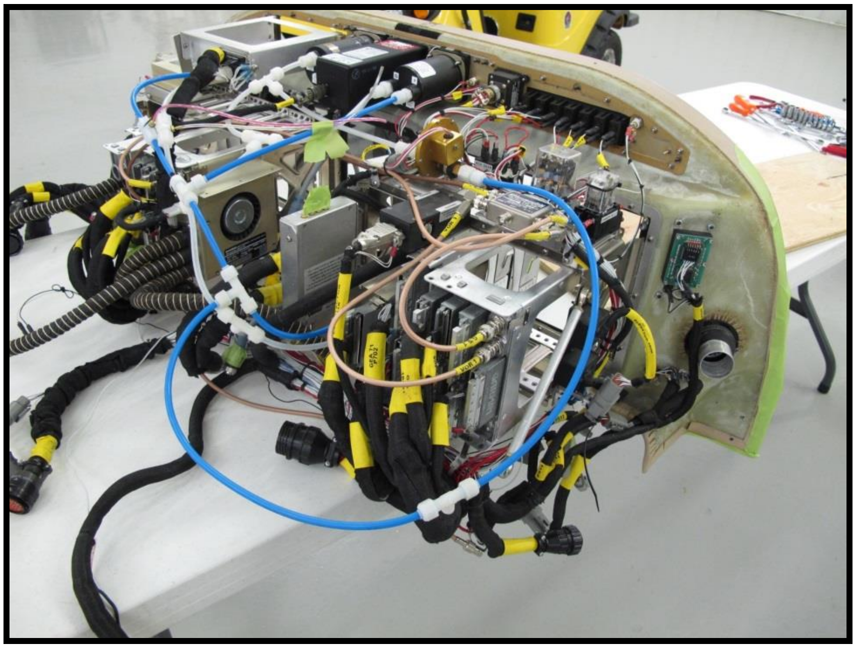
Diluter demand and pressure demand systems supply oxygen only when the user inhales through the mask. An automatic lever allows the regulators to automatically mix cabin air and oxygen, or supply 100% oxygen, depending on the altitude. The demand mask provides a tight seal over the face to prevent dilution with outside air, and can be used safely up to 40,000 feet. Pilots who fly at those altitudes should not have beards and moustaches because air can easily seep in through the border of the mask. Pressure demand regulators also create airtight and oxygen tight seals, but they also provide a positive pressure application of oxygen to the mask face piece, which allows the user’s lings to pressurize with oxygen. This feature makes pressure demand regulators safe at altitudes above 40,000 feet. The above is reprinted from FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AN D/OR MACH NUMBERS (MMO) GREATER THAN .75

Fire Danger

Pilots should be aware of the danger of fire when using oxygen. Materials that are nearly fireproof in ordinary air may be susceptible to burning in oxygen. Oils and greases, such as lipstick or chapstick, may catch fire if exposed to oxygen. Oil should not be used for sealing the valves and fittings of oxygen equipment. Smoking during any kind of oxygen equipment use must also be strictly forbidden. The above is reprinted from FAA AC 61-107A OPERATIONS OF AIRCRAFT AT ALTITUDES ABOVE 25,000 FEET MSL AN D/OR MACH NUMBERS (MMO) GREATER THAN .75

Instruments

Most Evolutions are equipped with a Garmin G900X panel. Early models are equipped with a Trutrak Sorcer autopilot while later serial numbers have a Garmin GFC7X autopilot. The aircraft may be equipped with mechanical standby gauges or electronic standbys. Also some owners have an AOA system installed. A Maritz/ Radiant touchscreen (shown in the middle and on the right) controls environmental and electrical functions. Some of the Maritz/Radiant touchscreens have been replaced with similar units from another manufacturer.



AOA (angle of attack system)

Lancair Systems Quiz

The hydraulic system operates the landing gear via:

a) electric landing gear switch on the instrument panel

b) hydraulic control valves on control pedestal for normal gear mechanical levers that connect via push pull cables to the landing gear
c) telepathy

The fuel system on your aircraft has ______ gallons useable fuel.

You must use what type of hydraulic fluid to service the hydraulic reservoir?

a) Skydrol
b) Mil H 5606
c) Automatic transmission fluid

The brake reservoir is located _____________ ?

How much supplemental O2 is required by 91.211?

a) 1 hour for each passenger
b) 10 minutes for each occupant
c) 30 minutes for the pilot

The outflow valve is located ________________ and must be serviced how frequently?

The nose gear strut is extended by—

a) The hydraulic nose gear cylinder
b) The emergency gear down hand pump
c) The gas strut

Operating Limitations

Model PW&C PT6A-135A

Max continuous, HP / RPM.	750 /1900
Max continuous ITT.	805C
Max recommended climb HP / RPM	750 / 1900
Max recommended ITT	805C
Oil Temperatures - Deg. C.	
Maximum	99
Min., Max. Limit-Maximum Cruise	0 - 99
Oil Pressure - PSI	
Normal operation	85 - 105
Idle, Minimum	40
Max Allowable (cold oil)	105
Fuel Flow	
Fuel Flow vs. Horsepower:	
See Model Spec sheets.	
Fuel Grades	JET A, JET A1

POWERPLANT LIMITATIONS for a PT6A-135A Engine

It is recommended that the following markings be made on the engine instrument gauges to conform to convention.

NOTE
Pratt & Whitney values shown. The owner/operator should compare and correct (where different) for the particular model specifications for his installation.

OIL TEMPERATURE (Deg. C.)

Normal Operating range (Green arc)	-40 - 99
Maximum (Red line)	100
Recommended Takeoff Minimum	0 - 99

OIL PRESSURE (PSI)

Minimum (Idle, Red line)	40
Operating Range (Green arc)	85 - 105

Maximum (Red Line)	105

Np (RPM)

Caution Range (Yellow Arc)	400-1200 *For four bladed Hartzell propeller applications
Operating Range (Green Arc)	0-399/ 1201-1900
Maximum (Red Line)	2090

ITT (Deg. C)

Max. Continuous (Green Arc)	805
Peak 2 Second limit (Red Line)	880

MISC. INSTRUMENT MARKINGS

PROPELLER

Number of Propellers: 1
Propeller Manufacturer: Hartzell Propeller, Inc.
Propeller Hub and Blade Model Numbers: 8C-E4N-3NX and D8292BX, respectively
Propeller Diameters
  Minimum: TBD
  Maximum: 86 inches (218 cm)
Propeller Blade Angle at 30 inch Station
  Low: TBD
  High: TBD

Limitations:
Do not exceed 1900 RPM
Do not operate propeller between 400 and 1200 RPM

FUEL

Takeoff and maneuvering……………………………………………15 Gal. Minimum

HYDRAULIC

Hydraulic Normal System Pressure	2000

Accumulator pre-charge	1000

AIRCRAFT OPERATING AIRSPEEDS

SPEED	MARKING	KCAS
Never exceed speed	V_{NE} Red Line	256
Never exceed speed (Mach)	M_{mo}	see notes
Caution, smooth air only	Yellow Arc	220-256
Maneuvering Speed	V_A	190
Normal Operating range	V_{NO} Green Arc	76-220
Max Flap Operating Speed	50 Deg (Landing)	160
Max Flap Extension Speed	V_{FE} White Arc	61-140
Best Angle of climb speed	V_X	85
Best Rate of climb speed	V_Y	105
Stall Speed clean	V_S	76
Stall Speed landing config.	V_{SO}	61
Landing Gear Operating speed	V_{LO}	150
Landing Gear Extended Speed	V_{LE}	165
Design Dive Speed	V_D	285
Max Structural cruising speed	V_{NO}	190

NOTE

- **V_{NO} must be reduced by 4 knots for each 1000 feet above 24,000 feet pressure altitude.**
- **V_{NE} must be reduced by 5 knots for each 1000 feet above 24,000 feet pressure altitude.**

WEIGHT LIMITS (lbs)

Maximum Empty Weight	3204
Maximum Takeoff Weight	4300
Maximum Landing Weight	4200
Maximum Baggage Weight	225

ALTITUDE LIMITATIONS

The service ceiling of the aircraft is 28,000 feet (RVSM limited).

The altitude where compressibility effects become important is 24,000 feet. Above this altitude, equivalent airspeeds must be reduced to maintain a constant Mach number.

M_C = 0.461 for cruise speed at 24,000 feet.

MNE = 0.621 for never exceed speed at 24,000 feet.

CENTER OF GRAVITY LIMITS (Gear Extended)

The allowable Center of Gravity (CG) range is from Fuselage Station (FS) 118.6 to (FS) 129.6 or 6.0 to 30% or the wing mean-aerodynamic-chord (MAC).

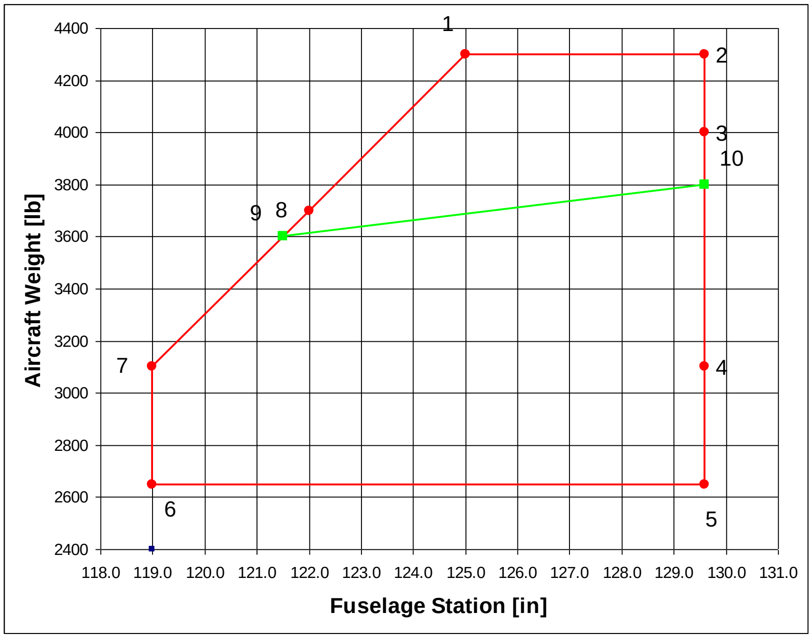
REFERENCE DATUM

The Datum is located at FS "0." This can be located by measuring 78" forward of the firewall.

MEAN AERODYNAMIC CHORD (MAC)

The MAC corresponding to the CG limits of 118.6 and 129.6 are 6.0% and 30%, respectively.

WEIGHT AND CG RANGE



Condition	Point	Weight (lb.)	CG (FS in.)
Max. Weight, Fwd. CG	1	4300	125.0
Max. Weight, Aft. CG	2	4300	129.6
Min. Weight, Aft CG	5	2650	129.6
MIN. WEIGHT, FWD. CG	6	2650	119.0
Light Weight, Fwd. CG	7	3000	119.0
Zero Fuel , Fwd. CG	9	3600	121.5
Zero Fuel , Aft. CG	10	3800	129.6

FLIGHT LOAD FACTOR LIMITS

Flaps up +5.5g / -3.5g

Flaps down +2g / 0g

TYPES OF OPERATIONS AND LIMITS

The airplane is approved for the following types of flight when the required equipment is installed and operations are conducted as defined in the LIMITATIONS section.

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

Warning

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

FUEL QUANTITIES (U.S. Gal.)

Standard fuel	144
Extended Fuel option	167

FUEL MANAGEMENT

Do not take off with less than 10 gallons in each tank. There is no fuel line interconnection between the wing tanks.

Warning

Limit excessive angles of attack (pitch up) during go around with less than 10 gallons in either tank.

SEATING

The aircraft accommodates 4 adult occupants. Fully functional controls allow the aircraft to be flown from either front seat.

WINTER OPERATIONS

Engine pre-heating is not required.

Operating Limits Quiz

The maximum RPM for this engine is

a) 2500 RPM
b) 1900 RPM
c) 2700 RPM

The maximum speed (Vne) is:

a) 274 KEAS
b) 220 KIAS
c) 256 KCAS

The minimum oil pressure (red line) in flight is:

a) 40 psi
b) 10 psi
c) 60 psi

The maximum cabin pressure is:

a) 4.5 psid
b) 5 psi
c) 6.5 psid

The maximum gear operating (Vlo) speed is

a) 170 KIAS
b) 150 KIAS
c) 165 KIAS

The maximum flap extend (Vfe) 10 degrees is

a) 170 KIAS
b) 160 KIAS
c) 150 KIAS

The maximum gross weight is:________

The maximum G is:

a) 3.4
b) 4.4
c) 6.6

The maximum flap operating speed (Vfo) full down

a) 160 KAIS
b) 140 KIAS
c) 152 KIAS

Best Glide is:

a) 110 KIAS
b) 120 KIAS
c) 130 KIAS

The engine ITT limit is?

a) 805 C
b) 750 F
c) 1650 F

FLYING THE LANCAIR EVOLUTION

The Lancair EVOLUTION series aircraft is a high performance single engine turboprop airplane. Unless you have experience in jet or turboprop aircraft it is likely you will “behind” the aircraft on your first flight. Anticipate this but do not be disappointed if you have some difficulty on your first flight—this is normal and will soon pass with training and experience.

NORMAL PROCEDURES

PREFLIGHT

ENGINE START

Engine starting procedures are probably the biggest difference pilots transitioning to turbine aircraft experience. One important thing to remember about starting—it is hard to hurt a piston engine on start. It is easy to destroy a turbine engine during the starting sequence. Improperly performed turbine engine starts have the potential to overtemp the turbine section destroying turbine blades in the process. Battery starts should be approached with caution. Experienced turbine pilots know that the source of most hot starts (overtemps) are the result of start attempts with low battery voltage. Ensure the deice door is closed, the starter generator off, the airconditioning off and the bleed air switch is off before start. All of thse items lead to a hotter start.

DO NOT ATTEMPT A BATTERY START WITH LESS THAN 24 VOLTS! A HOT START MAY RESULT SEVERELY DAMAGING THE ENGINE AND LEAADING TO COSTLY REPAIRS.

NORMAL START –

Cabin Pressurization Switch	Off
Deice Door	Closed
Aircraft Battery	24 VOLTS MIN
Door Lever	CLOSED/LATCHED
Door Seal Switch	ON (FWD)
Start Area	CLEAR
Ignition Switch	ON (note audible clicking)
Fuel Pump Switch	ON (35 PSI MIN)
Start Switch	
Verify ITT <100C (10 sec max)	START (HOLD)

Fuel Condition Lever (***Recommend 18%***. N1)	OVER GATE TO GROUND IDLE
Light Off	10 SEC MAX (MAX ITT – 1090° FOR 2 SECONDS) (IF MAX LIGHTOFF TEMP EXCEEDS 880° INVESTIGATE FOR CAUSE)
Start Switch (After 50 % N1)	RELEASE-- STEADY STATE GROUND IDLE 52 % N1 62% Flight Idle
Prop:	**Full Fwd**
Np:	**Greater Than 1200 RPM**
Oil Pressure	40 PSI MIN
Oil Temperature	-40° - +99°

TAXIING

The Lancair EVOLUTION uses differential braking to steer. Do not “ride” the brakes as you may overheat them. You will find that even under normal use you will go through brake pads very quickly.

PRETAKEOFF

DOOR SEAL: INFLATED
DOOR: LATCHED
BAGGAGE DOOR: LATCHED
PARKING BRAKE: OFF
AVIONICS: SET FOR DEPARTURE
FLIGHT CONTROLS: FREE & VISUALLY VERIFIED
FUEL SELECTOR: FULLEST TANK
PRESSURIZATION: SET FIELD ELEV +500’:
TRANSPONDER: CODE
RADIOS: CHECK & SET
FLAPS: 25*
FUEL PUMP: ON
FLIGHT INSTRUMENTS: GYROS CROSS CHECK CHECK /ALTIMETERS CHECKED
PITOT HEAT: ON
PROP DEICE: AS REQUIRED

LIGHTS: AS REQ.
PASSENGERS BRIEFED/VERIFY SEATBELTS

LINEUP & TAKEOFF

Runway verify proper & clear
Flight controls free & correct
PCL: 1280# torque (max)
75 KIAS: Rotate
Positive ROC: Gear up/ flaps up.

Normal takeoff configuration is flaps at 25 degrees, elevator trim set slightly nose up. The aircraft should be aligned with the centerline of the runway. When in position, roll forward slightly to ensure that the nose wheel is centered. Holding the brakes, advance the power lever, wipe out the controls one last time, and give the engine instruments a quick final check. Upon brake release anticipate the need for a significant amount of right rudder and smoothly apply 1200 pounds of Tq at 1900 rpm. Maintain directional control during the first part of the takeoff roll by use of rudder. The rudder is effective for directional control at low speeds. Check your engine gauges one last time before rotation. Any out of limit parameter is reason to abort. Rotate at 75 kts—it makes for a better takeoff to raise the nose wheel off the ground and let the airplane fly itself off of the mains. Increase pitch to 7° nose up and allow the airplane to accelerate to the desired climb speed of either Vx, Vy, or cruise climb. When a positive rate of climb has been established, and there is insufficient runway remaining on which to land, retract the gear. Accelerating through 110-120 KIAS retract the flaps. Cruise climb of 150 KIAS -160 is recommended. You may maintain full power 2080 # Tq and 1900 RPM in climb to level off minding ITT limits as well. Maximum recommended cruise torque is 1940 pounds. Monitor engine instruments to avoid exceeding engine limitations.

CLIMB

N1 – 100%   N2 – 1900   ITT < Redline   A/S – 140-180 KIAS

FLIGHT INSTRUMENTS CROSS: CHECK
ENGINE INSTRUMENTS: MONITOR

ITT	805° C MAX CLIMB
N1	101.6% MAX
N2	1900 RPM MAX
Torque	1940 ft lbs MAX
Oil Pressure	85 – 105
Oil Temperature	10 – 99
Airspeed	**Vy 140 KIAS to** 180 KIAS NOMINAL

Cabin	PRESS CHECK

Normal cruise climb at sea level is 165 kts. Allow the climb airspeed to decrease 1 kt for each thousand feet of altitude above sea level. Monitor all gauges to ensure correct and optimum performance, and ensure the aircraft is trimmed for balanced flight.

10,000' check –Cabin Pressure check

18,000 Check

Cabin Pressure—check
Fuel Tank –switch
Altimeter—29.92

LEVEL OFF/ CRUISE

ITT	805 °C MAX CRUISE
Altimeter	SET
Cabin Pressure	CHECK
O2 & Backup O2 Operation Pressure	CHECK
Fuel Quantity	CHECK

The aircraft has excellent stability and control characteristics under all conditions of speed, power, load factor, and altitude. The controls are effective throughout the speed range of stall to Vne and aircraft response to control movement is quite rapid at slow speeds with heavier aileron forces at higher speeds. Nice handling characteristics, in both accelerated and unaccelerated flight are evident. The trim tabs are also effective at all speeds so that the aircraft may be easily trimmed to fly "hands off". Roll forces are heavy at cruise speeds with the original ailerons installed. New style ailerson users report lower lateral stick forces. Flight without an operational pitch trim system is difficult and may be uncontrollable at higher speeds. Wing flap extension as well as changes in power setting affects pitch trim, thus requiring a minimum of stick movement to maintain flight attitude.

DESCENT

N1 – 80%   N2 – 1900   A/S – 220 KIAS

Fuel Quantity	CHECK/BALANCE
Altimeter	SET

Heading / Attitude System	CHECK
Pressurization	SET (FE +500')
Pitot Heat	AS REQUIRED
Propeller De-Ice	AS REQUIRED
Defog	AS REQUIRED
ATIS	Check
Approach	Brief

A timely descent, particularly from high, fast cruise in the Lancair EVOLUTION requires that you be well ahead of the aircraft. In smooth air conditions descent can be accomplished at the Vne of 256 KCAS until reaching 10,000 feet MSL, where it should be reduced to comply with FARs. In turbulent air the aircraft must be slowed to its Vno of 220 KCAS or below. Throughout the letdown, monitor your engine instruments. Allow 4 nm from destination from each 1,000 feet to descend to reach pattern or FAF altitude. Hold enough power to maintain cabin pressurization.

APPROACH & LANDING

BEFORE LANDING

Fuel Selector	FULLEST TANK
Flaps	<160 KCAS 10 DEG
Landing Gear	<150 KIAS 3 DOWN & LOCKED
Brakes	TEST
Landing Light	ON
Flaps	< 130 KIAS 40°,
NORMAL LANDING	
Propeller Control Lever	FORWARD
Deice door	OPEN

Approaching the terminal area, keep the airspeed less than 160 KIAS to allow for 10 degrees of flaps, if necessary. Enter the pattern as directed, or at a 45° degree angle to downwind, at pattern altitude as appropriate. On the downwind leg, a power setting of about 400 pounds of torque, 1900 rpm and configured with 10° of flaps will hold the aircraft at 120 KIAS. Lower the gear prior to the abeam position-- opposite the intended point of touchdown. Landing gear position will be confirmed out loud by the Lancair pilot in training. Lower flaps to full and the plane should slow to about 100 KIAS with a 500 foot per minute rate of descent. Reference your angle of attack indication (AOA) –it should be in the donut when you are onspeed. Halfway through the base leg turn your altitude should be approximately 500 feet AGL. Turn final with at least ¼ mile straight away and at approximately 300 feet AGL. Cross check airspeed and AOA. Cross the threshold at about 85 KCAS cross checking AOA. Allow airspeed to decay to arrive at the intended touchdown point at 75 KCAS. Reduce power to idle, maintain directional control with rudders, and slowly apply beta. Beta is destabilizing so be judicious in its use.

NO FLAP LANDING

Fly a normal pattern except plan for 100 kts on short final. On the roll out, lower the nose gear onto the runway and brake and beta as necessary.

CROSSWIND LANDINGS

Analyze the wind before pattern entry, or on downwind, to determine if it is an undershooting or overshooting crosswind. Adjust for drift during the turn to final so that you will not undershoot or overshoot the approach or final leg. The optimum technique is to fly a crabbed approach, taking out the crab with rudder to align the aircract with the runway center line and direction of travel just before touchdown. After touchdown apply lateral stick into the wind to counter the upwind wing rising. Use judicious rudder to track down the runway center line and brake and beta (as necessary) to a stop.

GO AROUND

Smoothly Advance PCL	1200 Maximum Pounds of Tq if on the runway
Flaps	25 DEG
Gear	UP, POSITIVE ROC
Flaps	UP, BEFORE 120 KIAS
Propeller	1900 RPM /AS REQ’D

Do not delay the decision to go around to the point that control of the landing or rollout is in jeopardy. Smoothly advance the power lever using enough power for a positive rate of climb. Pitch the aircraft to a normal takeoff climb attitude. Check for a positive rate of climb and positive aircraft acceleration. Recheck trim. Anticipate the need for considerable right rudder input as power is applied. Raise the landing gear and flaps only after a safe climb has been established.

CLOSED TRAFFIC PATTERN (in training all landings are to a full stop)

For closed traffic, the takeoff technique and procedures and approximate power settings and airspeeds described earlier in this section still apply. However, the landing gear will be left down after takeoff and remain down throughout the pattern. This is to preclude excessive wear and tear on the landing gear mechanism and to minimize configuration changes so the pilot can more easily concentrate on flying a good pattern. Even though the gear remains down and locked throughout the pattern, a full before-landing-checklist will be conducted on each downwind leg. Landing gear position will be confirmed out loud by the Lancair pilot in training. Flaps will remain at the takeoff position until more flaps are needed to intercept and maintain the proper glide path. <u>All landings will be to a full stop</u> followed by a taxi back to the approach end of the runway for subsequent takeoff. This procedure will allow the pilot to enjoy the training benefit of doing a full takeoff and landing during each circuit. It will also eliminate all the essential configuration, trim, power, and flight control inputs that must be done quickly during touch and goes.

ENGINE SHUTDOWN

Power Control Lever	IDLE
Deice door	CLOSED
Fuel Condition Lever	CUTOFF
Propeller	FEATHER
Generator Switches	OFF
Fuel Pump	
(When Engine RPM IS = 0% N1)	OFF
Door Seal Switch	OFF (AFT)
Battery Switches	OFF
Fuel Selector	LEFT OR RIGHT
Chocks	IN

Lancair Evolution By The Numbers**

Conditions	Torque	RPM	Gear	Flaps	SB	Speed	Pitch	ROD/ ROC
Takeoff	1248	1900	Down	10	In	Vr 70		
Climb	2080	1900	Up	Up	in	Vy 140	7 ANU	
Climb	2080	1900	Up	Up	In	165	7 ANU	
Cruise	1940	1900	Up	Up	In		0	
Descent		1900	Up	Up	In/ Out		2-3 AND	
Downwind	400	1900	Up	10	In	120		
Base	400	1900	Down	Full	In	110	5 AND	
Final	400	1900	Down	Full	In	100		
Go Around	Full	1900	Up	Up	In	Accel	7 ANU	
Precision								
Downwind / Vector		1900	Up	10	In	140	2 ANU	
Base	400	1900	Down	10	In	120	3 ANU	
Final	400	1900	Down	10*	In	120		
Non Precision								
Downwind / Vector	400	1900	Up	10	In	140	2 ANU	
Base	400	1900	Down	10	In	120	3 ANU	
Final	400	1900	Down	10*	In	120	1-2 AND	
Level off		1900	Down	10	IN	120	3 ANU	
				* until field in sight				

** Due to differences in aircraft the above numbers are not absolute but provide a frame of reference to start analyzing your aircraft's performance. You should complete a "By the Numbers" form for your aircraft.

UPPER AIR WORK

CLEARING TURNS

Clearing turns will be performed prior to any maneuvering. The object is to visually clear the airspace you are working in to minimize the chance of a close encounter or midair with another aircraft. Clearing turns will consist of two 45° angle of bank turns in the clean configuration or 30° angle of bank turns in the dirty configuration for 90° of turn, or one 180° turn. All upper air work will be performed at 5,000 feet AGL or higher.

SLOW FLIGHT

Slow flight will be performed while maintaining a constant altitude and an angle of bank of no more than 30°. Enter slow flight from normal cruise as follows: Advance the the prop to high 1900 rpm.   Reduce the power. At 130 KIAS lower the landing gear and flaps. As the airspeed approaches 85 kts, increase the power to and maintain 85 kts. A large input of right rudder will be necessary at the power application to maintain balanced flight. Check trim.

IMMINENT STALL

Insure the prop is set at 1900 rpm. Visually check the cockpit for loose gear. Maintaining altitude, reduce the power. As the airplane decelerates, apply aft stick as necessary and check AOA (angle of attack). At approximately 61-65 kts the aircraft should stall—note your AOA verbal and visual cues. Notice the buffet on the tail felt in the stick prior to the stall. Notice all cues of impending stall. Before stall occurs occurs, reduce back pressure on the stick to reduce the angle of attack and simultaneously and smoothly apply full power. If your aircraft was flight tested properly to full stalls at forward and aft CG limits and stall stripas and or turbulators correctly located then your Evolutiont will have benign stall characteristics. If these conditions are not met then you are a test pilot.

STEEP TURNS

Establish the aircraft in straight and level flight at 140 -160 KIAS and align it with a prominent landmark or section line. Roll into a 45°-60° angle of bank and apply aft stick pressure as necessary to maintain altitude. Adjust the power lever to maintain the airspeed throughout the maneuver. Maintain altitude throughout the turn suing outside references and insuide cues. Your primairy focus should be outside on the horizon and scanning for traffic. If the aircraft starts a descent, as first indicated by the horizon and on the vertical speed indicator, take out a small amount of bank, correct the nose attitude, and then reestablish the bank angle. Conversely, if the aircraft starts to climb, steepen the angle of bank to allow the nose to drop to the desired pitch setting, then reestablish 45°-60° angle of bank. A complete maneuver will consist of a 360° turn both left and right.

UNUSUAL ATTITUDES

The flight instructor will induce an unusual attitude. The Lancair pilot will recover with power, pitch and roll application (as necessary) to straight and level flight. Nose high/ decreasing airspeed—add power and reduce angle of attack first. Roll wings level second. Extreme nose high you may want to roll to nearest horizon (nose slice) and then roll out to level as nose comes to horizon. Nose low/ increasing airspeed—reduce power, roll to wings level. Pitch to horizon.

INSTRUMENT FLIGHT

The Lancair EVOLUTION is generally equipped with all the necessary instruments and navigation aids for instrument flying. Flight into high-density traffic areas in IMC should only be undertaken after thorough planning preparation and with plenty of proficiency. Flight into icing conditions must be avoided for unprotected aircraft. Pilots flying aircraft equipped with deice systems should remembner that those systmes are not tested for flight into known ice conditions and should proceed with extreme caution.

Climb, cruise, and descent in instrument conditions will be the same as the VFR procedures described previously. Holding should be conducted at 140 -160KIAS, 1900 rpm, power as required.

INSTRUMENT LANDING SYSTEM

The downwind or radar vectors to final should be flown at 140-160 KIAS. The power settings should be as required with 1900 rpm with 10° of flaps. A power setting of 400 pounds of Tq. at 1900 rpm on base leg should give you about 120 KIAS with 10° of flaps. When the glideslope is one dot high on the indicator check flaps 10°, and lower the landing gear. Perform a before landing checklist. A power setting of about 400 pounds of Tq (aircraft dependent). should result in a 500 fpm rate of descent at 120 KIAS. Adjust power and heading as necessary to maintain centered ILS needles and 120 KIAS. Lower full flaps after breaking out into visual conditions. Prior to landing ensure that the before landing checklist is complete.

NON-PRECISION APPROACH

The downwind and radar vectors to final and base leg should be flown as described above for the ILS. From final approach fix inbound, a power setting of about 400 pounds of Tq at 1900 rpm, with gear down and flaps 10°, you should see a 700-fpm rate of descent. Complete your before landing checklist at this point. Just prior to reaching the minimum descent altitude increase the power slightly to level off and maintain 120 KIAS. The aircraft will be nose up and, again, a significant amount of right rudder will be required to maintain balanced flight.

LANDING FROM AN INSTRUMENT APPROACH

If you break out prior to 400 feet AGL, plan on reconfiguring the aircraft to flaps 40° (full). Continue down, or intercept the proper glide path, and land the aircraft. If you break out below 400 feet AGL, consider leaving the flaps set at 10°. Even with the flaps at 10°, 95 kts on short final provides for ample stall margin. Prior to landing ensure that the before landing checklist is complete.

MISSED APPROACH

Smoothly advance the PCL to full power and apply the flight controls as necessary to keep the aircraft in a trimmed condition. Once a climbing attitude is established, and a rate of climb is confirmed, raise the landing gear. Raise the flaps when the airspeed in 100 kts or greater and set cruise climb power when you are comfortable and above 400 feet AGL. Comply with air traffic control instructions.

EVOLUTION CONDITIONS OF FLIGHT INSTRUMENT PROCEDURES

NON-PRECISION APPROACH

CONDITION	SPEED	GEAR	FLAPS	TORQUE	PITCH
Arrival	160	UP	UP	~600	Level
Holding	140	UP	UP	~400	Level
Procedure Turn	140	UP	UP	~400	Level
Inbound FAF	slowing	UP	UP	~300	Level
2nm from FAF	110	UP	25	~300	Level
FAF	110	DOWN	25	~300	3 degrees
MDA	110	DOWN	25	~500	Level
RWY in sight	85	DOWN	50	~170	~3 degrees

If a descent is required between the IAF and FAF

Descent	110	UP	25	~150	~3 degrees

PRECISION APPROACH

CONDITION	SPEED	GEAR	FLAPS	TORQUE	PITCH
Arrival	160	UP	UP	~600	Level
5nm from FAF	slowing	UP	UP	~300	Level
GS Active	110	UP	25	~300	Level
GS Intercept	110	DOWN	25	~300	3 degrees
RWY in sight	85	DOWN	50	~170	~3 degrees

MISSED APPROACH

CONDITION	SPEED	GEAR	FLAPS	TORQUE	PITCH
Missed App	110	UP	25	1500	7 UP
1000' AGL	145	UP	UP	1500	~7 degrees

EMERGENCY PROCEDURES

This section contains procedures to correct an abnormal or emergency condition. Not every emergency you encounter will be in "the book" or covered by the POH. You may have to improvise. Modify these procedures as required in case of multiple emergencies, adverse weather or peculiar factors. Use common sense and sound judgment to determine the correct course of action. Apply the following rules to all emergencies:

1. Maintain aircraft control.
2. Analyze the situation and take proper action.
3. Land as soon as practical.

Do only those steps required to manage the problem. As soon as possible notify air traffic control (ATC), tower, etc., as applicable, of your emergency, position, and intended action. Do not hesitate to "declare and emergency". Tell ATC exactly what your problem is and how they can help you – climb, descent, radar vectors, airport information, etc. Do not assume ATC will do the right thing. Many times they will sit idly by and watch an airplane auger in. They will go home after it is all over. You may not.

EMERGENCY PROCEDURES

The following emgergency procedures are copied from the Evolution POH.

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.

GROUND EMERGENCIES

FALSE START/ HUNG START

Power Control Lever..........................IDLE
Fuel Condition Lever ....CUTOFF
Start Switch ....OFF
Fuel Pump ....ON THEN OFF AT 10% NG
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 Selector Valve............................CHECK OPEN
Fuel Pump ....CHECK ON THEN OFF AT 10% NG (PROVIDES LUBRICATION TO THE ENGINE DRIVEN FUEL PUMP ELEMENTS)
Start Switch ....OFF (FIRE OUT OR STARTER LIMIT)

IF FIRE PERSISTS

Fuel Pump ....OFF
Fuel Selector 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 Lever..........................IDLE
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
Concentrate on Landing

ERRATIC OR UNRESPONSIVE ENGINE OPERATION

Fuel Selector Valve..........CHECK ON, SWITCH TO FULLEST TANK
Power Control Lever...................MID RANGE
Propeller Control Lever............FULL FORWARD
Fuel Condition Lever................LOW IDLE
Emergency Fuel Control Pin..............PULL
Emergency Fuel Control ....OPERATE SLOWLY

CAUTION

Pushing the lever increases power, monitor ITT to prevent overtemp, the Power Control Lever may have to be reduced to idle for landing.

ENGINE FIRE/MECHANICAL FAILURE AIRBORNE

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

NOTE

If smoke is present in the cabin, 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 engine fire if Ng is above 50%.

ENGINE FLAMEOUT IF Ng IS ABOVE 50% (HOT AIR START)

Check Fuel Quantity ....SWITCH TO FULLEST TANK
Power Control Lever..........................IDLE
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 Aitfield & 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%.

AIRSTART IF Ng is < 10% (COLD START)

Airspeed .... 110 KIAS (90 KIAS MINIMUM, 260 KTAS MAXIMUM)
Power control Lever..........................IDLE
Fuel Condition Lever ....CUTOFF
Gen/Alt/Non-Essential Equipment ....OFF
Battery Switches ....ON
Fuel Selector Valve ....ON, SWITCH TO FULLEST TANK
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............................USEAIRSTART WITH STARTER ASSIST PROCEDURE

AIRSTART (WITH STARTER ASSIST, Ng < 10%)

Fuel Condition Lever ....CUTOFF
Power Control Lever..........................IDLE
Gen/Alt/Non-Essential Electrical
Systems ....OFF
Battery Master Switches ....CHECK ON
Fuel Selector Valve ....ON, SWITCH TO FULLEST TANK
Fuel Pump ....ON (CHECK 5 PSI MINIMUM)
Ignition ....ON
Start Switch ....ON
Fuel Condition Lever ....ON, AFTER 5 SECONDS STABILIZED Ng> 12%

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 & Investigate
If unable to restart ....PERFORM THE FORCED LANDING CHECKLIST

FORCED LANDING

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. The following 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
Flaps..UP
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 and approximately 1300' AGL for Low Key altitude with the propeller feathered. If unable to feather the propeller, use 3500 AGL for High Key and 1700 AGL for Low Key.
(CHECK DATA)

Flaps..25° 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 (HIGHER)

PROPELLER OVERSPEED

Power Control Lever..........................IDLE
Oil Pressure..CHECK
Propeller Control Lever ....REDUCE RPM
Airspeed ....REDUCE
Power Control Lever..........................AS REQUIRED TO MAINTAIN RPM
If overspeed was significant or vibration is experienced, Land at the Nearest Suitable Airfield

PRESSURIZATION SYSTEM MALFUNCTION

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
Bleed Air...ON
Cabin Entry/Baggage Door Seal Switches ....CHECK ON
Cabin Pressure Control ....CHECK SETTINGS
Emergency Descent ....EXECUTE, IF CABIN ALTITUDE CONTINUES TO RISE
Oxygen Masks ....DON &ACTIVATE

SMOKE/CONTAMINATION IN CABIN

Cabin Pressure Dump ....DUMP

Bleed Air..OFF

Vent/Defog Fan..................................ON

Emergency Descent ....EXECUTE
Oxygen Masks ....DON & ACTIVATE
Smoke Hood.......................................DON IF AVAILABLE
Fresh Air Valve (If Equipped on the
Aircraft) ....PULL THE AUX HEAT KNOB TO FULL (AFT) POSITION TO ALLOW FRESH AIR FLOW INTO THE CABIN
Land at Nearest Suitable Airfield

ELECTRICAL FAILURES

Generator Failure: (High Amps, Low Bus Voltage)
Ammeter ....CHECK SYSTEM PAGE ON THE MFD TO VERIFY FAILURE
Generator Switch ....OFF
Starter/Generator Circuit Breaker ...CHECK & RESET
Electrical Load ....REDUCE (SHED NON-ESSENTIAL LOADS SUCH AS AIR CONDITIONING, LANDING LIGHTS, ETC.)
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 nonessential electrical equipment disabled. 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.

ELECTRICAL SYSTEM CIRCUIT BREAKERS

Component	Breaker (Amp)	Typical Draw (Amp)
Circuit Breaker Panel		
Hydraulic Pump	35	23.5
Propeller Heat (E*)	35	23.5
Fuel Pump (E)	15	10
Flaps	10	6.7
Generator (E)	10	6.7
Pitot Heat (E*)	10	6.7
Auto Pilot (E)	7.5	5
Ignition (E)	5	3.5
Start	5	3.5
Pneumatic Heat (E)	5	3.5
Transponder (E)	5	3.5
PFD (E)	5	3.5
GPS1 (E)	5	3.5
Com1 (E)	5	3.5
MFD (E)	5	3.5
GPS2	5	3.5
Com2	5	3.5
AHRS (E)	5	3.5
Moritz (E)	3	2
Trim (E)	3	2
Gear Relay	2	1.5
ATT Gyro (E)	2	1.5
Touch Screen Circuit Breakers		
Air Conditioning	20	13.5
Fan Power	10	6.7
Nav Light	5	3.5
Strobe	5	3.5
Landing	5	3.5
Cabin Lights	5	3.5
Panel Lighting	3	2
Wig Wag	1	0.7

E – Essential Equipment (leave on)

* May be essential for conditions.

LOW FUEL PRESSURE

Turn Electric Boost Pump ON or verify ON. Record time that fuel pressure is less than 35 psi for engine records.

LOW OIL PRESSURE (<75 PSI)

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

Engine RPM (Ng) ....CHECK ABOVE 72%
Torque (lbs).......................................MAINTAIN 1000 TO 1200 LBS UNTIL FIELD IS ASSURED
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
Electric Fuel Pump..............................ON/CHECK ON

NOTE
Fuel heater operation not guaranteed.

HIGH OIL TEMPERATURE (>99 DEG C)

Power Setting ....REDUCE AS NECESSARY
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 valve 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

IF LIGHTS TEST GOOD & ONE OR MORE GEAR INDICATE UNSAFE

Airspeed ....BELOW 140 KIAS
Landing Gear Handle.........................DOWN

IF THE LANDING GEAR DOES NOT GO DOWN

Airspeed ....140 KIAS OR LESS
HYD PUMP Circuit Breaker ....PULL
GEAR SWITCH Circuit Breaker........PULL
Emergency Gear Extension Valve ......ROTATE CLOCKWISE
Landing Gear Position Lights ....CHECK INDICATIONS

IF LEFT MAIN GEAR STILL UNSAFE

Aircraft...YAW LEFT AND HOLD
Airspeed ....REDUCE TO 90 KIAS

IF RIGHT MAIN GEAR STILL UNSAFE

Aircraft..YAW RIGHT AND HOLD
Airspeed ....REDUCE TO 90 KIAS

IF NOSE GEAR STILL UNSAFE

Aircraft ....PITCH APPROXIMATELY 10° NOSE HIGH AT APPROXIMATELY 2 G'S (REPEAT IF NECESSARY)
Airspeed ....REDUCE TO 90 KIAS AFTER NOSE GEAR INDICATES DOWN AND LOCKED

NOTE
Once the landing gear is extended, it is not recommended that it be retracted again before landing and determining the cause of failure.

CAUTION
Observers for determining gear status should be used with caution. Air & ground observation is not always reliable and observers might not be familiar with the Lancair landing gear in its down & locked configuration. Not all pilots are formation qualified and should be used with caution.

FLAP SYSTEM MALFUNCTION

Airspeed ....140 to 160 KIAS
Flap Circuit Breaker..........................CHECK IN
Check that Flap Indicator and Flap Position Agree. If there is an Asymmetry and/or
Rolling Moment..............................RETRACT FLAPS

CAUTION
Higher than normal approach speeds will be required without flap extension. Add 10 KIAS to all pattern speeds and be aware that higher deck angles and longer landing distances will result.

EMERGENCY SPEED REDUCTION

NOTE
The nature of the emergency should be considered before taking this action.

Power Control Lever..........................IDLE
Pitch Attitude .... .INCREASE TO CLIMB, SITUATION PERMITTING
Landing Gear ....EXTEND BELOW 150 KIAS
Flaps..FULL EXTEND BELOW 140 KIAS
When Target Speed is Obtained: Gear..UP
Flaps...UP

EMERGENCYDESCENT

Power Control Lever..........................IDLE
Propeller Control Lever ....FORWARD
Airspeed .... 160 KIAS
Flaps..APPROACH
Gear...DOWN
Airspeed .... 140 KIAS
Flaps..FULL
Airspeed ....TRIM & MAINTAIN 135 KIAS
Expect 3500 to 4000 fpm rate of descent.

UNLATCHED DOOR IN FLIGHT

If the door becomes unlatched or opens in flight the first priority is to "FLY THE AIRPLANE". If the door is still hooked, have a passenger hold the handle to prevent further opening, if the door has completely opened do not attempt to close it. Slow the airplane down to approach speed, extend the flaps and return to the nearest suitable airfield and land.

EMERGENCY GROUND EGRESS

Engine ....SHUTDOWN, IF RUNNING
Emergency Power Lever (EPL) ....IDLE
Propeller ....FEATHER
Fuel Control ....OFF
Lap Belt/Shoulder Harness ....RELEASE
Main Entry/Baggage Door Seals ....DEFLATE
Battery Switches ....OFF
Fuel Selector Valve............................OFF
Main Entry Door ....UNLATCH & OPEN
Exit Aircraft

INADVERTANT ICING ENCOUNTER

Pitot Heat ....ON
Propeller De-Ice ....ON
Engine Ice Door ....BYPASS
Windshield Defrost ....ON
Vent/Defog Fan..................................ON
Wing and/or Windshield De-Ice ....ON
Heading/Altitude................................CHANGE TO EXIT ICING CONDITIONS

SPIN RECOVERY

Power Control Lever..........................IDLE
Control Stick ....NEUTRAL TO SLIGHTLY FORWARD, AILERONS NEUTRAL
Rudder...FULL OPPOSITE TO ROTATION

Rudder, When Rotation Stops ....NEUTRAL
Pitch ....DOWN, RECOVER AIRSPEED
Recover Smoothly From Ensuing Dive, Remaining Within Aircraft G Limits.

MAXIMUM GLIDE CONFIGURATION

Gear..UP
Flaps...UP
Propeller ....FEATHER
Airspeed ....110 KIAS

The above configuration should give maximum glide performance with approximately 500 fpm descent and an 18:1 glide ratio.

Glide distance is approximately 3.5 nm per 1000 feet of altitude loss, however this may vary significantly. It is suggested that it be established for your individual aircraft.

CONTINUED AIRWORTHINESS & MAINTENANCE

Continued airworthiness is an important concern for the owner/ pilot. While some Lancair owners built or participated greatly in the building of their aircraft, others have not. There are many Lancairs flying today that are on their second or third owner. Many of these pilots have never owned an experimental aircraft before. The points below may help you to understand your obligations under the Federal Aviation Regulations in flying and maintaining your aircraft. Many pilots are under the mistaken impression that the regulations that apply to normally certificated aircraft do not apply experimental/ amateur built aircraft. This is not true (with one exception explained below).

14 CFR 91.7 Civil aircraft airworthiness.

(a) No person may operate a civil aircraft unless it is in an airworthy condition.

(b) The pilot in command of a civil aircraft is responsible for determining whether that aircraft is in condition for safe flight. The pilot in command shall discontinue the flight when unairworthy mechanical, electrical, or structural conditions occur.

There is no exception for experimental aircraft here. Just because you built it does not give you license to fly an unsafe aircraft around the skies. Turbine aircraft may not fly with deferred itmes unles they have an approved MEL (minimum equipment list) approved by their FSDO. Again, no exceptions for experimental. 14 CFR 91.213 governs. You may not takeoff with inoperative equipment or instruments required under the regulations. For example, if you have an inoperative transponder you may not fly in Class A, B or C airspace. Inoperative oil pressure gauge? Grounded per 91.205. Inoperative altimeter or airspeed indicator ? Grounded until repairs are made. Too many Lancair pilots have come to grief flying airplanes with known deficiencies. Don’t be another statistic. You are better off on the ground wishing you were in the air rather than being in the air wishing you were on the ground.

The FAR’s make it pretty clear that the owner is responsible for maintaining the aircraft in an airworthy fashion.

14 CFR 91.213 Inoperative instruments and equipment.

You may not defer maintenance on a turbine powered aircraft! Everything must work or you must defer per an approved MEL you obtained from your FSDO.

(a) Except as provided in paragraph (d) of this section, no person may take off an aircraft with inoperative instruments or equipment installed unless the following conditions are met:

(1) An approved Minimum Equipment List exists for that aircraft.

(2) The aircraft has within it a letter of authorization, issued by the FAA Flight Standards district office having jurisdiction over the area in which the operator is located, authorizing operation of the aircraft under the Minimum Equipment List. The letter of authorization may be obtained by written request of the airworthiness certificate holder. The Minimum Equipment List and the letter of authorization constitute a supplemental type certificate for the aircraft.

(3) The approved Minimum Equipment List must—

(i) Be prepared in accordance with the limitations specified in paragraph (b) of this section; and

(ii) Provide for the operation of the aircraft with the instruments and equipment in an inoperable condition.

(4) The aircraft records available to the pilot must include an entry describing the inoperable instruments and equipment.

(5) The aircraft is operated under all applicable conditions and limitations contained in the Minimum Equipment List and the letter authorizing the use of the list.

(b) The following instruments and equipment may not be included in a Minimum Equipment List:

(1) Instruments and equipment that are either specifically or otherwise required by the airworthiness requirements under which the aircraft is type certificated and which are essential for safe operations under all operating conditions.

(2) Instruments and equipment required by an airworthiness directive to be in operable condition unless the airworthiness directive provides otherwise.

(3) Instruments and equipment required for specific operations by this part.

(c) A person authorized to use an approved Minimum Equipment List issued for a specific aircraft under subpart K of this part, part 121, 125, or 135 of this chapter must use that Minimum Equipment List to comply with the requirements in this section.

(d) Except for operations conducted in accordance with paragraph (a) or (c) of this section, a person may takeoff an aircraft in operations conducted under this part with inoperative instruments and equipment without an approved Minimum Equipment List provided—

(1) The flight operation is conducted in a—

(i) Rotorcraft, ***non-turbine-powered airplane***, glider, lighter-than-air aircraft, powered parachute, or weight-shift-control aircraft, for which a master minimum equipment list has not been developed; or

(ii) Small rotorcraft, nonturbine-powered small airplane, glider, or lighter-than-air aircraft for which a Master Minimum Equipment List has been developed; and

(2) The inoperative instruments and equipment are not—

(i) Part of the VFR-day type certification instruments and equipment prescribed in the applicable airworthiness regulations under which the aircraft was type certificated;

(ii) Indicated as required on the aircraft's equipment list, or on the Kinds of Operations Equipment List for the kind of flight operation being conducted;

(iii) Required by §91.205 or any other rule of this part for the specific kind of flight operation being conducted; or

(iv) Required to be operational by an airworthiness directive; and

(3) The inoperative instruments and equipment are—

(i) Removed from the aircraft, the cockpit control placarded, and the maintenance recorded in accordance with §43.9 of this chapter; or

(ii) Deactivated and placarded "Inoperative." If deactivation of the inoperative instrument or equipment involves maintenance, it must be accomplished and recorded in accordance with part 43 of this chapter; and

(4) A determination is made by a pilot, who is certificated and appropriately rated under part 61 of this chapter, or by a person, who is certificated and appropriately rated to perform maintenance on the aircraft, that the inoperative instrument or equipment does not constitute a hazard to the aircraft.

An aircraft with inoperative instruments or equipment as provided in paragraph (d) of this section is considered to be in a properly altered condition acceptable to the Administrator.

(e) Notwithstanding any other provision of this section, an aircraft with inoperable instruments or equipment may be operated under a special flight permit issued in accordance with §§21.197 and 21.199 of this chapter.

[Doc. No. 18334, 54 FR 34304, Aug. 18, 1989, as amended by Amdt. 91-280, 68 FR 54560, Sept. 17, 2003; Amdt. 91-282, 69 FR 44880, July 27, 2004]

14 CFR 91.319: Aircraft having experimental certificates: Operating limitations.

(a) No person may operate an aircraft that has an experimental certificate—

(1) For other than the purpose for which the certificate was issued; or

(2) Carrying persons or property for compensation or hire.

(b) No person may operate an aircraft that has an experimental certificate outside of an area assigned by the Administrator until it is shown that—

(1) The aircraft is controllable throughout its normal range of speeds and throughout all the maneuvers to be executed; and

(2) The aircraft has no hazardous operating characteristics or design features.

(c) Unless otherwise authorized by the Administrator in special operating limitations, no person may operate an aircraft that has an experimental certificate over a densely populated area or in a congested airway. The Administrator may issue special operating limitations for particular aircraft to permit takeoffs and landings to be conducted over a densely populated area or in a congested airway, in accordance with terms and conditions specified in the authorization in the interest of safety in air commerce.

(d) Each person operating an aircraft that has an experimental certificate shall—

(1) Advise each person carried of the experimental nature of the aircraft;

(2) Operate under VFR, day only, unless otherwise specifically authorized by the Administrator; and

(3) Notify the control tower of the experimental nature of the aircraft when operating the aircraft into or out of airports with operating control towers.

(e) No person may operate an aircraft that is issued an experimental certificate under §21.191(i) of this chapter for compensation or hire, except a person may operate an aircraft issued an experimental certificate under §21.191(i)(1) for compensation or hire to—

(1) Tow a glider that is a light-sport aircraft or unpowered ultralight vehicle in accordance with §91.309; or

(2) Conduct flight training in an aircraft which that person provides prior to January 31, 2010.

(f) No person may lease an aircraft that is issued an experimental certificate under §21.191(i) of this chapter, except in accordance with paragraph (e)(1) of this section.

(g) No person may operate an aircraft issued an experimental certificate under §21.191(i)(1) of this chapter to tow a glider that is a light-sport aircraft or unpowered ultralight vehicle for compensation or hire or to conduct flight training for compensation or hire in an aircraft which that persons provides unless within the preceding 100 hours of time in service the aircraft has—

(1) Been inspected by a certificated repairman (light-sport aircraft) with a maintenance rating, an appropriately rated mechanic, or an appropriately rated repair station in accordance with inspection procedures developed by the aircraft manufacturer or a person acceptable to the FAA; or

(2) Received an inspection for the issuance of an airworthiness certificate in accordance with part 21 of this chapter.

(h) The FAA may issue deviation authority providing relief from the provisions of paragraph (a) of this section for the purpose of conducting flight training. The FAA will issue this deviation authority as a letter of deviation authority.

(1) The FAA may cancel or amend a letter of deviation authority at any time.

(2) An applicant must submit a request for deviation authority to the FAA at least 60 days before the date of intended operations. A request for deviation authority must contain a complete description of the proposed operation and justification that establishes a level of safety equivalent to that provided under the regulations for the deviation requested.

(i) The Administrator may prescribe additional limitations that the Administrator considers necessary, including limitations on the persons that may be carried in the aircraft.

You must display the following placard in a readily visible location in the cabin or cockpit, unless your aircraft has only one seat:

"Passenger Warning: This aircraft is amateur-built and does not comply with Federal safety regulations for standard aircraft."

In accordance with § 91.203(b), you must display the airworthiness certificate and attached operating limitations at the cabin or cockpit entrance so that it is legible to passengers or crew while the aircraft is being operated. The pilot must conduct all flights under the operating limitations and Part 91. Details concerning flight test areas are discussed in paragraph 13.

(1) In addition to 14 CFR requirements, the guidelines you use to operate and maintain your aircraft are included in your operating limitations, which become part of the special airworthiness certificate.

14 CFR 91.403

General.

(a) The owner or operator of an aircraft is primarily responsible for maintaining that aircraft in an airworthy condition, including compliance with part 39 of this chapter.

(b) No person may perform maintenance, preventive maintenance, or alterations on an aircraft other than as prescribed in this subpart and other applicable regulations, including part 43 of this chapter.

There is no exception for experimental aircraft here.

I’ll repeat this again, many pilots are under the mistaken impression that the FAR’s that apply to normally certificated aircraft do not apply experimental/ amateur built aircraft. This is not completely correct. 14 CFR 43.1 states:

14 CFR 91.417 Maintenance records.

(a) Except for work performed in accordance with §§91.411 and 91.413, each registered owner or operator shall keep the following records for the periods specified in paragraph (b) of this section:

(1) Records of the maintenance, preventive maintenance, and alteration and records of the 100-hour, annual, progressive, and ***other required or approved inspections***, as appropriate, for each aircraft (including the airframe) and each engine, propeller, rotor, and appliance of an aircraft. The records must include—

(i) A description (or reference to data acceptable to the Administrator) of the work performed; and

(ii) The date of completion of the work performed; and

(iii) The signature, and certificate number of the person approving the aircraft for return to service.

(2) Records containing the following information:

(i) The total time in service of the airframe, each engine, each propeller, and each rotor.

(ii) The current status of life-limited parts of each airframe, engine, propeller, rotor, and appliance.

(iii) The time since last overhaul of all items installed on the aircraft which are required to be overhauled on a specified time basis.

(Evolution) The current inspection status of the aircraft, including the time since the last inspection required by the inspection program under which the aircraft and its appliances are maintained.

(v) The current status of applicable airworthiness directives (AD) including, for each, the method of compliance, the AD number, and revision date. If the AD involves recurring action, the time and date when the next action is required.

(vi) Copies of the forms prescribed by §43.9(a) of this chapter for each major alteration to the airframe and currently installed engines, rotors, propellers, and appliances.

(b) The owner or operator shall retain the following records for the periods prescribed:

(1) The records specified in paragraph (a)(1) of this section shall be retained until the work is repeated or superseded by other work or for 1 year after the work is performed.

(2) The records specified in paragraph (a)(2) of this section shall be retained and transferred with the aircraft at the time the aircraft is sold.

(3) A list of defects furnished to a registered owner or operator under §43.11 of this chapter shall be retained until the defects are repaired and the aircraft is approved for return to service.

(c) The owner or operator shall make all maintenance records required to be kept by this section available for inspection by the Administrator or any authorized representative of the National Transportation Safety Board (NTSB). In addition, the owner or operator shall present Form 337 described in paragraph (d) of this section for inspection upon request of any law enforcement officer.

(d) When a fuel tank is installed within the passenger compartment or a baggage compartment pursuant to part 43 of this chapter, a copy of FAA Form 337 shall be kept on board the modified aircraft by the owner or operator.

So does this mean you don't have to do an annual or have the ELT checked or transponder and static system inspected? No. The operating limitations issued with the airworthiness certificate for the aircraft specify that you must have a condition inspection performed on the aircraft within the past 12 calendar months. The operating limitations specify the inspection must be conducted in accordance with Appendix D of Part 43. So essentially you must have an "annual" done just like every other aircraft. May you perform your own condition inspection? That depends. If your hold an A&P certificate or a Repairman certificate for the aircraft in question you may perform the condition inspection yourself. If you do not, you may have an A&P perform the condition inspection.

As far as the ELT, transponder, altimeter and static system checks, those inspections must be performed as they are on normally certificated aircraft because the regulations that govern them are found in Part 91—not Part 43. Transponders, altimeters and static systems are required to be tested every 24 calendar months. ELTs are required to be inspected every 12 calendar months.

Some other important items you need to know:

14 CFR 39 Airworthiness Directives

Must I comply with AD's issued against components on my experimental aircraft? Yes, there is no provision in 14 CFR 39 that exempts experimental aircraft. AD's are issued for the purpose of safety and AD's that apply to components on your airplane must meet the requirements of the AD. Although the FAA has never issued an AD against experimental aircraft it does routinely have AD's that pertain to engines, propellers, and other aircraft components. Kit builders issue service bulletins and Lancair has a long list of service bulletins that should frequently checked to ensure compliance.

Here is the exception:

14 CFR 43.1

Applicability.

(a) Except as provided in paragraphs (b) and (d) of this section, this part prescribes rules governing the maintenance, preventive maintenance, rebuilding, and alteration of any—

(1) Aircraft having a U.S. airworthiness certificate;

(2) Foreign-registered civil aircraft used in common carriage or carriage of mail under the provisions of Part 121 or 135 of this chapter; and

(3) Airframe, aircraft engines, propellers, appliances, and component parts of such aircraft.

(b) This part does not apply to any aircraft for which the FAA has issued an experimental certificate, unless the FAA has previously issued a different kind of airworthiness certificate for that aircraft.

What does this mean? Well for one thing any person may perform maintenance or repairs on an experimental aircraft—they do not need to be an A&P to sign off the work. Records do not have to be kept in the manner prescribed in Part 43 but records do need to be maintained per Part 91.417.

Some Notes on Taking Care of your EVO

PWC requires a borescope inspection every 400 hours of the hot section. Also an engine wash to remove sulfidation especially if you live near the coast is strongly recommended.

The starter generator brushes on one brand (I don't recall which brand) wear out exceedingly fast. The shop will not just replace the brushes they want to perform a $2000 + overhaul. When that occurs replace the unit with one that gets longer life on the brushes. AVMATS in St. Louis will replace brushes for $600.

Inspect the prop deice brush blocks every 100 hours-- they last about 500 hours. Brushes can be orderd from Aircraft Spruce. Replacement is not hard.

The bolt that attaches the landing gear door to the forward weldment on the gear leg may shear. Remove and inspect AN 3 bolt. Makes a hell of a racket when it breaks but no effect on flying.

Check your aileron, rudder and elevator bearings for looseness/ wear--replace as necessary.

Make sure you do the most recent bulletin on the fuel vent naca duct making it smaller to reduce wing pressure.

I replaced my forward cabin door aluminum cam pieces with stainless steel cams after one failed in flight causing the door to partially bulge out. It was a fix the Brian Harris, Kevin Risse and Lancair did.

The electric fuel pump will last 500-600 hours with continuous use. CG Aviation overhauled mine for $950. EPS recommends flying with the electric boost pump off if you have a mechanical fuel pump.

The pitot heat lasted 600 hours before it failed. Check your ammeter load by turning pitot heat on and off in flight. The annunciator only tells you the pitot tube has power. It does not tell you if it is working. It is a preflight check.

My engine driven fuel pump lasted less than 100 hours. I replaced it with an overhauled unit. About $6000.

The Maritz touch screens have a defective screen. At first you can touch a button and something else happens. Finally nothing works. The manufacturer wants $2000 plus for repair. As I understand it all Evos need screen replacement. If you have been flying less than a year it may still be under warranty.

CONTINUED AIRWORTHINESS AND MAINTENANCE QUIZ

1. AD's do not apply to experimental aircraft
    a. true
    b. false

2. You must have a condition inspection performed on an experimental aircraft in accordance with 14 CFR 43 Appendix D every
    a. Every 24 calendar months by an IA
    b. Every 12 calendar months by an IA
    c. Every 12 calendar months by an IA or a repairman who built the aircraft

2. You must have what other inspections performed on the aircraft to be legal to fly IFR?
3. If the aircraft has a cylinder that will not stay below 500F in flight may you fly the aircraft to another facility to be repaired? Explain.
4. The altimeter does not work properly. Can you operate the aircraft? Explain.
5. You converted your aircraft to a turbine. Must you make a record entry and do anything else before you carry passengers? Explain.

PHASE I FLIGHT TESTING

Advisory Circular AC90-116 Additional Pilot Program is available to Evolution builders and allows a qualified second pilot in the cockpit during Phase I flight testing. Call Bob Pastusek for details. You must apply to the FAA for a letter of authorization. Fmi: https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_90-116.pdf

The following information is reproduced from FAA AC 20-27G dated 9/30/2009

14. Phase I Flight Testing.
a. Flight Tests. Section 91.319(b) requires you to show that your aircraft is controllable at all its normal speeds during all the maneuvers you might expect to execute. You also need to show that your aircraft has no hazardous operating characteristics or design features.
b. Number of Flight Test Hours. The number of hours depends on your aircraft's characteristics. See table 7 below for specific requirements. The FAA may decide you need additional hours of flight testing beyond those shown in the table to comply with § 91.319(b).

Table 7. Aircraft Flight Test Requirements
Aircraft Characteristics Required Flight Testing
Type-certificated engine/propeller combination 25 hours
Non-type-certificated engine/propeller combination 40 hours

c. Location. You may suggest the location of a flight test area to the FAA. If the FAA approves your suggestion, they will specify it in your operating limitations. Usually, the flight test area should be within a 25-statute-mile radius from your aircraft's base of operation. Under § 91.305, the flight test is required to be over open water or sparsely populated areas with light air traffic so it does not pose a hazard to persons or property on the ground. You can ask us to help you pick a suitable area to ensure adequate airspace for flight testing.

d. Procedures. See AC 90-89 for recommended flight testing procedures. We strongly recommend amateur builders get a copy of this AC and follow its guidance. Also, the EAA will help its members in developing flight testing programs.

e. Restrictions.

(1) Carrying Passengers. You may not carry passengers while you are restricted to the flight test area or during any portion of your phase I flight test program. We suggest you use a tape or video recorder for recording readings and other similar tasks. If you need an additional crewmember for a particular flight test, specify that in your application program letter for the airworthiness certificate. We will list this need in your operating limitations.

(2) Flight Instruction. You may not receive flight instruction during your flight test.

(3) Operating Limitations. When we issue an unlimited duration special airworthiness certificate, the operating limitations may be prescribed in accordance with Order 8130.2. The purpose of the operating limitations is for you to show and maintain compliance with § 91.319. The operating limitations include a requirement for you to endorse the aircraft logbook and maintenance records with a statement certifying the aircraft has been shown to comply with that section. The limitations may vary for some aircraft, and we may issue additional limitations in unusual conditions in the interest of safety. We will review the limitations with you to ensure you thoroughly understand each one.

15. Continuing To Operate Your Amateur-Built Aircraft.

a. After you complete all required flight tests, hours, and maneuvers, the aircraft is considered safe for continued flight. To continue operating your aircraft, you are required to follow the operating limitations issued with the special airworthiness certificate.

b. You may not operate your aircraft without the original airworthiness certificate and operating limitations aboard. If you lose the operating limitations or they are mutilated or no longer legible, you need to contact AFS-750 in Oklahoma City, Oklahoma (see Appendix 7 to this AC for the address) to obtain a copy of the operating limitations. Once you receive a copy from AFS-750, take that copy to your local FAA office to issue an original replacement FAA Form 8130-7 and/or operating limitations. If you can document that the aircraft has completed the flight test requirements (through aircraft logbook and maintenance records entries), we may issue new operating limitations without initial flight test operating limitations.

c. You should be aware of the responsibilities for maintenance and recordkeeping as prescribed in your operating limitations.

17. Becoming a Repairman Of Your Amateur-Built Aircraft.

a. You can get a repairman certificate under certain circumstances. However, the only privilege this

certificate gives you under 14 CFR § 65.104, Repairman certificate—experimental aircraft builder—Eligibility, privileges and limitations, is to do the annual condition inspection. The certificate will be valid only for a specific person and a specific aircraft. The privileges and limitations in part 65, Certification: Airmen Other Than Flight Crewmembers, § 65.103, Repairman certificate: Privileges and limitations, do not apply to becoming this type of repairman (experimental aircraft builder). To get a certificate, apply to your local FAA office. See Appendix 14 to this AC and AC 65-23, Certification of Repairmen (Experimental Aircraft Builders), for additional application information. You can get a certificate if you are—

a. The primary builder of your aircraft, even as the second builder, and can satisfactorily prove to us that you can determine whether the aircraft is in a condition for safe operation.

b. One of the builders of an amateur-built aircraft registered in a corporation's name. The applicant should prove through use of the builder's log that they can determine whether the aircraft is in a condition for safe operation.

18. Safety Recommendations.

a. Pilot Responsibilities. As a pilot, you should—
(1) Be thoroughly familiar with the aircraft, its engine and propeller operation, and ground handling characteristics, including operation of the brakes. You should test these operations by conducting taxi tests before attempting flight operations. You are not authorized to take off during taxi tests without an airworthiness certificate.
(2) Take precautions to ensure emergency equipment and personnel are readily available in the event of an accident, before the first flight of an amateur-built aircraft.
(3) Refrain from aerobatic maneuvers until you have enough flight experience to establish that the aircraft is satisfactorily controllable throughout its normal range of speeds and maneuvers. You should document all satisfactorily conducted maneuvers in the aircraft logbook, flight test program log, or equivalent document.
b. Operating Limitations.

(1) The operating limitations require that you operate the aircraft under the applicable air traffic control and general operating rules of part 91. If you plan to operate under instrument flight rules (IFR), pay particular attention to the applicable requirements in part 91.
(2) The operating limitations will authorize all operations to be conducted (visual flight rules, day/night, and IFR). These operating limitations may state that the instruments and equipment mandated by § 91.205(b), (c), and/or (d), Powered civil aircraft with standard category U.S. airworthiness certificates: Instrument and equipment requirements, need to be installed and operable. In addition, these operating limitations may identify flight test are as defined in § 91.305.

c. Equipment.
(1) Unless you received deviation authority from air traffic control, if your aircraft has a Mode C transponder, the aircraft also is required to have a calibrated airspeed/static pressure system to prevent an error in altitude reporting. You should have the transponder tested and inspected under § 91.413, ATC transponder tests and inspections.
(2) Once your aircraft has been released from the flight test area, you are required to have an emergency locator transmitter aboard in accordance with § 91.207, Emergency locator transmitters. An aircraft with only one seat is exempt from this requirement according to § 91.207(f)(9). (from AC 20-27G, dated 9/30/2009)

Advisory Circular AC90-116 Additional Pilot Program is available to Evolution builders and allows a qualified second pilot in the cockpit during Phase I flight testing. Call Bob Pastusek for details. You must apply to the FAA for a letter of authorization. Fmi: https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_90-116.pdf