TRAINING MANUAL LANCAIR IV/IVP

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PREFACE

"One thing to consider before you begin your Lancair IV 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 driven 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 IV/ IVP 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 IV and IVP 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. For example, early serial number Lancair IV's and IVP aircraft were equipped by owner/ builders with steam gauge cockpits whereas today most are finished with EFIS cockpits. 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 IV and IVP 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 IV and IVP.

Lancair IV/ IVP Flight and Aeronautical Decision Making

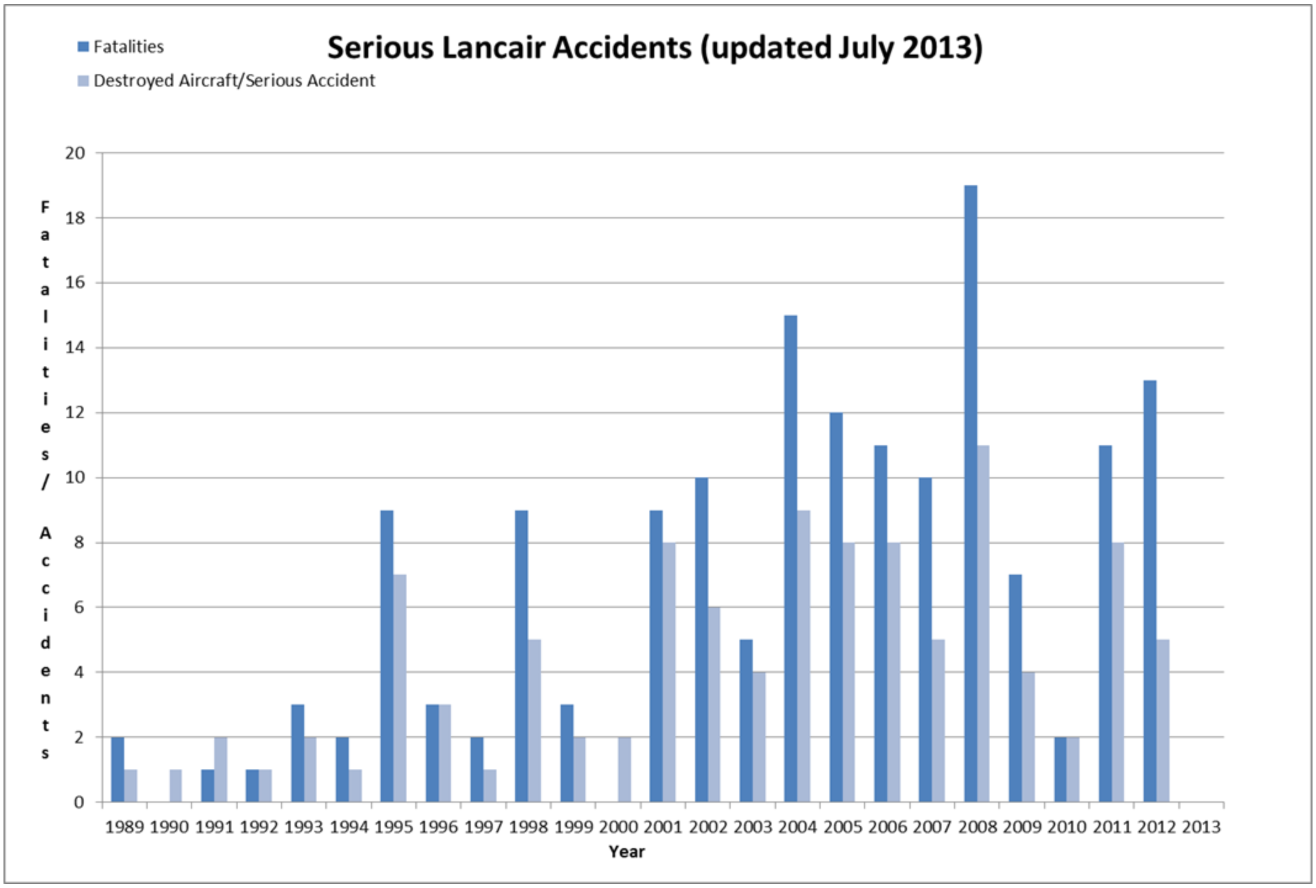
The standard of care of a General Aviation (GA) Pilot with an Instrument Rating certificated in the United States is outlined in many government and industry documents ranging from Federal regulations found in, but not limited to,14 CFR 61 and 91 series and a multitude of advisory materials published by the federal government (Federal Aviation Administration--FAA) and industry. The advisory material expands on and explains the regulatory information. The core subject aeronautical knowledge areas are found at 14 CFR 61.125, 14 CFR 61.65, the Commercial Pilot Practical Test Standards and Instrument Rating Practical Test Standards. The Commercial Pilot Practical Test Standards (FAA-S- 8081-12B, (appendix A-2)) and the Instrument Rating Practical Test Standards (FAA-S-8081-4 (appendix A-2)) contain a listing of all of the advisory material that expound on the core subject areas. Commercial Pilot and Instrument Pilot applicants must learn and be familiar with these core subject aeronautical areas in order to pass the Commercial Pilot and Instrument Rating check rides and be issued an FAA Commercial Pilot certificate with an Instrument Rating. The FAA also publishes a variety of handbooks including the Pilot’s Handbook of Aeronautical Knowledge, Instrument Flying Handbook, Instrument Procedures Handbook, Airplane Flying Handbook, among other publications, in order to convey important aeronautical information to prospective and current pilots. Pilots are taught much of this information by flight instructors and are required to demonstrate their knowledge of the various aeronautical subjects on written as well as oral and practical flight tests given by instructors and examiners. These subject areas include aviation weather, aircraft maintenance and airworthiness, aeronautical decision making, aero medical issues, instrument flying, instrument approach procedures among a few. In addition to subject knowledge areas, Pilots aspiring to become Commercial Pilots with Instrument Ratings are trained to flight proficiency on a variety of flight and flight related tasks and maneuvers, including flight by reference to instruments, instrument approaches, single engine instrument approaches, missed approaches, holding, etc. The Commercial Pilot Practical Test Standard, by which Commercial Pilot applicants are judged on the respective checkride, emphasizes good judgment and prudent safe operation of the aircraft. After a person passes a Commercial Pilot and Instrument Rating checkride and receives a Commercial Pilot certificate and Instrument Rating from the FAA, that person is allowed to carry passengers for hire and is expected to always operate in a safe and prudent manner at a higher standard than that for a Private Pilot. Commercial Pilots are further instructed and refreshed on this aeronautical information during their required flight review training every two years at a minimum. Commercial Pilots should refresh themselves regularly on the important information contained in the advisory documents.

In addition to the government literature, the General Aviation industry information available to the General Aviation Pilot is prodigious. There are many publications, organizations, clubs and other activities that publish information related to safe prudent flying. For example, although there are only about 600,000 pilots in the United States, over 400,000 people belong to the Aircraft Owners and Pilots Association (AOPA). AOPA publishes monthly magazines and electronic or “e” magazines for its members containing a wealth of information on safe aircraft operating and flying techniques. There are also “type clubs” for owner/operators of various aircraft like the aircraft involved in this accident. All of these clubs and associations encourage and foster good safe operating practices.

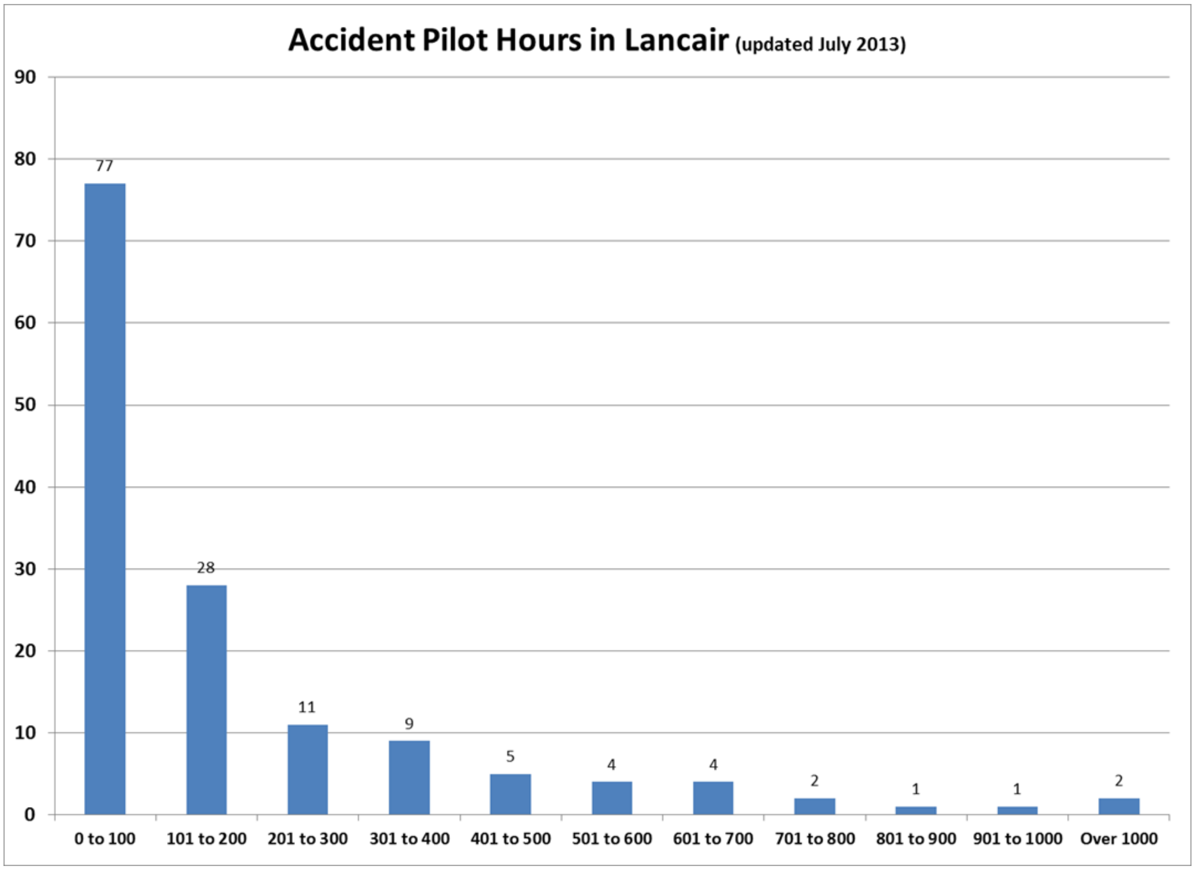
General Aviation flying as a hobby is not without risk. However, that risk can be managed to a safe and acceptable level by adhering to good safe operating practices found in the body of information that has been developed over the last 100 years of powered flight. When a pilot disregards or chooses to ignore the government and industry recommendations, the risk of having an accident rises greatly.

Unfortunately, when there is an aviation accident, it is sometimes discovered that the Pilot in Command 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. Flying skills are very perishable skills that need constant practice and exercise. Skill and knowledge are the two cornerstones of what it takes to be a good safe pilot. It takes practice and study to maintain these two qualities.

As of October 2012, there have been over 191Lancair accidents with 91 fatalities in Lancairs since the first on August 1, 1989 at Oshkosh when a Lancair 235 was lost with two fatalities.

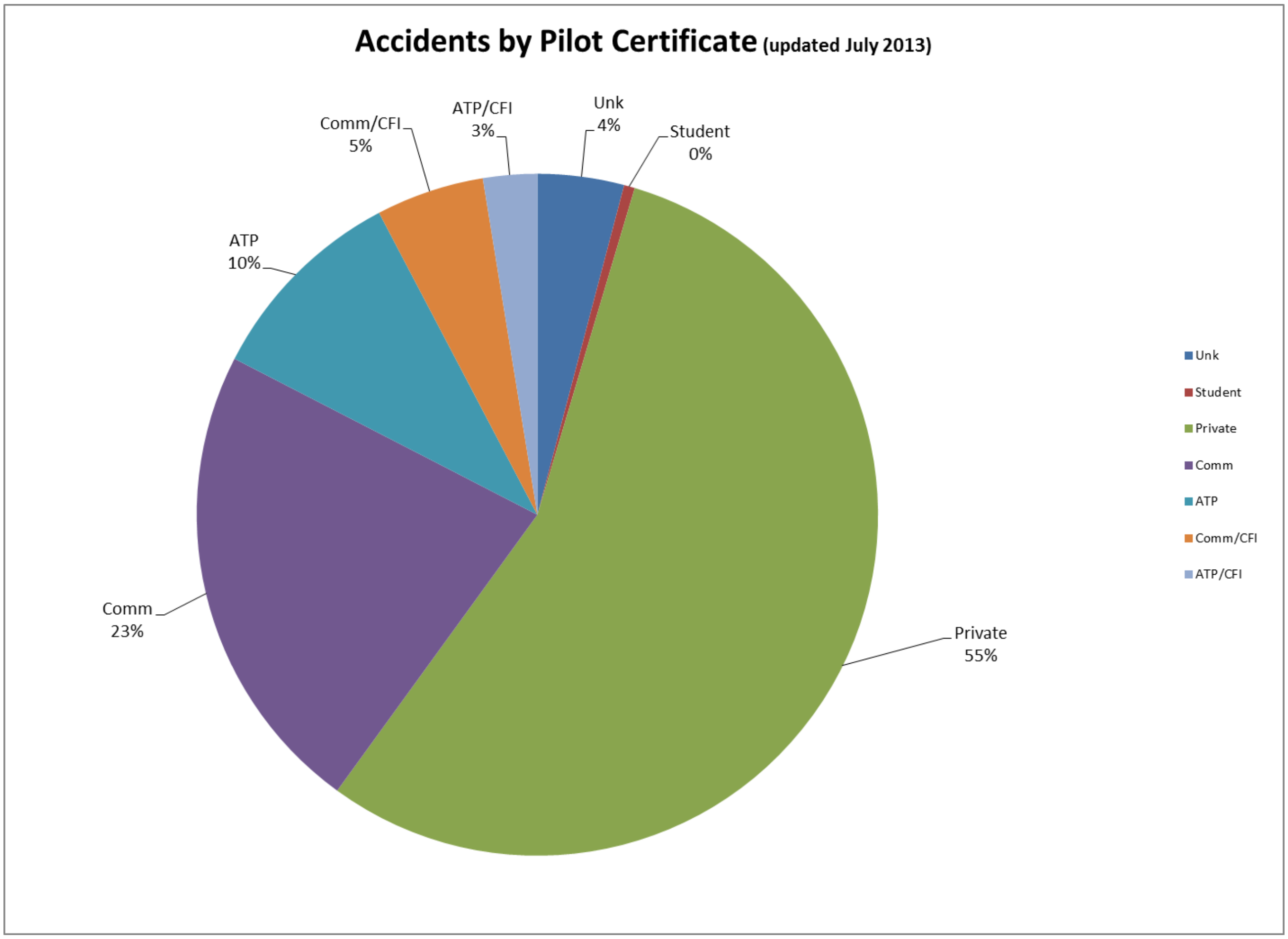


The reasons for the accidents are varied but in the majority of cases the pilot failed the airplane, the airplane did not fail the pilot. The most striking statistic is that 43% of our accidents to date have been with PIC's who have less than 100 hours in make and model. Many of our losses have occurred on the first flight. Good flight training cannot be overemphasized with these statistics.

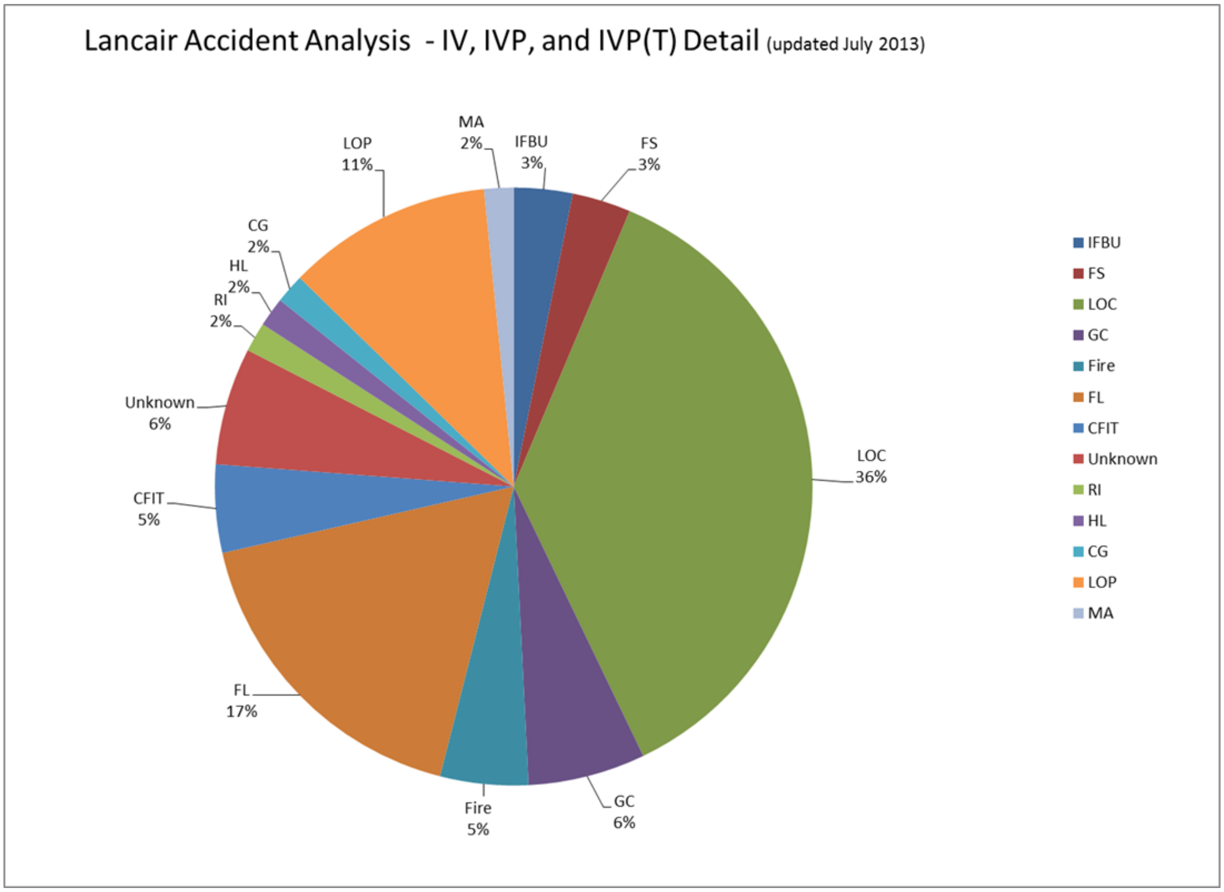


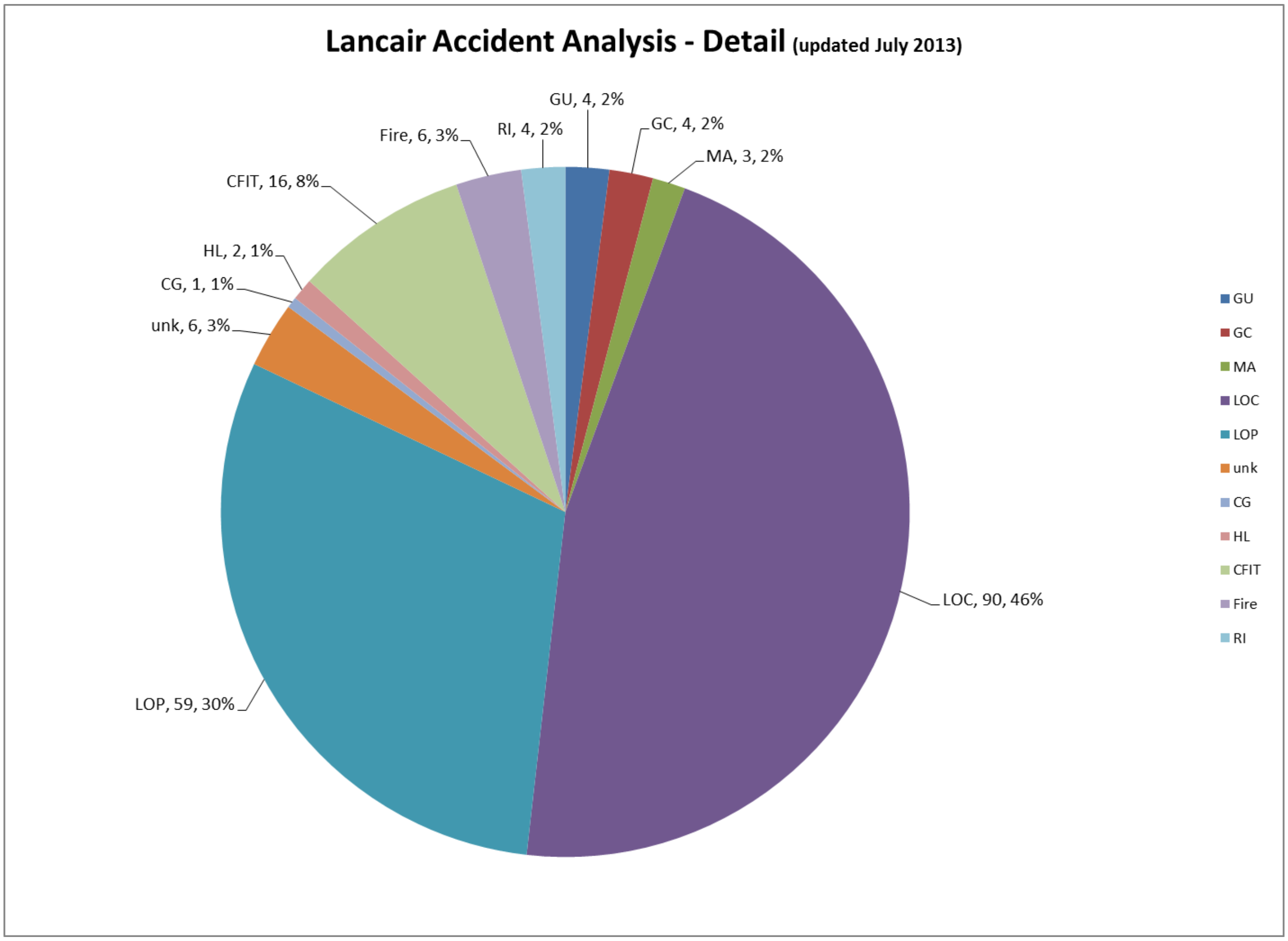
Also notable is that only there have been just two serious accidents with Lancair pilots who have more than 1000 hours in type. Experience counts.

When looking at Lancair accident pilots and certificates we find that 55% of the Lancair accident pilots hold a Private Pilot certificate while only 35% of the U.S. pilots hold a private pilots certificate. Again this points to a possibly strong correlation to pilot training and accidents.



What is the cause of all Lancair accidents? Well, broadly speaking two main areas comprise the bulk of the accidents. Loss of Control and Loss of Power.

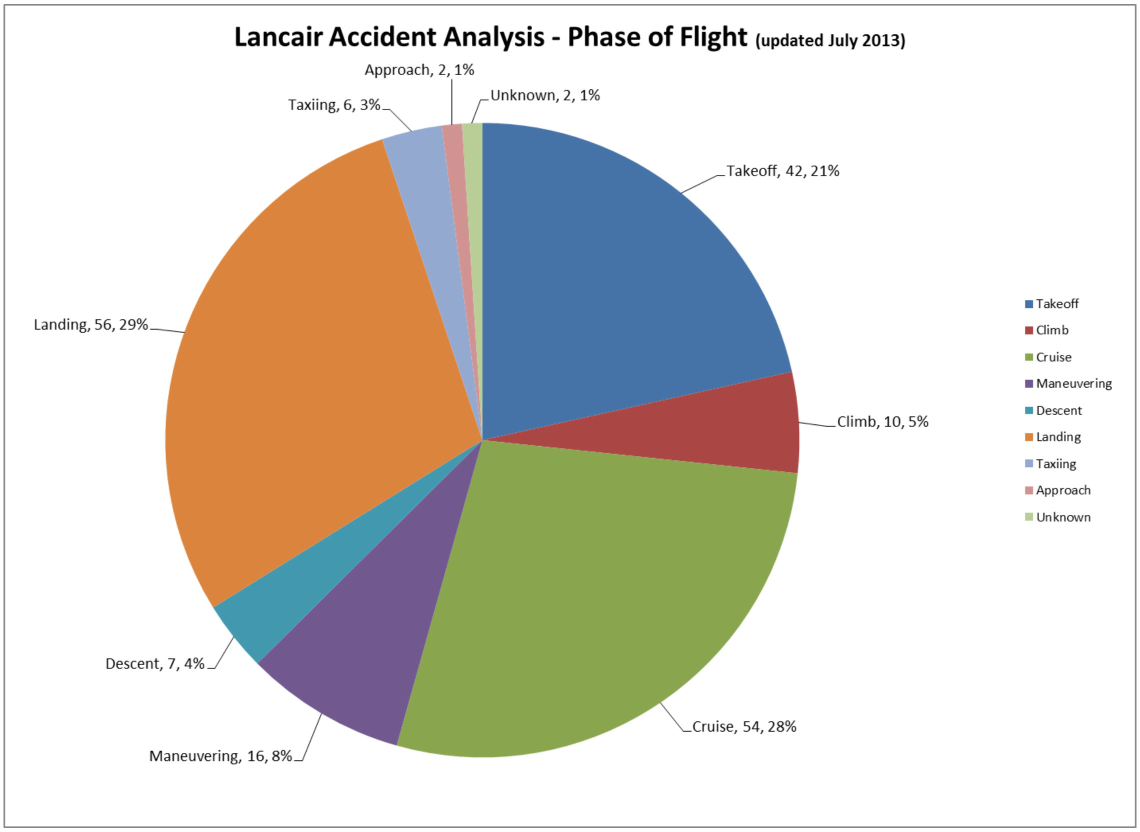

Lancair Accident Analysis - IV, IVP, and IVP(T) Detail (updated July 2013)
MA 2%
IFBU 3%
FS 3%
LOP 11%
CG 2%
HL 2%
RI 2%
Unknown 6%
CFIT 5%
FL 17%
Fire 5%
GC 6%
LOC 36%
IFBU
FS
LOC
GC
Fire
FL
CFIT
Unknown
RI
HL
CG
LOP
MA

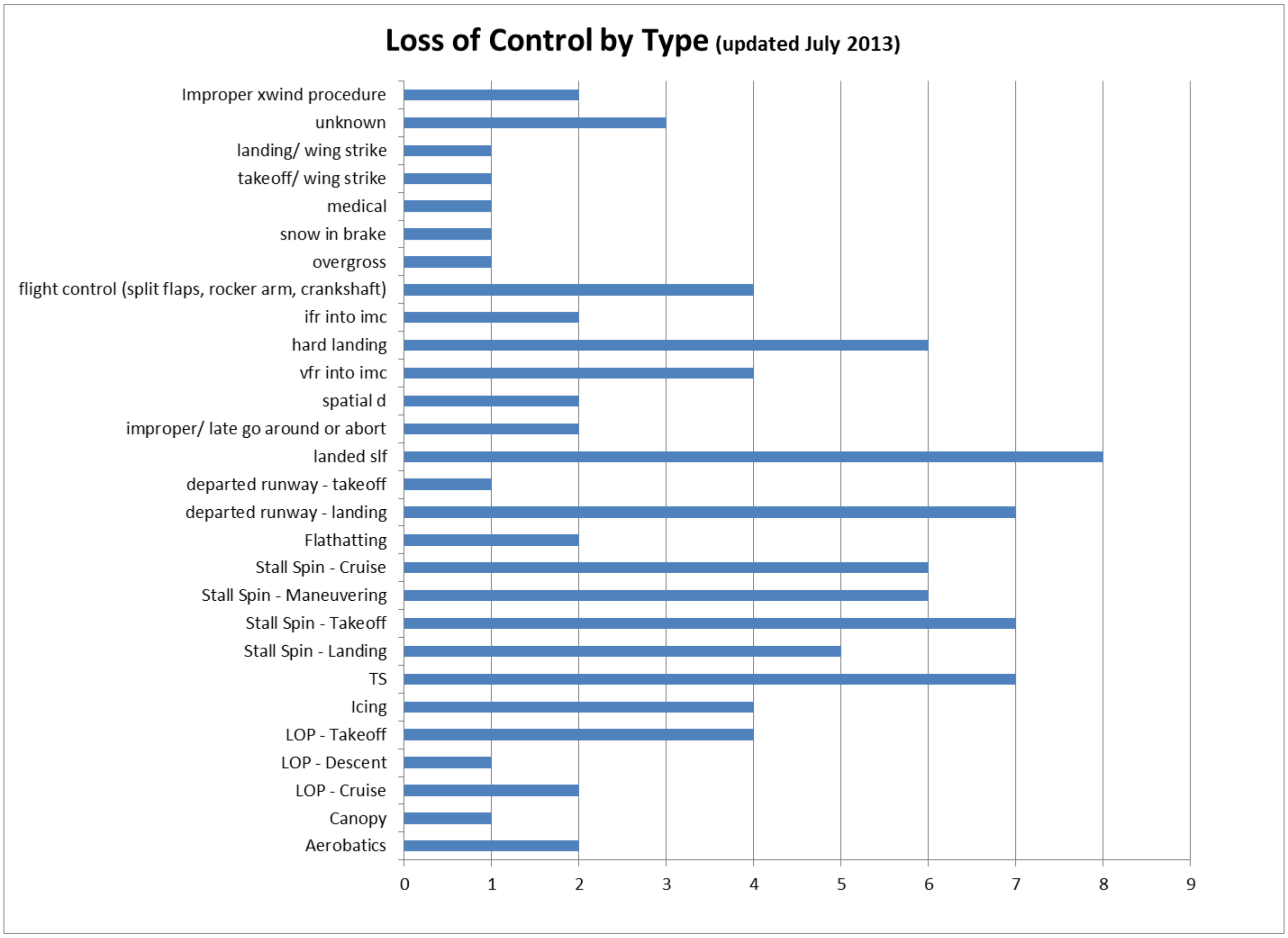


Key:

LOC- loss of control	LOP- loss of power
MA- midair	CG- collapse landing gear
HL-hard landing	CFIT-controlled fligth into terrain
Fire-inflight or ground fire	RI-runway incursion
GU-gear up	GC-ground collision

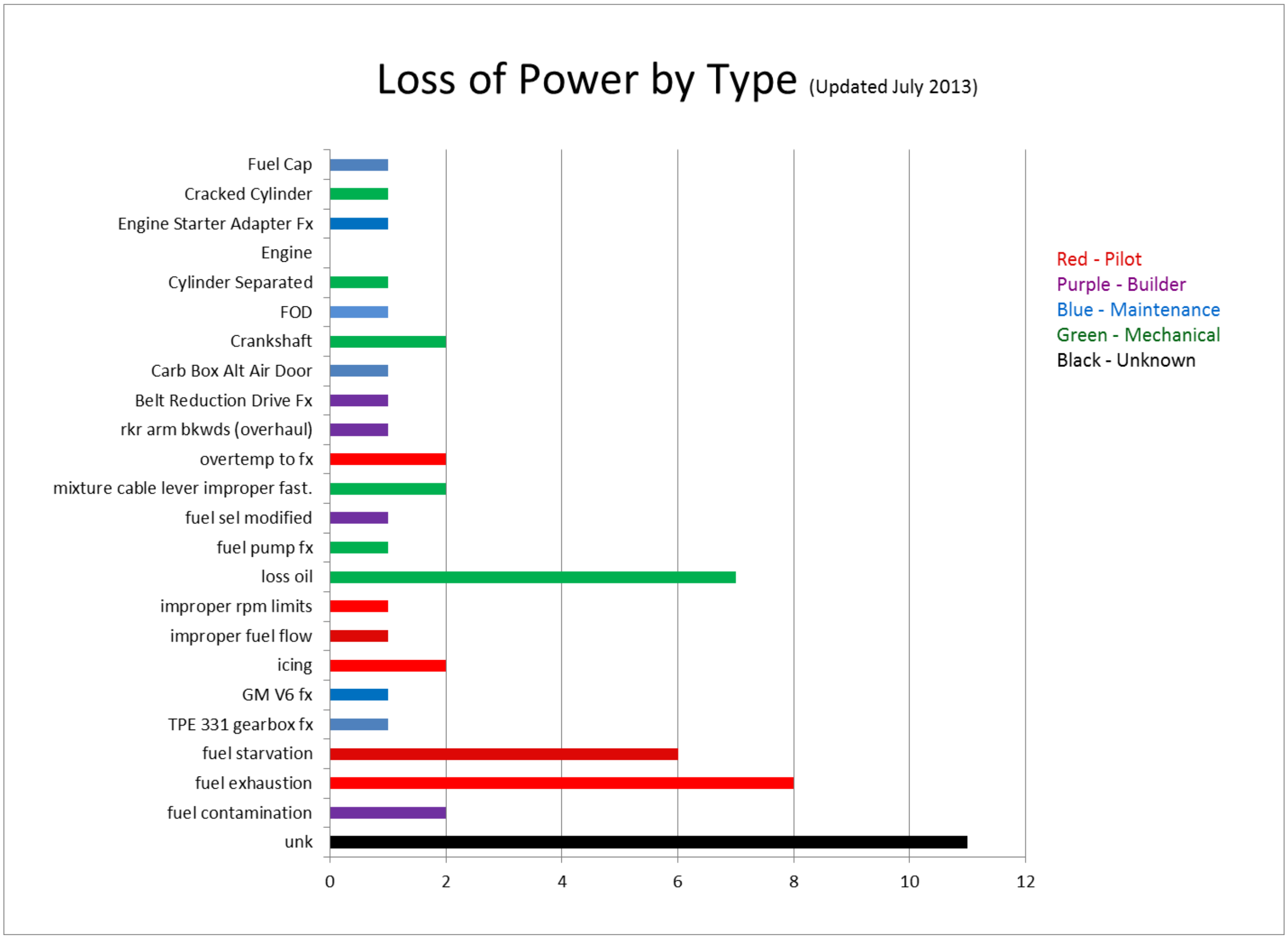
Many of the Lancair accidents are Loss of Control type accidents under a variety of circumstances. In many cases the pilot stoppped flying the airplane or put the airplane into a situation in which control was lost. All too frequently this occurred on or near the runway in a takeoff or landing situation in which the pilot was too fast or too slow on landing or landed too long or short of the runway . Over half of all Lancair accidents occur on takeoff or landing. Remember what your flight instructor said –“never stop flying the airplane”.


Lancair Accident Analysis - Phase of Flight (updated July 2013)
Approach, 2, 1%
Unknown, 2, 1%
Taxiing, 6, 3%
Takeoff, 42, 21%
Landing, 56, 29%
Climb, 10, 5%
Descent, 7, 4%
Cruise, 54, 28%
Maneuvering, 16, 8%
Takeoff
Climb
Cruise
Maneuvering
Descent
Landing
Taxiing
Approach
Unknown

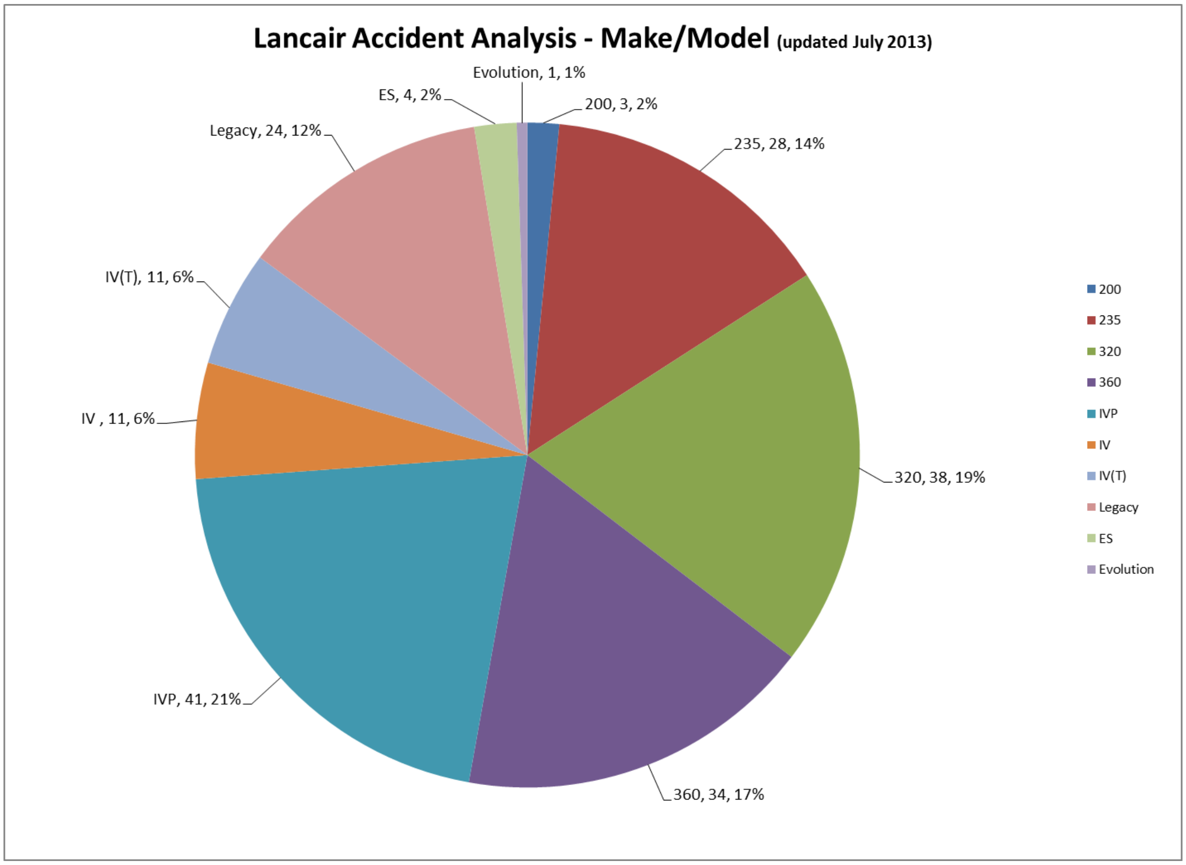


Many of the Lancair Loss of Control accidents involve pilots pressing into poor weather conditions involving thunderstorms, VFR into IMC, or icing. Let's face it—the Lancair is a great airplane but it is not an all weather aircraft. The IV and IVP cannot top all weather—it can get you into the middle of the worst of it. The IV series aircraft is a great cross country machine that can cover a lot of territory in a day but it cannot do it all the time.

Loss of Power accidents covers the other broad area of accidents and concern. Aside from the "cause unknown" accidents, fuel exhaustion and fuel starvation comprise the largest number of Loss of Power accidents. In other words, the pilot ran out of gas. In second place is loss of oil, often due to chaffing oil lines or loose oil fittings.

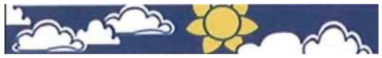


Where does the IV and IVP stack up against other Lancair models? About one quarter of all Lancair accidents involve a IV or IVP airplane. With over 2000 Lancair kits sold (close to 600 IV and IVP kits) and over 1000 Lancairs flying the accidents are prettty evenly spread out.



So, bottom line is if you are going to fly the Lancair IV and IVP safely you have to have a set of rules. The Federal Aviation Regulations sometimes referred to as "the FARs" is pretty much a rock bottom set of regs that forms the floor of accepted pilot behavior. How does a pilot get themselves into trouble? Minimize training, fly in weather conditions over your head, operate into or out of airports with minimal field length, etc. What are some examples? Pilot flies IVP without a documented flight review in over 19 years, pilot flies into a 2500 foot runway after demonstrating he could not land and stop a IV in over 3000', pilot flies aircraft with malfunctioning engine. A flight instructor can only do so much—like leading a horse to water.

LOBO recommends the following set of guidelines be adopted by its members for establishing their weather criteria.

QUALIFICATION	DAY		NIGHT	
ALL FLIGHTS UNDER VFR NON-INST RATED OR IFR RATED (NON-PROFICIENT)	 OPERATE AT OR ABOVE 3000′ CEILINGS 5 SM VISIBILITY		 OPERATE AT OR ABOVE 5000′ CEILINGS 10 SM VISIBILITY	
IFR RATED (PROFICIENT)	Less than 100 hours in Type	More than 100 hours in Type	Less than 100 Hours in Type	More than 100 Hours in Type
	No	Operate at or Above 500′ Ceilings 1 SM Visibility	No	**Operate at or Above 600′ Ceilings 2 SM Visibility**
IFR RATED (PROFICIENT TO CAT 1 MINIMUMS WITHIN 60 DAYS)	Less than 100 hours in Type	More than 100 hours in Type	Less than 100 Hours in Type	More than 100 Hours in Type
	No	Operate at or Above 200′ Ceilings ½ SM Visibility	No	**Operate at or Above 200′ Ceilings ½ SM Visibility**
NOTE: File IFR anytime the weather is below 3000′/5 SM				
Less than 25 hours in Type	25 KNOTS SUSTAINED AND/OR 15 KNOT CROSSWIND		25 KNOTS TOTAL SUSTAINED AND/OR 10 KNOT CROSSWIND	
Between 25 and 100 hours in Type	30 KNOTS SUSTAINED AND/OR 15 KNOT CROSSWIND		25 KNOTS SUSTAINED AND/OR 15 KNOT CROSSWIND	
More than 100 hours in Type	35 KNOTS SUSTAINED AND OR 20 KNOT CROSSWIND OR MAX DEMONSTRATED		35 KNOTS SUSTAINED AND/OR 20 KNOT CROSSWIND OR MAX DEMONSTRATED	
FLIGHT INTO KNOWN ICING PROHIBITED				

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;
(iv) 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) Preventive 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.

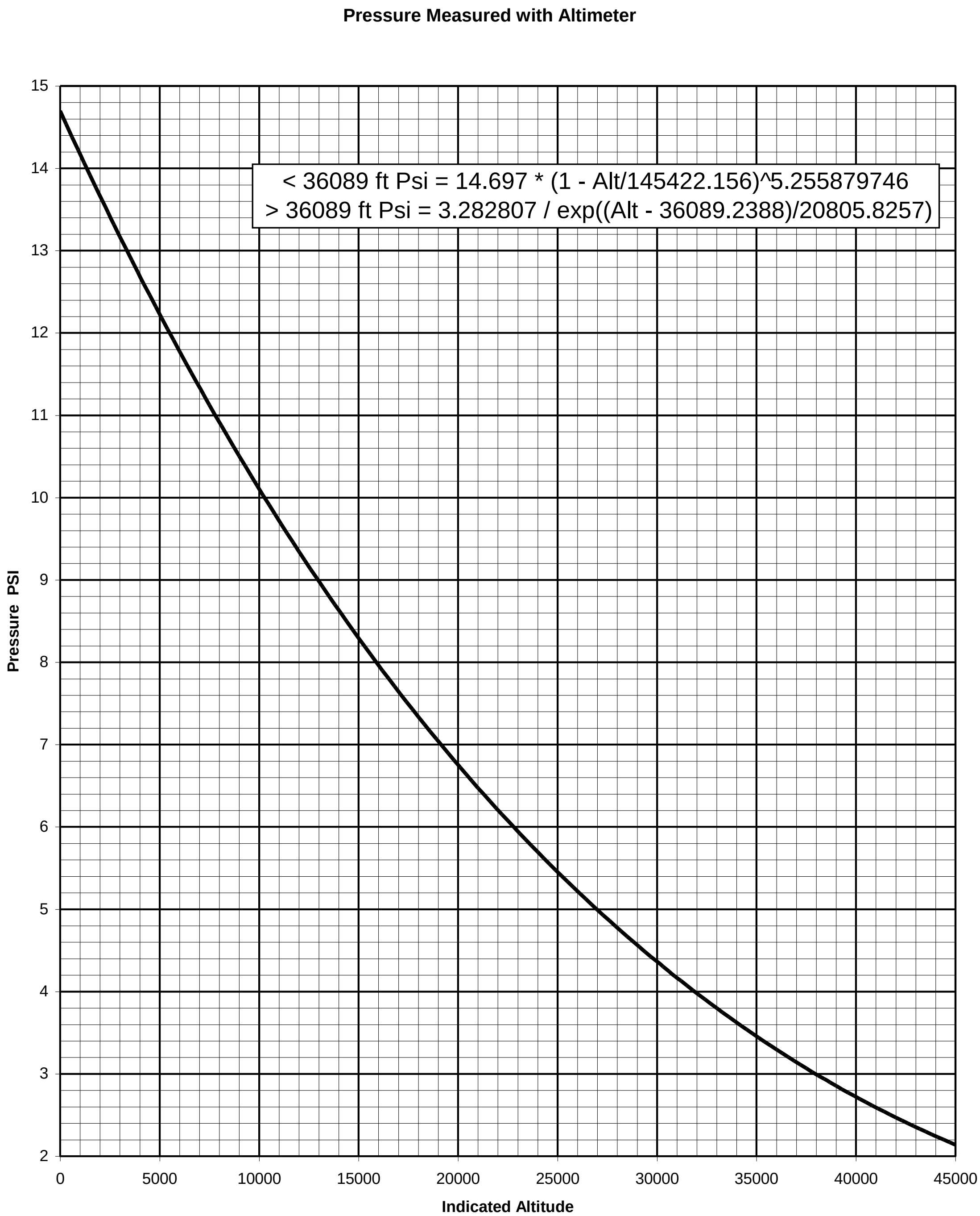
(3) The training and endorsement required by paragraphs (g)(1) and (g)(2) of this section are not required if that person can document satisfactory accomplishment of any of the following in a pressurized aircraft, or in a flight simulator or flight training device that is representative of a pressurized 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
(iv) 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 LIV-P at FL240 at 5 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.



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 IV, 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 IV-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 IV-P

Operating the pressurized LIV-P 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:

1. Don oxygen mask, check flow (100%) inform passengers.
2. Inform ATC of the problem and request lower altitude.
3. Make normal descent, keeping turbos at maximum output, consistent with descent rate and airspeed limitations.
4. Consider terrain and level off at 2,000' AGL or 10,000 MSL whichever is higher

If cabin pressure loss is rapid:

1. Don oxygen mask – check flow (100%), inform passengers.
2. Auto pilot off.
3. Turn 90 degrees from airway course, if flying airways.
4. Set transponder to code 7700.
5. Reduce power to minimum.
6. Configure aircraft for maximum sink rate.
    a. Consider aircraft structure. If sound:

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

    b. 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.

(3) Consider use of speed brakes.

Physiology Quiz:

1. The time of useful consciousness (TUC) for a person is dependent on?
    a. Smoking, fatigue and depressants usage
    b. Cabin altitude, decompression rate
    c. Both A and B
2. At FL 240 our cabin altitude in a Lancair IVP will be?
    a. 12,000’
    b. 5,000’
    c. 9,000’
3. We should test our O2 standby system for servicing and operation?
    a. When we reach cruising altitude
    b. On preflight
    c. During the condition inspection
4. If we have a cabin decompression we should?
    a. Advise ATC and wait for clearance to descend, set autopilot for descent, don O2 mask
    b. Don O2 mask, check O2 flow “on”, declare an emergency with ATC, descend to lower altitude, check passengers
    c. Declare emergency, descend to lower altitude, check O2 mask “on”
5. The Lancair IVP cabin pressure differential is?
    a. 4.5 psid
    b. 5 psi
    c. 5 psid

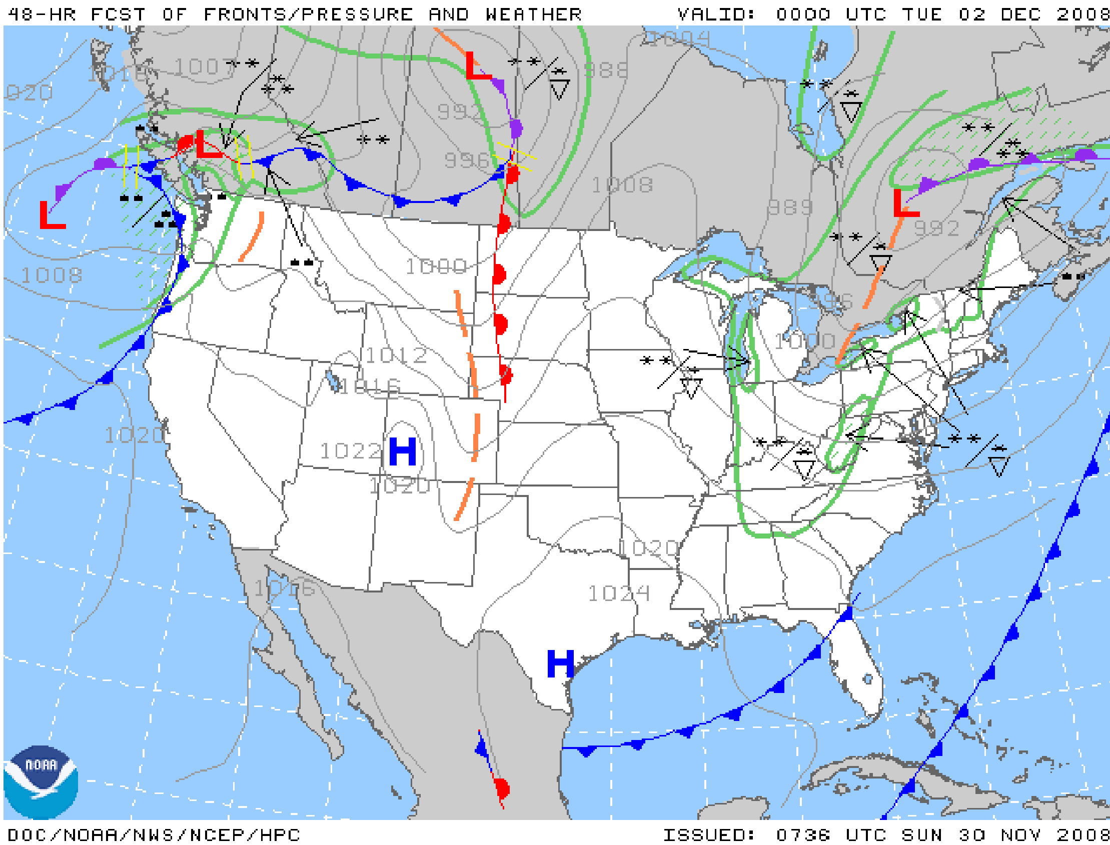
WEATHER FLYING

Unlike surface travelers, pilots ply their trade in the midst of the ocean of air. Operation within the ever changing atmosphere requires pilots to possess special training, knowledge and skill about weather. Lack of that specialized knowledge and skill can be deadly. Many fliers have come to grief while navigating around and through hazardous flight conditions including thunderstorms, icing, turbulence, low ceilings and visibility. Lancair pilots are no different. In the past 20 years, 20 Lancairs have been lost in weather related accidents. Many accidents have involved pilots flying into thunderstorms; other pilots have attempted VFR flight into IMC conditions, including a particularly egregious accident involving two pilots who filed an instrument flight plan in February 2008 for a proposed cross country flight. Icing conditions were forecast and made known to the pilots by the AFSS briefer. The Lancair ES crashed less than 30 minutes after takeoff killing the two pilots and their passenger. What was remarkable was that neither pilot possessed an instrument rating. The common thread that all of these accidents shared is that weather did not cause the accidents--- the pilot did. In many cases the pilot in command was warned well before the flight commenced that hazardous weather conditions would be found along his flight path—yet the pilot chose to proceed. Most of these accidents involved Lancairs on extended cross country flight—some on their way to vacations or airshows like Oshkosh or Sun N Fun. Many of these accidents involved pilots like the above ES example who were not qualified to undertake the instrument flight from a regulatory standpoint.

This section will not cover classic weather instruction like that found in Advisory Circular AC 00-45 or AC 00-6. For the pilot interested in how weather and weather systems form these two primers are available online or in most aviation bookshops. A basic understanding of weather is essential to safe flying and it is presumed that the Lancair pilot has had this training. This section will concentrate instead on prudent weather flying practices for Lancair pilots flying single pilot in "the system". The section will also concentrate on how GA pilots run afoul of foul weather (pun intended) and guide the Lancair pilot into making better decisions.

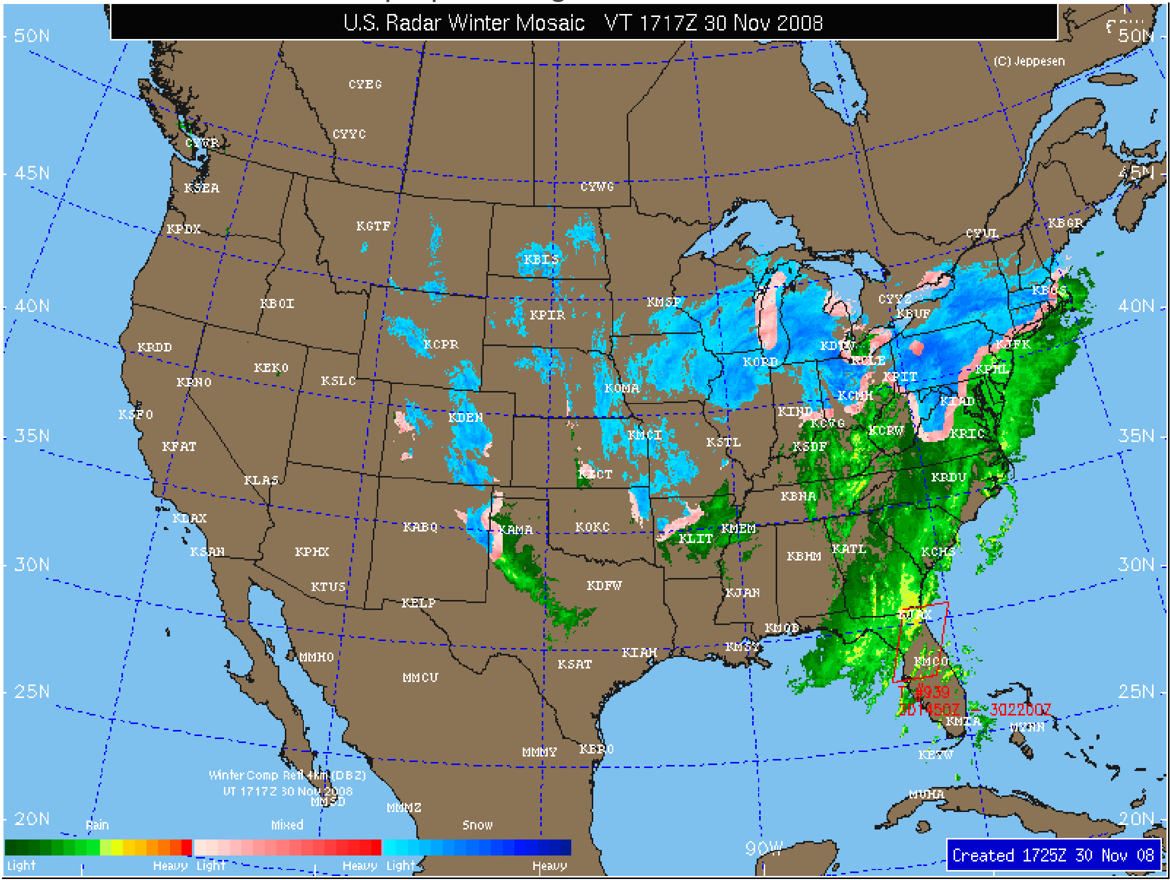
Noted pilot, author, and aviation weather expert, Captain Robert Buck, wrote in his autobiography, North Star Over My Shoulder, that in all of his flying around the world conducting weather related research for the Army during World War II that the most hazardous weather he ever found was in the Midwest United States. While the weather we experience today is no different than the weather Captain Buck experienced almost 70 years ago—our ability to make ourselves aware of the weather's impact on our proposed flight is much greater thanks to the technology of the 21st century. Satellite imagery, NEXRAD weather radar, weather web cams, improved forecasting tools, datalink and the internet give pilots so much more information. Unfortunately, for some, the technological advances have not altered the outcome for those who ignore the dangers.

Today's pilots have many weather resources available to help them make decisions about the flight they propose that did not exist ten or fifteen years ago. A prudent pilot today begins his or her flight planning days in advance of a proposed cross country flight. Prognostic charts and area forecasts are excellent planning tools .



A
A check of the Weather Channel or the aviation weather sites available on many web sites is recommended to assist a pilot in planning when the best weather

window is available for the proposed flight.



Cell phone technology has improved to the point that internet weather is found there as well. This helps the business man pilot who is stuck in a meeting keep up with changing weather while sitting in a conference room. In some cases an early "launch" or a delay of a few hours to a day is all that is necessary to reduce the risk of hazardous weather. In extreme cases, a delay of several days or cancelation is required. The old adage, "time to spare…go by air" certainly applies. The GA pilot who is unwilling to adjust his or her schedule to accommodate hazardous weather is a hazard to themselves and their passengers.

While on the subject of flight planning, it is important to note that per the Aeronautical Information Manual (AIM) the FAA does not disapprove of the use of non FAA resources for pilots to conduct preflight weather planning, but only two resources maintain a record of your briefing: AFSS telephonic briefs and DUATS. Every time you make a phone call to AFSS to file a flight plan or to get a briefing it is recorded. Every time you log into DUATS it is recorded. This is important should an incident or accident arise. If you choose to self brief using internet resources a record of your briefing will not be found to support your defense should one be necessary. A short phone call to AFSS for an abbreviated weather brief with the statement, "I have checked the weather" is all that is necessary to cover your six.

Also important to note is that when you call AFSS to get a telephonic brief that you ask for the appropriate brief. Often times a rambling out loud thought process is frequently heard on audio tapes of accident pilots attempting to get a brief with AFSS. It is clear that the pilot has not spent any time in preflight planning prior to picking up the phone. The time to begin preflight preparation for a long cross country in difficult weather conditions does not start ten minutes before the proposed flight. Remember, there are three types of briefs: standard, abbreviated and outlook. A standard brief contains all the elements of the brief: hazards, area forecast, terminals (current and forecast), winds aloft, local and distant notams TFRs, etc. An abbreviated brief is a condensed brief to brief you on significant changes from your original brief. An outlook gives you forecast conditions for a proposed flight in the future. A good practice is to first do some preflight planning for your trip including a check of internet weather resources like http://aviationweather.gov/ or http://www.duats.com/ or http://www.aopa.org/members/wx/ before calling the Lockheed Martin AFSS. When you do call the AFSS it is recommended you first file the flight plan and then ask for a standard weather brief. That way the briefer knows all the information they need from you (route, altitude departure and arrival times, etc) to conduct a proper weather brief. Let the briefer conduct the brief without interruption. Numerous interruptions may cause the briefer to skip or miss an important part of the brief. Save your questions for the end.

As a side note on flight planning, it is important to remember that the PIC is responsible to file an alternate airport if the forecast weather at the destination plus or minus one hour of arrival is less than a 2000 foot ceiling or 3 miles visibility. Forecast weather at the alternate must be at least a 600’ ceiling and 2 miles visibility for a precision approach and 800’ ceiling and 2 miles visibility for a non precision approach. If the alternate does not have an approach procedure the weather must be such that you can descend from the MEA and land under VFR conditions. A smart pilot always has a “Plan B”.

Once you have received your brief, it is important that you maintain your mental picture of the weather along your flight path. In years past the only way to maintain this mental picture was via the radio with calls to AFSS’s along the way or to Flight Watch on 122.0 MHz or listen to EFAS.

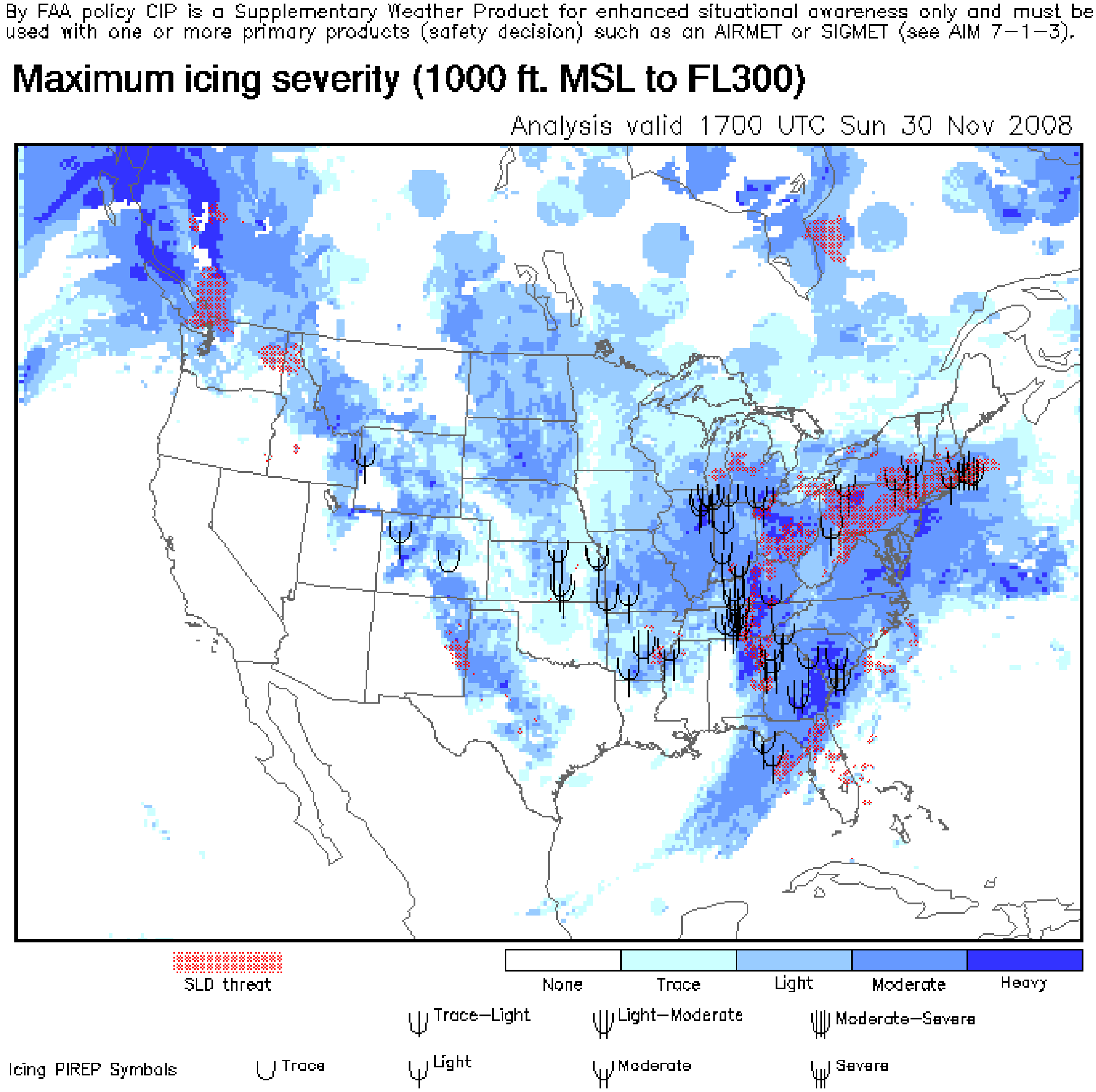
Those options still exist today for pilots—but there is a better way. Datalink weather is an excellent way to maintain the big weather picture in small aircraft like Lancair's. Datalink weather is one of the most significant technologies to come to GA in the last twenty years. Datalink gives the pilot the ability to see "near real time" weather information on display screens in the cockpit and can be found on devices as small as PDA's, Garmin 396's or as large as an MFD like Chelton , Garmin and Avidyne.

These handy devices not only show precipitation detected by the nation's ground based NEXRAD weather radar system but they also can give you METARS and TAFs for selected destination airports, depict SIGMETs and AIRMETs, show winds aloft, freezing levels, etc.

As with any instrument you must be aware of Datalink's limitations in order to use it properly in the cockpit. Datalink is a great device for making strategic decisions about weather flying. Shall we fly through Tennessee or Kentucky on our way to Norfolk, Virginia? Datalink is not a good tool to navigate through a line of embedded thunderstorms in IMC conditions. The reason for this is the delay in collecting, analyzing, correcting and posting the data stream to the satellite and then the download and processing on the aircraft end. All of this takes time and meanwhile the cell you are trying to stay out of may be moving at 50 knots right into your path—so you have to give your self a wide berth if you are IMC. The other issues to consider is that the information posted on the datalink may not be accurate for the altitude you are flying. The area you are in may be showing light green precipitation but you may not be getting any precipitation or may be getting worse precip.

Another limitation that datalink has is there is limited coverage outside of the Continental United States as well as limited NEXRAD coverage in mountain states. Two Lancair accidents in recent years involved pilots who may have expected coverage outside of the U.S. and flew into severe weather. One occurred in Canada and one in the Bahamas.

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. A great way to check for the possibility of forecast icing conditions is to check the aviationweather.gov web site. The graphical tools available can assist a pilot in determining the best altitudes to fly to avoid icing conditions.



NASA's recommended ice avoidance strategies:

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

2. Navigate around cumulus clouds when at or below freezing level

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

After cruising for hours towards your destination and giving an occasional PIREP to Flight Service or Flight Watch, time has come to plan your descent and arrival. The wise pilot knows in advance what the weather will be like at his or her destination. The prudent pilot does not wait until he is turned on to final by approach that weather at the destination is below minimums. Again, a good weather brief, updates enroute and use of Datalink weather can help avoid these nasty surprises. Get a check of the weather when you are about 45 minutes to one hour out your destination—but no later than 30 minutes. Leave yourself plenty of options in case things have gone south. It's better to fold early and go to your alternate than execute a missed approach on a rainy night with minimal reserves. When you are in range of the field (30-50 miles depending on altitude) tune in ATIS, ASOS, or AWOS on the number 2 radio and copy the latest weather.

If you have done everything properly you should never be surprised by the weather. You may have to execute Plan B, divert, change altitudes, route, or stay the night but you should not be surprised.

WEATHER QUIZ:

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

FLIGHT PLANNING AND NAVIGATION

Flight planning today is much different than the detailed chart study and navigation log computations of yesteryear. A visit I made recently to my old Navy training squadron showed me just how far things have come since I went through flight school in Pensacola.

In BC (before computer) days paper charts were used for flight planning. VOR airways were chosen, magnetic courses determined, distances added, winds applied, headings and groundspeeds computed using the trusty E6B whiz wheel and finally fuel burn was calculated. It often took hours to plan a cross country flight to the exacting standards of the squadron instructors.

Today, the Navy's newest ensigns plan their cross country and low level training missions (think VFR nav flights) on laptop computers in minutes. The laptops contain the aircraft performance data; the student enters the waypoints and the computer does the hard part.

Like the Navy ensign, we can use the power of the internet and sophisticated software to plan our cross country flight to our favorite destinations. There are a number of good flight planning software programs available today. I have been using RMS Flightsoft for years. AOPA and EAA have online flight planning tools, too. These tools allow you to pick a departure point, destination, enroute cruising altitude and type aircraft. The software does the rest, calculating time enroute, headings, and fuel usage.

Fltplan.com

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. Winglets increase wing area, however aileron area has stayed the same, requiring more control force input.

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.

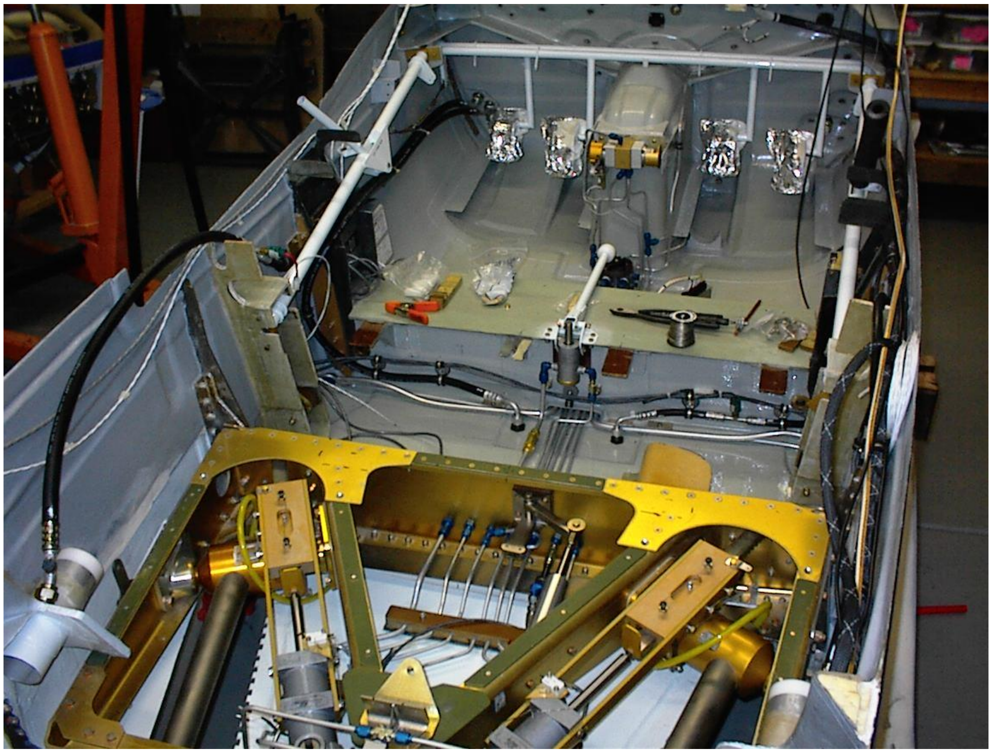
(2) Controllability is the ability of an aircraft to respond positively to control surface displacement, and to achieve the desired condition of flight.

(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.

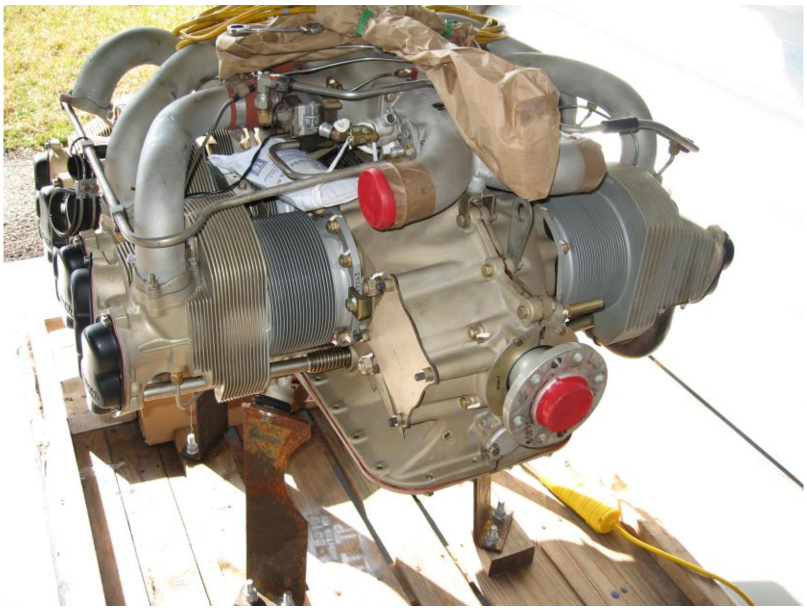
Lancair IV/ IVP AIRCRAFT SYSTEMS



The Lancair IV is a high performance, four-seat, amateur built aircraft, and it is normally powered by the Teledyne/Continental TSIO-550 or the IO-550. The selected engine will drive either a two, three, or four blade constant speed propeller. Common propellers used on the airplane are the Hartzell HC-H3YF-1RF and the MTV-9. The aircraft features a composite airframe of predominately carbon fiber in an epoxy resin matrix. The wings have hydraulically actuated full slotted fowler flaps and mechanically actuated high aspect ratio ailerons. Speed brakes may be installed at approximately mid-span of the top of the wings. 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 main gear struts are made of tubular steel. The main wheel brakes have their own independent system and are hydraulically actuated.

POWERPLANT

TSIO-550



At takeoff power of 2700 rpm and 38(A,B) or 38.5 (E) in. Hg., the TSIO-550 develops 350 horsepower. The engine may be operated at maximum takeoff power in the climb to cruise altitude. Maximum recommended cruise power setting is 2500 rpm and 31.5 in. Hg., which yields 263 horsepower or 75% power. The engine is equipped with two Airesearch turbochargers and dual intercoolers. Overboost protection is provided by a pressure relief valve to limit compressor discharge pressure. The two magnetos are pressurized to accommodate high altitude operations. The engine is equipped with a TCM continuous fuel flow injection system. This system meters fuel flow in proportion to engine rpm., throttle angle, and throttle entrance pressure. Manual mixture control and idle cut-off are provided. A Dukes auxiliary boost pump is installed. The low-pressure position is used for suppression of vapor at altitude. The high-pressure pump position is used as a primer or as an emergency source for fuel pressure. A primer pump is also installed to assist in engine start. The engine is provided with a wet sump, high-pressure oil system of 12-quart capacity.

IO-550

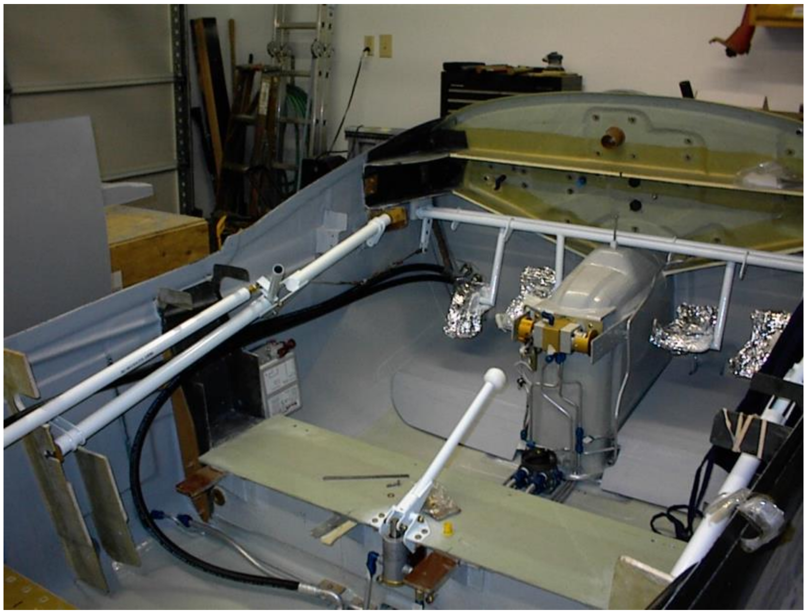
The IO-550 develops 300 horsepower at full throttle, 29.6 in. Hg., and 2700 rpm. A cruise climb setting of 2500 rpm and full throttle initially yields 240 horsepower, but power available will start decreasing after approximately 6,000 feet MSL. The engine driven altitude compensating fuel pump will automatically lean engine mixture for the airplane's pressure altitude, so manual leaning is not necessary until cruise altitude is reached. The manual mixture control also provides for idle cut-off. A Dukes auxiliary boost pump is installed. The low-pressure position is used for suppression of vapor at altitude. The high-pressure pump position is used as a primer or as an emergency source for fuel pressure. The engine oil system is the full pressure, wet sump type and it has a 12-quart capacity

PROPELLER

The engine drives a two, three, or four bladed constant speed propeller. 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. Loss of oil pressure will cause the prop to go to high rpm and thus possible overspeed. The propeller should be cycled occasionally, especially during cold conditions, to maintain warm oil in the hub.

FLIGHT CONTROLS

The primary flight controls are the ailerons, rudder, and elevator. These control surfaces are operable from either front seat by interconnected side stick controls and rudder pedals. On the LIVP the controls run through the pressure bulkheads to the non pressurized side of the cabin. A pressure compensator is used on older used to compensate for the effects of an expanding cabin.



All primary flight controls use centerline hinging on bearings. The ailerons and

elevator are push rod actuated. Both side stick controls have positive grip handles and should have a radio transmit button mounted on them. Other switches may be mounted on the grips. The rudder pedals actuate the rudder with stainless steel cables. The wheel brakes are actuated by pressure on the top of the rudder pedals.

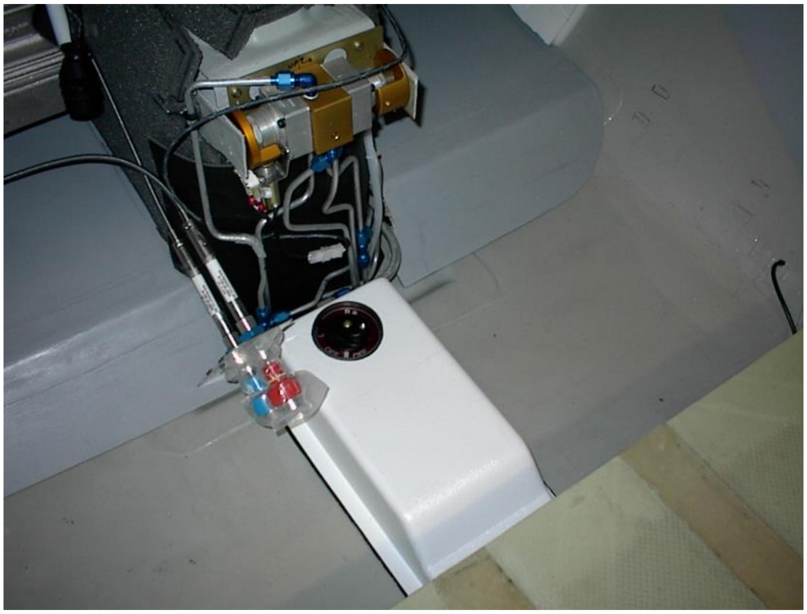
The secondary flight controls are the wing flaps and speed brakes.

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

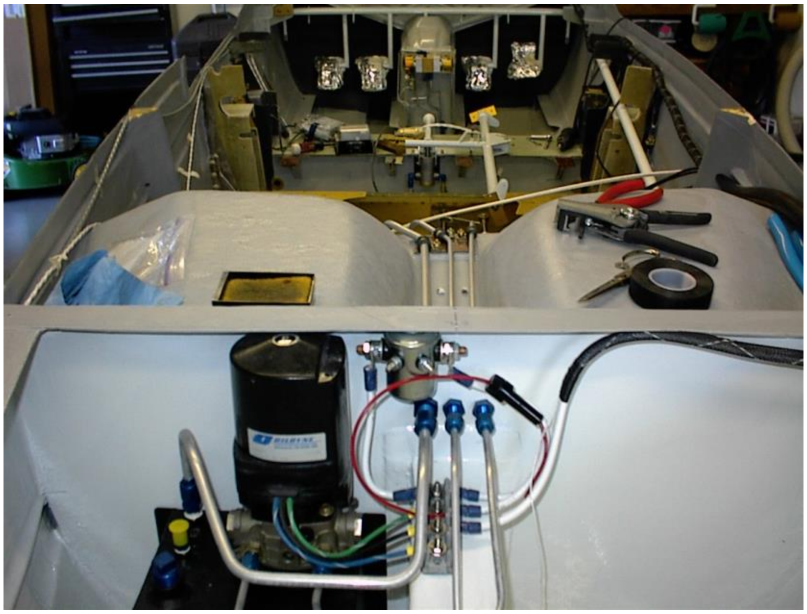
The flaps are operated by a flap valve mounted below the throttle quadrant and are selectable to any setting between zero and forty degrees. Electrically or manually operated speed brakes may be installed on the wings. Precise Flight speed brakes deployment will give the aircraft approximately a 1,300 fpm descent at a constant power setting and airspeed.

LANDING GEAR

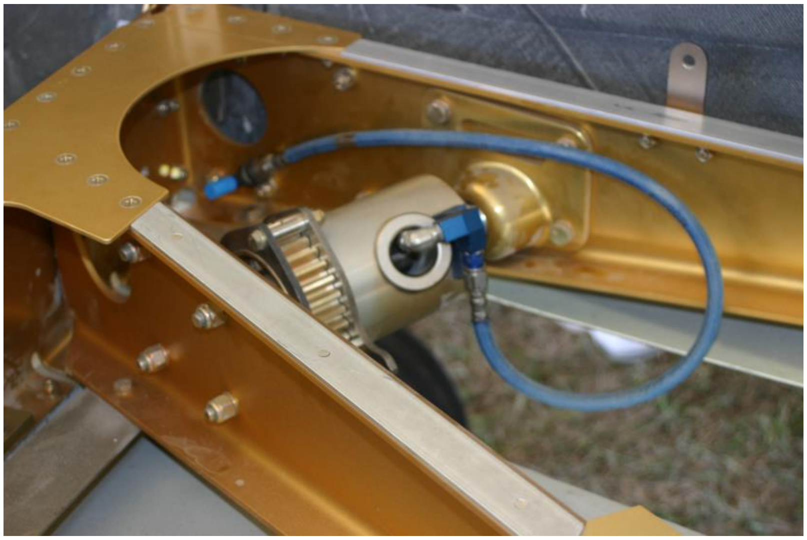
The landing gear system is electrically controlled and hydraulically operated. The landing gear and flap control valves are located below the throttle quadrant and operate a rotating hydraulic valve.



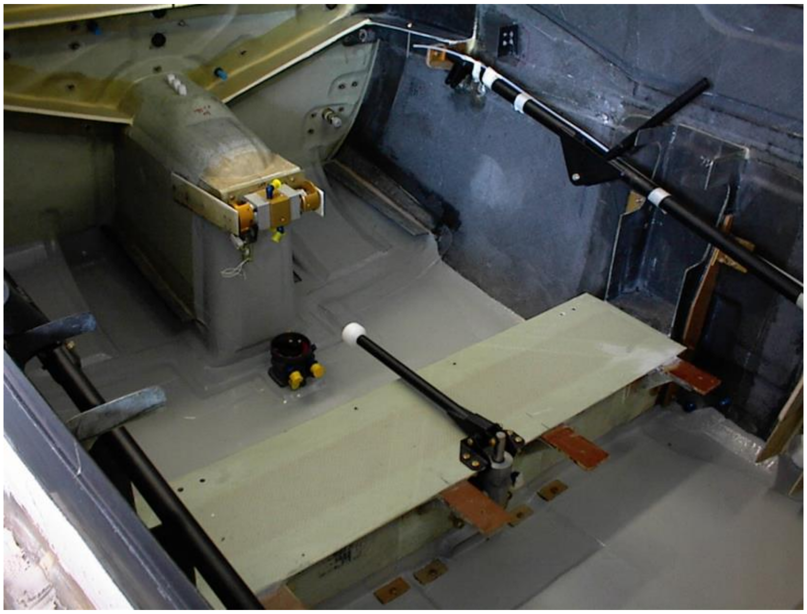
This hydraulic system operates at 1100 psi.



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. A balloon will also do the trick. The main gear is retracted into the fuselage via full rack and pinion gears, and the nose gear also retracts aft.



The mains and the nose gear are held up by hydraulic pressure. The mains have mechanical down locks in the hydraulic actuating cylinder 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.

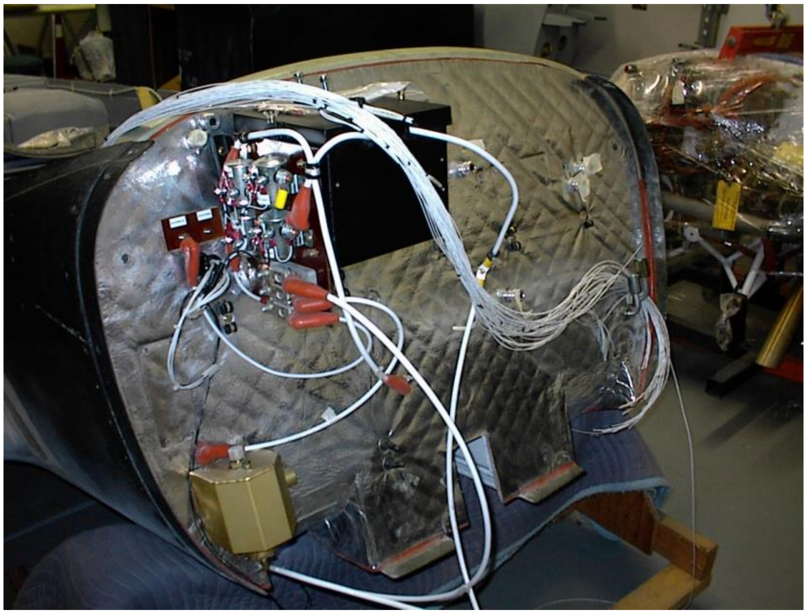


An emergency landing gear hand pump is located between the front seats. This hand pump has its own supply of hydraulic fluid in the secondary reservoir located within the primary hydraulic reservoir. The same extension hydraulic lines are used by both the normal and emergency systems. The main gear is made of tubular steel with 15 x 600 x 6 wheel and tires and hydraulically operated Cleveland disc brakes. 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. The nose gear has a 500 x 5 wheel and tire. On older LIV's a tire guide strap centers the nose gear to insure full retraction. Differential braking is used for directional control on the ground until the rudder becomes effective. A two-position landing gear handle is located below the throttle quadrant. The landing gear position indicating system consists of three green lights that illuminate when all three gear are down and locked. Correct tire pressures are 60 psi for the mains and 50 psi for the nose tire if Goodyear or Condor tires are mounted, or 40 and 30 psi respectively if McCreary tires are mounted.

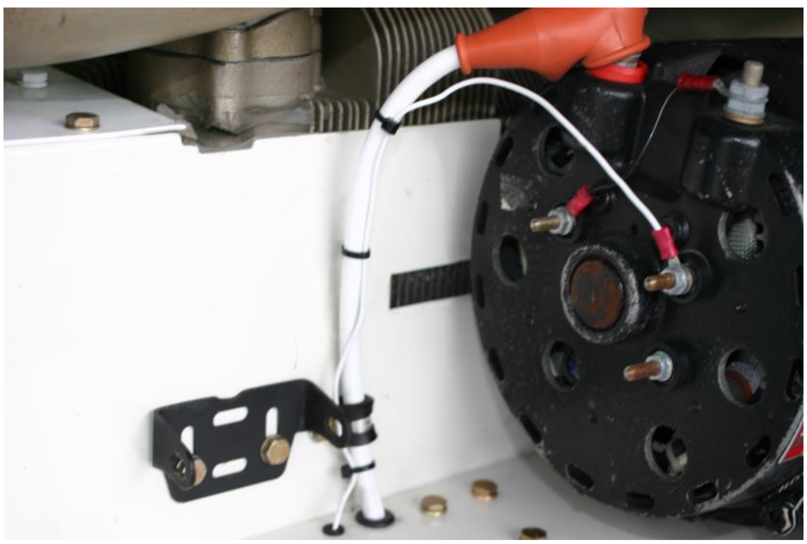
ELECTRICAL

In general, the airplane's circuitry is dual – wire with ground return.

The battery, alternator, and the magneto/start witches are located on the left subpanel. The circuit breakers are generally located on the far right of the panel. The standard battery installation is one 12 or 24 -volt battery located just forward of the firewall on the right side. Some aircraft have dual alternators and dual battery installations.



A 60 or 100 ampere gear driven alternator is mounted on the right front of the engine.



A transistorized voltage regulator adjusts alternator output to the required load, which may be either 14 or 28 volts. The engine starter is located on the engine accessory case (aft right side). To energize the starter circuit, hold the magneto start switch in the START position. There is a 30 second limit on starter operation. The radio master, pitot heat and internal and external light switches are also located on the left subpanel. An ammeter/ loadmeter generally should be installed.

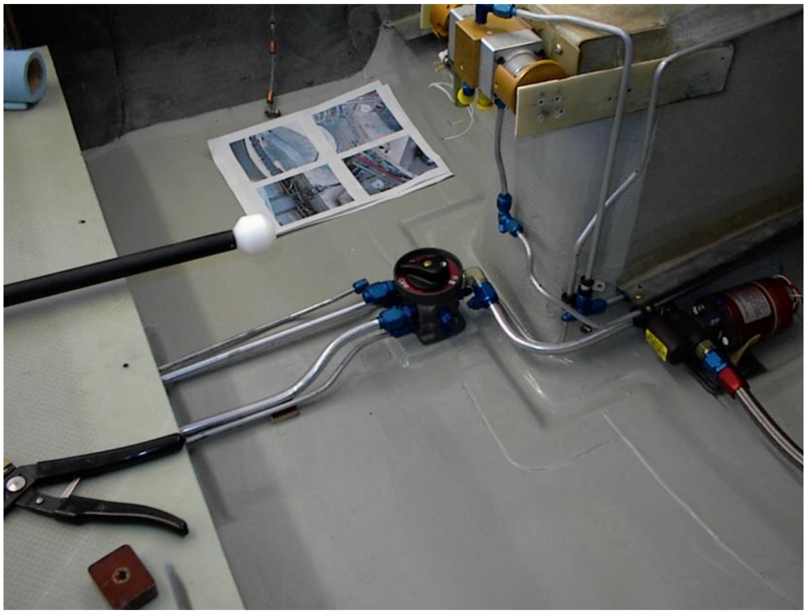
PITOT STATIC/VACUUM

The aircraft will generally have one electrically heated pitot tube mounted on the left wing underside. The unheated static source may be on the pitot tube or mounted on the aft fuselage. Generally, a static drain is not installed. The alternate static source toggle switch (if installed) is located under the left subpanel and uses ambient cabin air as its source. A vacuum pump (if installed) is located on the engine accessory case. It delivers 4.5 – 5.4 in. Hg. for the vacuum operated gyroscopic flight instruments.

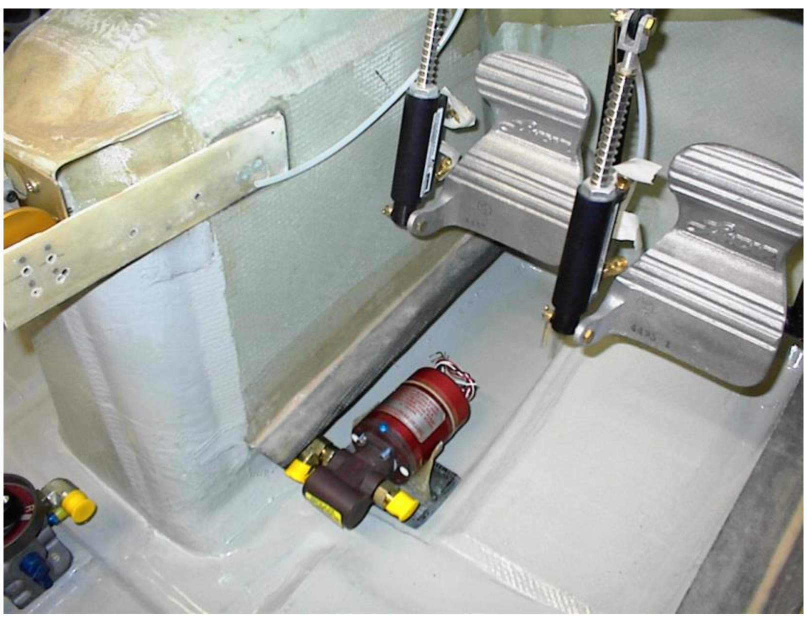
FUEL SYSTEM

The aircraft has two wet wing fuel tanks. The fuel tanks vary in size from 80 gallons to 110 gallons and run from the inboard to outboard end of each wing. The tanks are vented to the outside atmosphere by ports on the bottom of the wingtip and each cell has flush type filler caps mounted above the cell. There are one or two low point drains on each wing. 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.

The selector valve located on the floor below the throttle quadrant 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 flows from the selector valve to an electric boost pump located on the floor or sidewall and then through the firewall to the fuel filter/ sump. The boost pump has an overboard drain should the pump diaphragm fail.

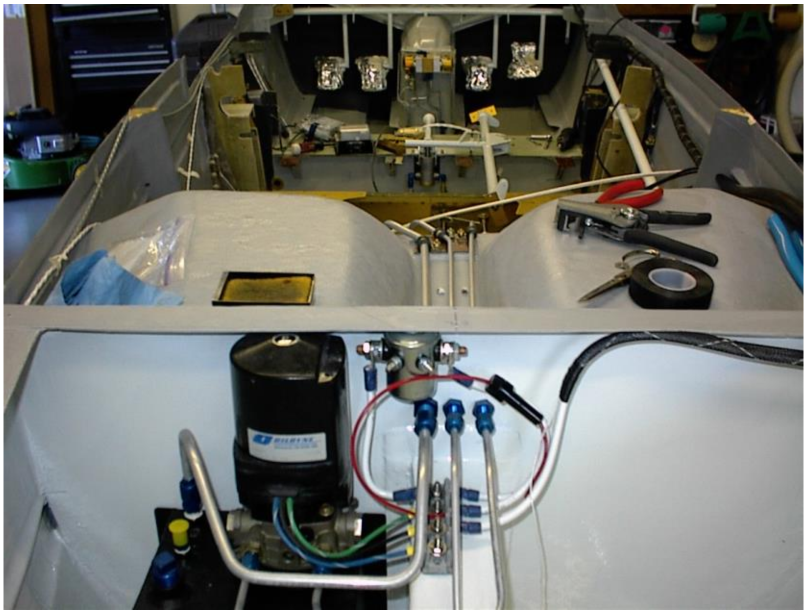


The sump should be drained often to keep water and debris out of the engine. Annually, it should be disassembled, cleaned and reassembled per the Lancair drawings.

Fuel flows from the filter to the engine driven fuel pump on the accessory pad of the engine. Excess fuel returns to the fuel tank selected via a return fuel line.

HYDRAULIC

An 1100 psi hydraulic system operates the landing gear and flaps. The electrically powered hydraulic pump “power pack” is mounted on the aft side (left) of the 172 bulkhead accessed through the baggage door. A reservoir is located below and attached to the pump. Service the reservoir with MIL H 5606 hydraulic fluid. With the landing gear down and the flaps “up” the reservoir should be filled to within an inch of the filler neck.



An accumulator acts as a “shock absorber” in the system. A check of flap operation with the system “off” will tell you if the accumulator is working – you should be able to cycle the flaps up and down with pump off.

ENVIRONMENTAL

NON-PRESSURIZED

A heater muffler on the right engine exhaust stack provides for heated air to the cabin. A fresh air intake provides air to a mixer valve that combines the heated air with a controlled quantity of unheated air to provide for the selected temperature. This air may then be routed for cabin heat, windshield defrost, or a combination of the two. Fresh ram air enters an intake on the right side of the vertical tail. An electric blower fan and ducting routes this fresh ram air to four overhead eyeball outlets. For ground operations, the blower maintains airflow through the system. Each outlet can be positioned to direct the flow of air as desired. A system shutoff valve is installed in the duct between the tail ram air scoop and the individual fresh air outlets.

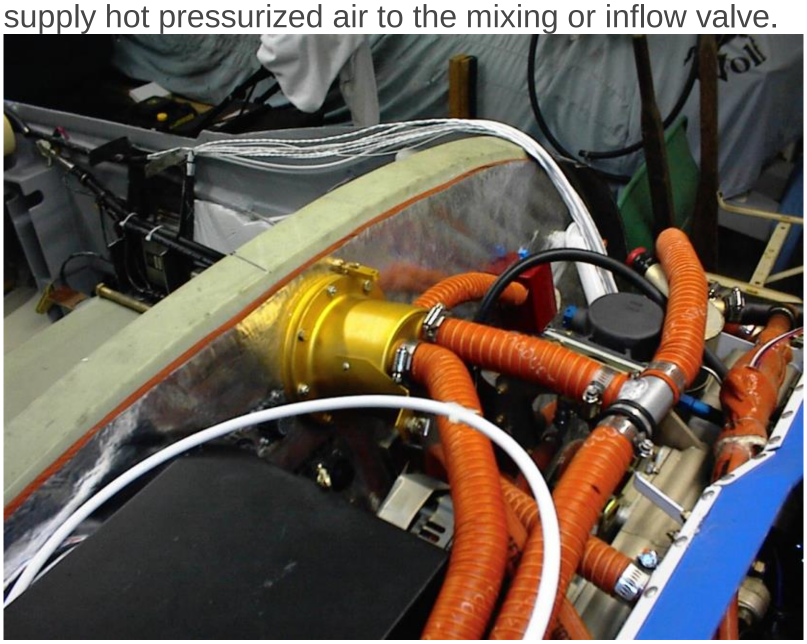
PRESSURIZED

The Lancair IV-P aircraft has a determined maximum pressure differential, (5PSID) which is the maximum differential between cabin and ambient altitudes that the pressurized section of the aircraft can support. Cabin pressurization is the compression of air in the aircraft cabin to maintain a cabin altitude lower than the actual flight altitude. At FL 250 and 5 psid the cabin altitude is maintained at 9,000’ MSL.

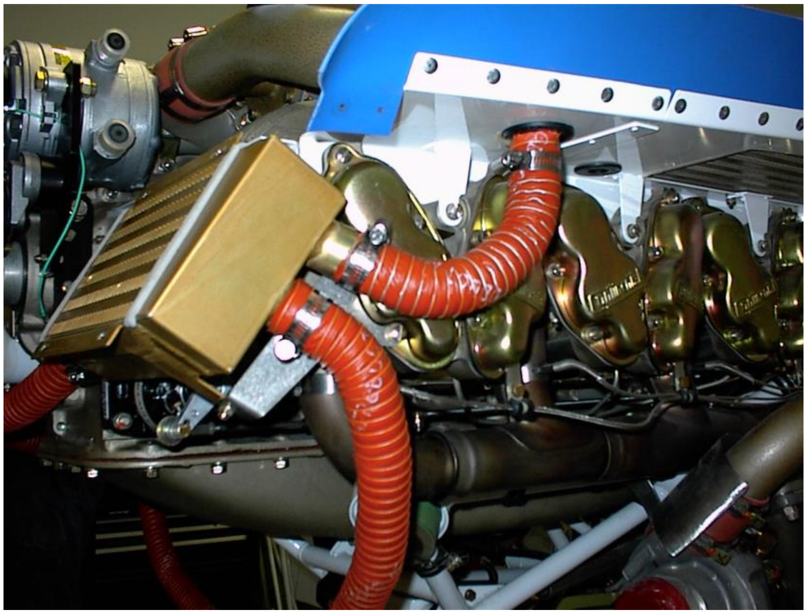
The pilot must be familiar with these limitations.

The cabin altitude can be manually selected and is monitored by a gauge, which indicated the pressure difference between the cabin and ambient altitudes. The rate of change between those two pressures is automatically controlled.

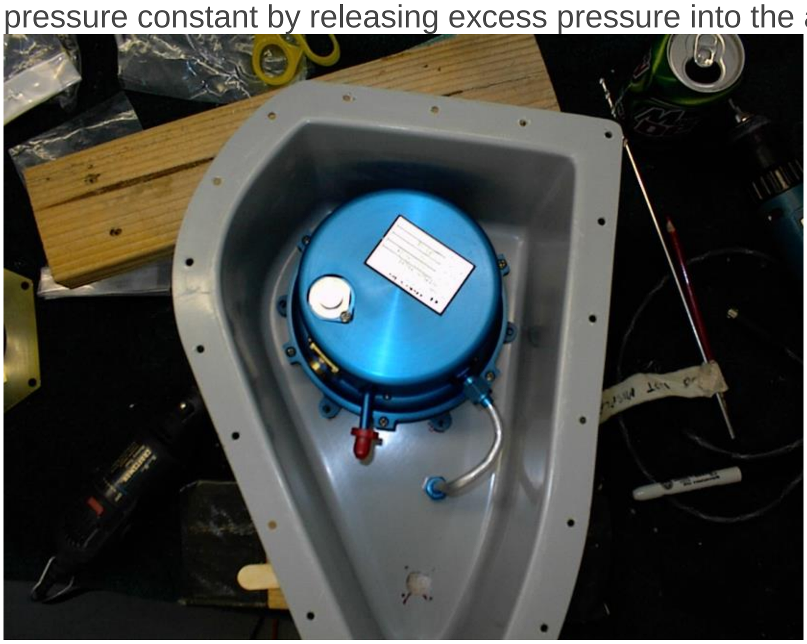
Compressed air is drawn from four calibrated sonic nozzles placed in the induction system. One set of two is located prior to the main intercooler. They supply hot pressurized air to the mixing or inflow valve.



Another set of two nozzles draw pressurized air after the main intercoolers and is then routed to a cabin air intercooler just inside of the left cowling air inlet.

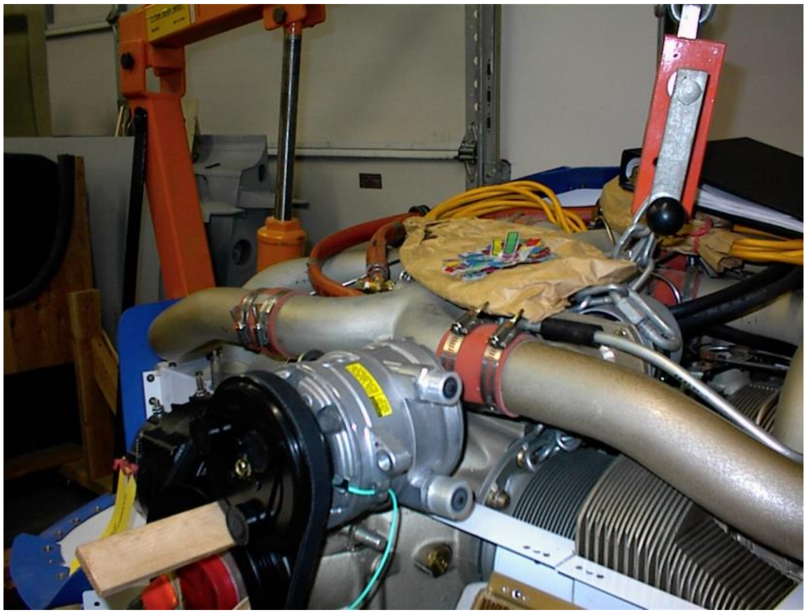


This air is also routed to the mixing valve. It is close to ambient air temperature. A cockpit control cable selects temperature from a mix of these two air supplies. Additionally, another control cable selects an overboard dump of all engine air for unpressurized flight, or for smoke in the induction system. The flow of compressed air into the cabin is regulated by an outflow valve that keeps the pressure constant by releasing excess pressure into the atmosphere.

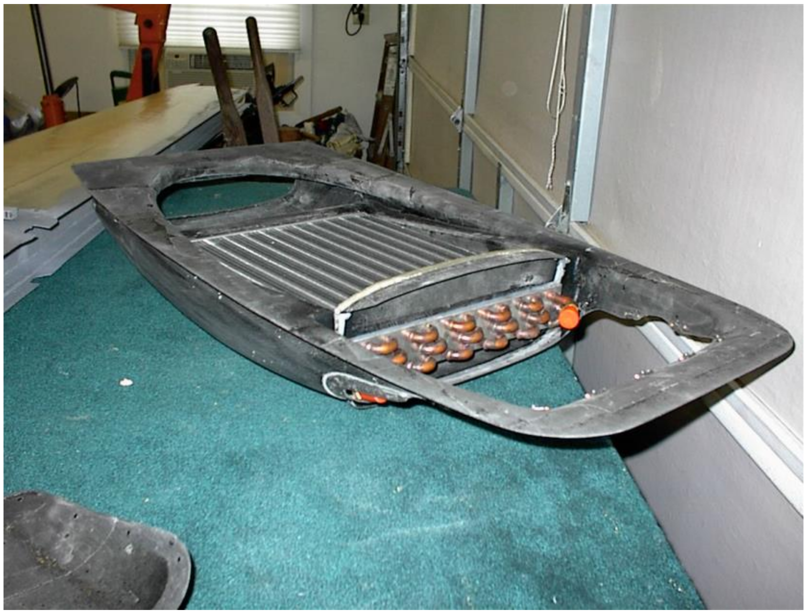


AIR CONDITIONING

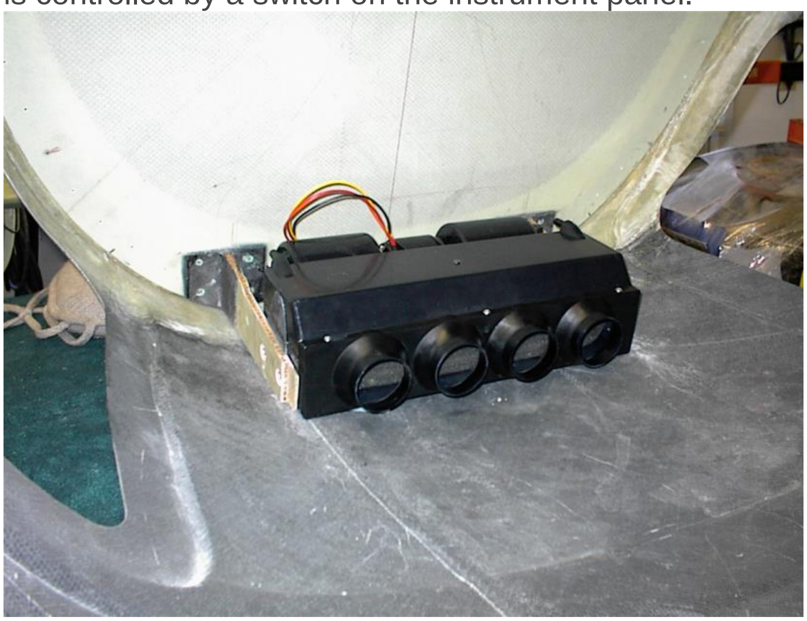
Air Conditioning is an attractive option added by many builders. It may be a belly mounted Air Flow Systems unit or an aft bay mounted Lancair system. The compressor on the belly scoop system is mounted on the engine and is belt driven. A refrigerant supply and return hose connects the compressor to the rest of the system.



The condenser may be belly mounted making the Lancair look somewhat like a P-51.



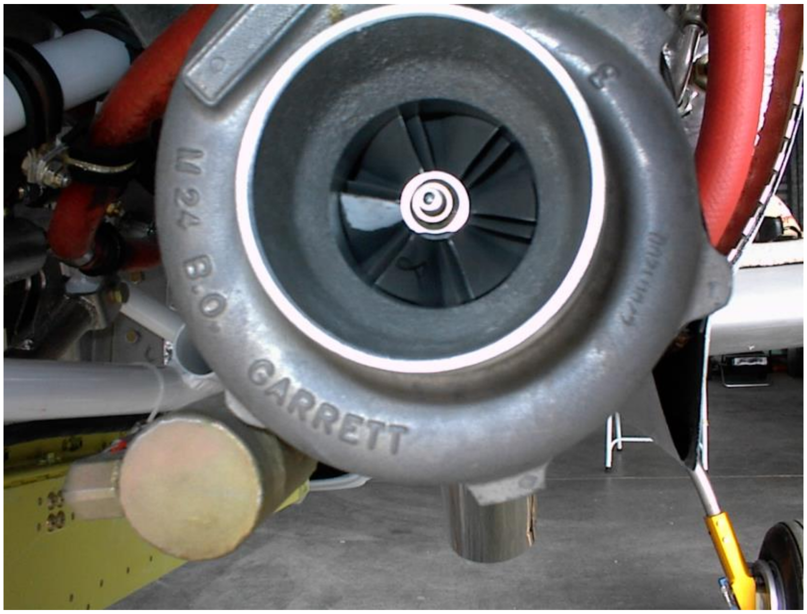
The evaporator is mounted in the aft cabin and supplies chilled air to the cabin. It is controlled by a switch on the instrument panel.



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.

Turbochargers



Turbochargers compress air in the intake to the cylinder by using exhaust gases from an engine-driven turbine wheel to drive a compressor. The increased air density provides greater power and improved performance. The turbocharger system allows the engine to develop higher than sea level pressure (up to 38.5 inches of manifold pressure) up to a critical altitude. To operate at altitudes below the critical altitude an automatic waste gate is installed in the turbocompressor to release unnecessary gas pressure. The waste gate is a damper-like device that controls the amount of exhaust that strikes the turbine rotor. As the waste gate closes with altitude, it sends more gases through the turbine compressor, causing the rotor to spin faster. This allows the engine to function as if it were maintaining sea level or, in the case of a supercharger, above sea level manifold pressure.

Automatic Waste Gate

Automatic waste gates operate on internal pressure. When internal pressure builds towards an overboost, the waste gate opens to relieve pressure, keeping the engine within normal operating limits regardless of the air density.

(a) The pressure-reference automatic waste gate system maintains the manifold pressure set b the throttle. Engine oil pressure moves the waste gate to maintain the appropriate manifold pressure, thus reducing the pilot’s workload and eliminating the possibility of overboost. If the airplane engine is started up and followed by an immediate takeoff, cold oil may cause a higher than intended manifold pressure. Allow the oil to warm up and circulate throughout the system before takeoff.

(b) The density-reference waste gate system is controlled by compressor discharge air. A density controller holds a given density of air by automatically adjusting manifold pressure as airspeed, ambient pressure, temperature, altitude, and other variables change.

Pressurized Magnetos

Thin air at high altitudes makes the unpressurized magneto susceptible to arcing or crossfiring. The high-tension pressurized system is composed of sealed caps and plugs that keep the electrodes contained within the body. A pressure line extends directly from the upper deck to the magneto.

Pressurized magnetos perform better at high altitudes where low pressure and cold atmosphere have a detrimental effect on electrical conductivity. Flight above 14,000 feet with an unpressurized magneto should be avoided because of its high susceptibility to arcing. Once arcing has occurred, magneto overhaul is required to replace distributor blocks that have carbon traces.

Oxygen

Most high-altitude airplanes come equipped with some type of fixed oxygen installation. 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 f 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.

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 pat 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.

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 sea 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.

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.

Lancair Systems Quiz

1. The hydraulic system operates the landing gear and flaps via:
    a. electric gear and flap switches on the control pedestal
    b. hydraulic control valves on control pedestal for normal gear and flaps
    c. mechanical levers that connect via push pull cables to the landing gear and flaps
2. The fuel system on your aircraft has _____ gallons useable fuel.
3. You must use what type of hydraulic fluid to service the hydraulic reservoir?
    a. Skydrol
    b. Mil H 5606
    c. Automatic transmission fluid
4. The brake reservoir is located ____________ ?
5. 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
6. The outflow valve is located _______________ and must be serviced how frequently?
7. Explain Lean of Peak operation
8. 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 IO-550

Rated Maximum Takeoff Horsepower……………………………….300 (-0, +5%)
Rated Maximum Continuous Horsepower………………………..300 (-0, +5%)
Rated Speed – Crank rpm……………………………………………2700
Rated Manifold Pressure……………………………………………...29.6
Fuel…..100 or 100 LL
Oil Pressure – psi
Normal Operation……………………………………………30 – 60
Idle, Minimum………………………………………………...10
Maximum Allowable…………………………………………100
Oil Temperature – Degrees Fahrenheit
Maximum Allowable...240
Takeoff Minimum…………………………………………….76
Maximum Cylinder Head Temperature
Degree Fahrenheit…………………………………………..460

WARNING: THIS ENGINE IS NOT APPROVED FOR SUSTAINED NEGATIVE OR ZERO "G" OPERATION.

1. **CAUTION:** Do not operate the starter continuously for more than thirty (30) seconds in any four (4) minute period. Allow the starter to cool again before cranking.

2. ***CAUTION:*** *Reduce power slowly from cruise conditions to prevent shock cooling.*

OPERATING LIMITATIONS

Model TSIO-550

Rated Maximum Takeoff Horsepower……………………….350 (-0, +5%)
Rated Maximum Continuous Horsepower…………………350 (-0, +5%)
Rated Speed – Crank rpm………………………………….2700
Rated Manifold Pressure……………………………………38 – 38.5
Maximum Continuous, bhp/rpm……………………………350/2700
Manifold Pressure – in. Hg………………………………….38 – 38.5 to 12,000 feet
Maximum Recommended Climb, bhp/rpm………………...263/2500
Manifold Pressure – in. Hg………………………………….31 – 31.5 to 25,000 feet
Fuel…..100 or 100 LL
Oil Grade……………………………………………………...20w – 50, 15w – 50
Ashless Dispersant 50
Oil Pressure – psi
Normal Operation……………………………………………30 – 60
Idle, Minimum………………………………………………...10
Maximum Allowable…………………………………………100
Oil Temperature – Degrees Fahrenheit
Maximum Allowable...240
Takeoff Minimum……………………………………………100
Cruise…………………………………………………………160-180
Turbochargers, Heat – Degrees Fahrenheit
Continuous……………………………………………………1750
Peak – 30 Second Limit……………………………………..1800
Maximum rpm at 1800 Degrees……………………………120,500

WARNING: THIS ENGINE IS NOT APPROVED FOR SUSTAINED NEGATIVE OR ZERO "G" OPERATION.

1. **CAUTION:** Do not operate the starter continuously for more than thirty (30) seconds in any four (4) minute period. Allow the starter to cool again before cranking.

2. **CAUTION:** After landing, allow the engine to run at idle for four (4) minutes before shutdown to prevent damage to the turbochargers***. Taxi time may be considered part of the four (4) minutes.***

3. **CAUTION:** Reduce power slowly from cruise conditions to prevent shock cooling.

AIRSPEEDS

Speed Brakes……………………………………………………………….274 KIAS
Vne………………………………………………………………………......274 KIAS
Vno……………………………………………………………………......220 KIAS
Vfe 1-10°'s…………………………………………………………………...174 KIAS
Vfe 11-40°'s………………………………………………………………….132 KIAS
Va…………………………………………………………………………….170 KIAS
Vlo……………………………………………………………………………150 KIAS
Vle……………………………………………………………………………165 KIAS
Vs…………………………………………………………………………….69 KIAS
Vso…………………………………………………………………………..61 KIAS
Vx……………………………………………………………………………..110 KIAS
Best Glide…………………………………………………………...……120 KIAS
Maximum Demonstrated Crosswind Component……………………..……25 KIAS

G Loading

....+4.4, -2.2 G's (utility)
+3.8, -2.0 G's (normal)

WEIGHTS

Maximum Gross Weight…………………………………………...…………3,400 lbs.
Maximum Baggage Weight…………………………….……………......150 lbs.

FUEL

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

ALTITUDE

Service Ceiling……………………………………………………….…………29,000 feet

Operating Limits Quiz

1. The maximum RPM for this engine is
    a. 2500 RPM
    b. 2550 RPM
    c. 2700 RPM
2. The maximum speed (Vne) is:
    a. 274 KEAS
    b. 220 KIAS
    c. 274 KIAS
3. The minimum oil pressure in flight is:
    a. 30 psi
    b. 10 pis
    c. 60 psi
4. The maximum cabin pressure is:
    a. 4.5 psid
    b. 5 psi
    c. 7 psi
5. The maximum gear operating (Vlo) speed is
    a. 170 KIAS
    b. 150 KIAS
    c. 165 KIAS
6. The maximum flap extend (Vfe) 10 degrees is
    a. 170 KIAS
    b. 160 KIAS
    c. 150 KIAS
7. The maximum gross weight is:
8. The maximum G is:
    a. 3.4
    b. 4.4
    c. 6.6
9. The maximum flap operating speed (Vfe) full down
    a. 132 KAIS
    b. 122 KIAS
    c. 152 KIAS
    d. 10 Best
10. Best Glide is:
    a. 110 KIAS
    b. 120 KIAS
    c. 130 KIAS
11. The turbo charger has a TIT limit is?
    a. 1725 C
    b. 1750F
    c. 1650F
12. Manifold pressure limit is
    a. 38.5 inches

b. 38 inches
c. 29.5 inches

NORMAL PROCEDURES AND OPERATIONAL TECHNIQUES

The Lancair IV and IVP series aircraft is a high performance single engine piston airplane with performance numbers akin to many twin turboprop aircraft. 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.

TAXIING

The Lancair IVIVP 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.

TAKEOFF

Normal takeoff configuration is flaps at 10 degrees, elevator trim set slightly nose up, and rudder trim set at approximately 2-3 degrees right rudder. If the aircraft is equipped with speed brakes ensure that they are retracted. 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 throttle to 12 in. Hg., 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 full power of 38.5 in. Hg. and 2700 rpm. Maintain directional control during the first part of the takeoff roll by use of rudder. The rudder is totally effective for directional control above approximately 30 kts. Check your engine gauges one last time before rotation. Any out of limit parameter is reason to abort. Rotate at 70 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 (about 5 degrees on the Chelton) 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 kts, retract the flaps. Anticipate the constantly changing rudder trim that will be required as the Lancair IV accelerates. The aircraft will require near full right rudder at Vr but by 165 kts. in the climb the requirement will be for slight left rudder to keep the aircraft trimmed for balanced flight. You may maintain full power 38.5 inches and 2700 RPM to level off.

CLIMB

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. Cylinder head temperature will increase as airspeed decreases in the climb. If necessary, increase airspeed to keep cylinder head temperatures within limits. It may be necessary to level off to cool off under extreme conditions.

CRUISE

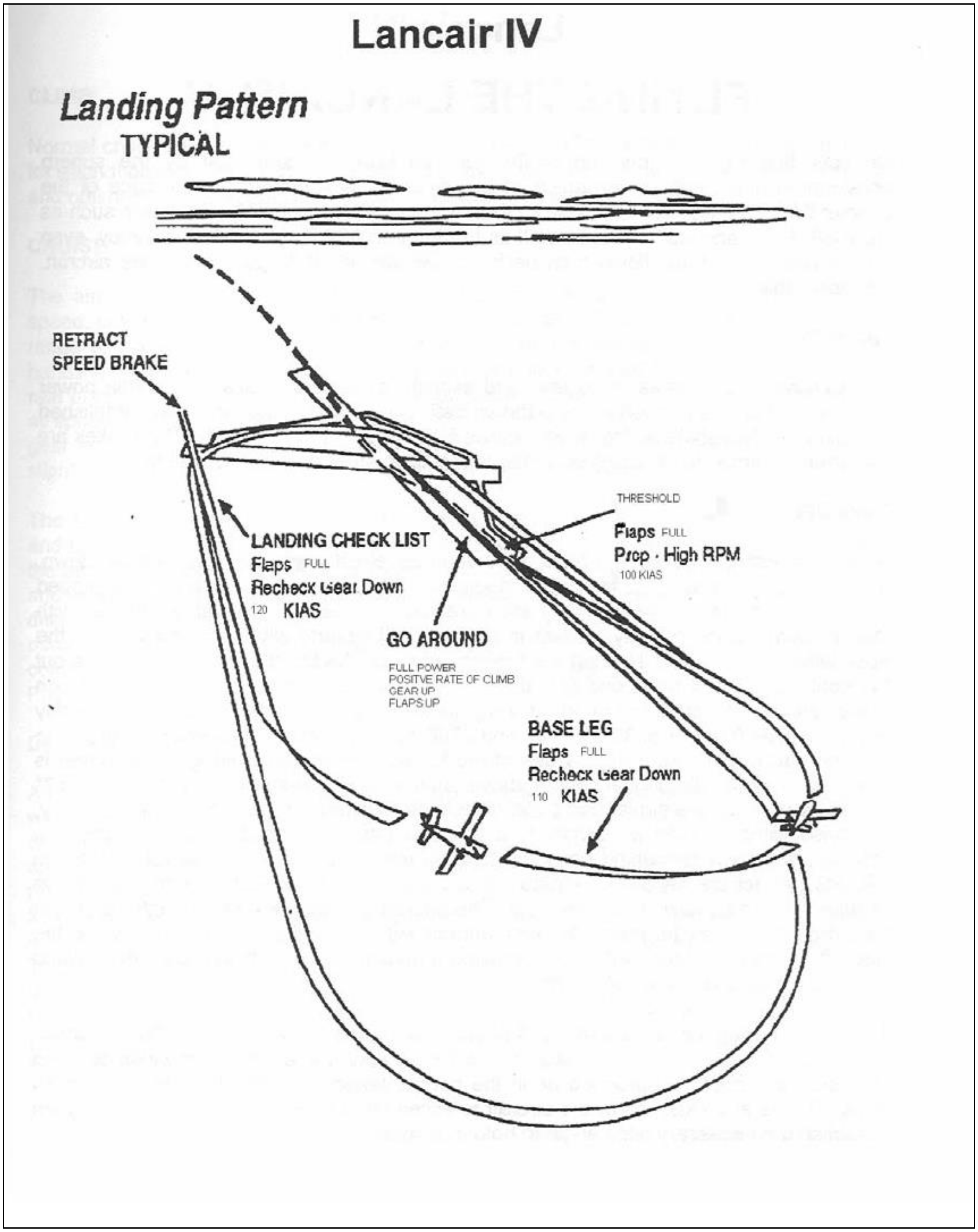
The aircraft has excellent stability and control characteristics under all conditions of speed, power, load factor, and altitude. The controls are effective throughout the speed range of stall to Vne and aircraft response to control movement is quite rapid. Nice handling characteristics, in both accelerated and unaccelerated flight are evident. The rate of roll and pitch are brisk for a four seat aircraft. The trim tabs are also effective at all speeds so that the aircraft may be easily trimmed to fly “hands off”. Flight without an operational pitch trim system is difficult. In fact, flight is difficult without an operable pitch trim and may be uncontrollable at higher speeds. Operation of the gear affects yaw stability only slightly with an oscillation as the mains extend asymmetrically. Don’t flight it. Wing flap extension as well as changes in power setting affects pitch trim, thus requiring a minimum of stick movement to maintain flight attitude. The Lancair IV possesses neutral static stability and positive dynamic stability in roll, and both positive static and positive dynamic stability in the pitch and yaw axis. When the aircraft is placed in an angle of bank, its tendency is to remain in that angle of bank and neither continue to roll nor return to wings level. However, if a yaw or pitch displacement is induced, the aircraft has a tendency to dampen out the resulting oscillation and returns quickly to aerodynamic equilibrium. This gives the Lancair IV a control feel very similar to many modern fighters such as the McDonnell Douglas F/A-18 Hornet. This airplane is a real pleasure to fly.

DESCENT

A timely descent, particularly from high, fast cruise in the Lancair IV requires that you be well ahead of the aircraft. In smooth air conditions descent can be accomplished at the Vne of 274 kts until reaching 10,000 feet MSL, where it should be reduced to 250 KIAS to comply with FARs. In turbulent air the aircraft must be slowed to its Vno of 220 kts. Throughout the letdown, monitor your engine instruments. If your aircraft has speed brakes, allow 3nm from destination from each 1,000 feet to descend to reach pattern or FAF altitude, or if your aircraft does not have speed brakes allow 4nm per 1,000 feet. Power should be reduced so as to maintain cylinder head temperature and oil temperature well in the green arcs. Hold enough power to maintain cabin pressurization.

APPROACH & LANDING

Approaching the terminal area, keep the airspeed less than 174 KIAS to allow for 10 degrees of flaps, if necessary. A shallow descent at 15 to 18 in. Hg. And 2500 rpm will allow for this. Monitor that cylinder head temperature and oil temperature are still well within their green areas. Enter the pattern as directed, or at a 45° degree angle to downwind, at 1,500 feet AGL as appropriate. On the downwind leg, a power setting of 14 to 18 in. Hg., 2500 rpm and configured with10° of flaps will hold the aircraft at 120 KIAS. Lower the gear prior to the abeam position--opposite the intended point of touchdown. Maintain 14 to 18 in. Hg. and 2500 rpm at 120 KIAS. Halfway through base leg your altitude should be approximately 700 feet AGL. Turn final with at least ¼ mile straight away and at approximately 300 feet AGL. Lower flaps to full and set high RPM. Cross the threshold at 100 KIAS. Allow airspeed to decay to arrive at the intended touchdown point at 85 KIAS. Fly the aircraft onto the runway. Very little if any flare is needed to perform a nice landing. Watch for pilot induced oscillations (PIO). Reduce power to idle, maintain directional control with rudders (don't overcorrect and PIO), and apply brakes as necessary. The key to the above described approach is to leave the throttle alone and to fly the aircraft onto the ground.



NO FLAP LANDING

Abeam the intended point of landing, retard the throttle to approximately 11 to 12 in. Hg. This should provide for 110 kts with the aircraft configured with the landing gear down. Fly a normal pattern except shoot for 110 kts on short final.

The prop control may be set at high rpm anytime during the pattern if more drag is needed to intercept the proper glide path. As in the full flap landing procedure, some power is left on the aircraft until it is firmly on the runway. On the fallout, lower the nose gear onto the runway and brake 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 leg. The optimum technique is to fly a crabbed approach, taking out the crab 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 centerline and brake to a stop.

GO AROUND/ ABORTED LANDING

On the ground--Do not delay the decision to go around to the point that control of the landing or rollout is in jeopardy. Takeoff distances at full power are short provided that aircraft has not decelerated to a slow speed. Advance the throttle to full power. 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 full power is applied. Raise the landing gear and flaps only after a safe climb has been established.

In the air- Do not delay the decision to go around. If the landing approach is unstable—i.e., airspeed, sink rate, or lineup are not within proper parameters then a go around should be immediately initiated. Advance the throttle to full power. Apply right rudder to compensate for torque effect. 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 full power is applied. Raise the landing gear and flaps only after a safe climb has been established.

CLOSED TRAFFIC PATTERN

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. All landings will be to a full stop 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.

Lancair By The Numbers**

Conditions	**MAP**	**RPM**	**Gear**	**Flaps**	**SB**	**Speed**	**Pitch**	**ROD/ ROC**
Takeoff	38.5"	2700	Down	10	In	Vr 70		
Climb	38.5"	2700	Up	Up	in	Vy 140	7 ANU	
Climb	38.5"	2700	Up	Up	In	165	7 ANU	
Cruise 75% Power	31.5"	2600	Up	Up	In	Depends	0	
Descent	31.5"	2600	Up	Up	In/ Out		2-3 AND	
Downwind	14-18"	2600	Up	10	In	120		
Base	14-18"	2600	Down	10	In	110	5 AND	
Final	14-18"	Full	Down	Full	In	100		
Go Around	Full	Full	Up	Up	In	Accel	7 ANU	
Precision								
Downwind / Vector	14-18"	2500	Up	10	In	140	2 ANU	
Base	14-18"	2500	Down	10	In	120	3 ANU	
Final	12-18"	Full	Down	10*	In	120		
Non Precision								
Downwind / Vector	14-18"	2500	Up	10	In	140	2 ANU	
Base	14-18"	2500	Down	10	In	120	3 ANU	
Final	12-18"	Full	Down	10*	In	120	1-2 AND	
Level off	17-20"	2700	Down	10	IN	120	3 ANU	

* until field in sight

** Dues 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 mixture to rich and the prop to high rpm. Retard the throttle to 11 in. Hg. and, if so equipped, extend the speed brakes. At 120 kts retract the speed brakes and lower the landing gear and flaps. As the airspeed approaches 85 kts, increase the power to and maintain 85 kts. A hefty input of right rudder will be necessary at the power application to maintain balanced flight.

IMMINENT STALL

Insure the mixture is rich and the prop is at high rpm. Visually check the cockpit for loose gear. Maintaining altitude, reduce the power to 11 in. Hg. As the airplane decelerates, apply aft stick as necessary. At approximately 69-72 kts the aircraft should stall. 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. Anticipate the turbos kicking in at approximately 29-30 in. Hg. and the need for an ample amount of right rudder during the recovery.

STEEP TURNS

Establish the aircraft in straight and level flight at 140 kts and align it with a prominent landmark or section line. Roll into 45° angle of bank and apply aft stick pressure as necessary to maintain altitude. Adjust the throttle to maintain 140 kts throughout the maneuver. If the aircraft starts a descent, as first indicated 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° angle of bank. A complete maneuver will consist of on 360° turn both left and right.

Unusual attitude. The flight instructor will induce an unusual attitude. The Lancair pilot will recover with power, pitch and roll application to straight and level flight. Nose high/ decreasing airspeed—add power, 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 IV 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. Flight into icing conditions must be avoided for unprotected aircraft.

Climb, cruise, and descent in instrument conditions will be the same as the VFR procedures described previously. Holding should be conducted at 140 kts, 2500 rpm, power as required and mixture normal.

INSTRUMENT LANDING SYSTEM

The downwind or radar vectors to final should be flown at 140 kts. The power settings should be 14-18 in. Hg. and 2500 rpm with 10° of flaps. A power setting of 14-18 in. Hg. at 2500 rpm on base leg should give you about 120 kts with 10° of flaps. When the glideslope is one dot high on the indicator, advance the prop to high rpm, check flaps 10°, and lower the landing gear. Perform a before landing checklist. A power setting of about 12-18 (aircraft dependent) in. Hg. should result in a 500 fpm rate of descent at 120 kts. Adjust power and heading as necessary to maintain centered ILS needles and 120 kts. 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 12-18 in. Hg. at 2700 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 to about 17-20 in. Hg. to level off and maintain 120 kts. The aircraft will be slightly cocked 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°. 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 throttle to full power and apply the flight controls as necessary to keep the aircraft in a trimmed condition. Anticipate the need for right rudder to compensate for torque effect, p factor, etc.. Do not over rotate the aircraft. Once a climbing attitude is of approximately 7 degrees 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.

DEFINITIONS

a. Aspect Ratio is the relationship between the wing chord and the wingspan. A short wingspan and wide wing chord equal a low aspect ratio.

b. Aileron buzz is a very rapid oscillation of an aileron, at certain critical air speeds of some aircraft, which does not usually reach large magnitudes nor become dangerous. It is often caused by shock-induced separation of the boundary layer.

c. Drag Divergence is a phenomenon that occurs when an airfoil's drag increases sharply and requires substantial increases in power (thrust) to produce further increases in speed.
This is not to be confused with MACH crit. The drag increase is due to the unstable formation of shock waves that transform a large amount of energy into heat and into pressure pulses that act to consume a major portion of the available propulsive energy. Turbulent air may produce a resultant increase in the coefficient of drag.

d. Force is generally defined as the cause for motion or of change or stoppage of motion. The ocean of air through which an aircraft must fly has both mass and inertia and, thus, is capable of exerting tremendous forces on an aircraft moving through the atmosphere. When all of the above forces are equal, the aircraft is said to be in a state of equilibrium. For instance, when an aircraft is in level unaccelerated 1 G flight, thrust and drag are equal, and lift and gravity (or weight plus aerodynamic downloads on the aircraft) are equal. Forces that act on any aircraft as the result of air resistance, friction, and other factors are:

> (1) **Thrust.** The force required to counteract the forces of drag in order to move an aircraft in forward flight.
>
> (2) **Drag.** The force which acts in opposition to thrust.
>
> (3) **Lift.** The force which sustains the aircraft during flight.
>
> (4) **Gravity.** The force which acts in opposition to lift.

e. MACH, named after Ernst Mach, a 19th century Austrian physicist, is the ratio of an aircraft's true speed as compared to the local speed of sound at a given time or place.

f. MACH Buffet is the airflow separation behind a shock-wave pressure barrier caused by airflow over flight surfaces exceeding the speed of sound.

g. MACH (or Aileron) Buzz is a term used to describe a shock-induced flow separation of the boundary layer air before reaching the ailerons.
h. MACH Meter is an instrument designed to indicate MACH number. MACH indicating capability is incorporated into the airspeed indicator(s) of current generation turbine powered aircraft capable of MACH range speeds.

i. MACH number is a decimal number (M) representing the true airspeed (TAS) relationship to the local speed of sound (e.g., TAS 75 percent (.75M) of the speed of sound where 100 percent of the speed of sound is represented as MACH 1 (1.0M)). The local speed of sound varies with changes in temperature.

j. MACH number (Critical) is the free stream MACH number at which local sonic flow such as buffet, airflow separation, and shock waves becomes evident. These phenomena occur above the critical MACH number, often referred to as MACH crit. These phenomena are listed as follows:

(1) SUBSONIC MACH Numbers below .75

(2) TRANSONIC MACH Numbers from .75 to 1.20

(3) SUPERSONIC MACH Numbers from 1.20 to 5.0

(4) HYPERSONIC MACH Numbers above 5.0

k. MACH Speed is the ratio or percentage of the TAS to the speed of sound (e.g., 1,120 feet per second (660 Knots (Kts)) at mean sea level (MSL)). This may be represented by MACH number.

l. MACH Tuck is the result of an aftward shift in the center of lift causing a nose down pitching moment.

m. MMO (MACH; maximum operation) is an airplane's maximum certificated MACH number. Any excursion past MMO, whether intentional or accidental, may cause induced flow separation of boundary layer air over the ailerons and elevators of an airplane and result in a loss of control surface authority and/or control surface buzz or snatch.

n. Q-Corner or Coffin Corner is a term used to describe operations at high altitudes where low indicated airspeeds yield high true airspeeds (MACH number) at high angles of attack. The high angle of attack results in flow separation which causes buffet. Turning maneuvers at these altitudes increase the angle of attack and result in stability deterioration with a decrease in control effectiveness. The relationship of stall speed to MACH crit narrows to a point where sudden increases in angle of attack, roll rates, and/or disturbances (e.g., clear air turbulence) cause the limits of the airspeed envelope to be exceeded.

Coffin Corner exists in the upper portion of the maneuvering envelope for a given gross weight and G-force.

o. VMO (Velocity maximum operation) is an airplane's indicated airspeed limit. Exceeding VMO may cause aerodynamic flutter and G-load limitations to become critical during dive recovery. Structural design integrity is not predictable at velocities greater than VMO.

a. 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).

(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. At flight altitudes above FL 350, one pilot at the controls of the airplane must wear and use an oxygen mask that is secured and sealed. The oxygen mask must supply oxygen at all times or must automatically supply oxygen when the cabin pressure altitude of the airplane exceeds 14,000 feet MSL. An exception to this regulation exists for two-pilot crews that operate at or below FL 410. One pilot does not need to wear and use an oxygen mask if both pilots are at the controls and each pilot has a quick donning type of oxygen mask that can be placed on the face with one hand from the ready position and be properly secured, sealed, and operational within 5 seconds. If one pilot of a two-pilot crew is away from the controls, then the pilot that is at the controls must wear and use an oxygen mask that is secured and sealed.

(4) Title 14 CFR section 91.121 requires that aircraft use an altimeter setting of 29.92" Hg at all times when operating at or above FL 180.

(5) Title 14 CFR section 91.135 requires that all flights operating within Class A Airspace be conducted under instrument flight rules (IFR) in an aircraft equipped for IFR and flown by a pilot, who is rated for instrument flight.

(6) Title 14 CFR section 91.159 specifies cruising altitudes and flight levels for visual flight rules (VFR) and IFR flights, respectively. For VFR flights between FL 180 to 290, except within the Class A Airspace where VFR flight is prohibited, odd flight levels plus 500 feet should be flown if the magnetic course is 0° to 179°, and even flight levels plus 500 feet should be flown if the magnetic course is 180° to 359°. VFR flights above FL 290 should be flown at 4,000 foot intervals beginning at FL 300 if the magnetic course is 0° to 179° and FL 320 if the magnetic course is 180° to 359°.

(7) Title 14 CFR section 91.179 specifies IFR flights in uncontrolled airspace between FL 180 and FL 290, odd flight levels should be flown if the magnetic course is 0° to 179°, and even flight levels should be flown if the magnetic course is 180° to 359°. IFR flights in uncontrolled airspace at or above FL 290 should be flown at 4,000 foot intervals beginning at FL 290 if the magnetic course is 0° to 179° and FL 310 if the magnetic course is 180° to 359°. When flying in the Class A Airspace, flight levels assigned by air traffic control (ATC) should be maintained.

References
AC 61-98A
AC 61-107

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 an 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.

GROUND EMERGENCIES

ENGINE FIRE DURING START

If flames are observed in the induction or exhaust system during engine starting, proceed as follows:

1. Mixture Control – IDLE CUT-OFF
2. Throttle Control – FULL OPEN
3. Starter Switch – START

ENGINE FIRE AFTER START

If an engine fire occurs after the engine has started, proceed as follows:

1. Fuel Shutoff Handle – OFF
2. Mixture Control – IDLE CUTOFF
3. Throttle – FULL OPEN
4. Ignition Switch – OFF
5. Master – OFF

FUSELAGE FIRE ON GROUND

Should a fuselage fire occur while the aircraft is on the ground, proceed as follows:

1. Fuel Shutoff Handle – OFF
2. Mixture Control – IDLE CUTOFF
3. Throttle – CLOSED
4. Ignition Switch – OFF
5. Master Switch – OFF

TAKEOFF EMERGENCIES

ENGINE FAILURE DURING TAKEOFF ROLL (Still on runway)

Should the engine fail during takeoff, or if it becomes necessary to abort, proceed as follows:

1. Throttle – CLOSED
2. Brakes – APPLY
3. Mixture Control – IDLE CUTOFF
4. Flap Handle – UP

   If anticipating going off runway into unprepared terrain in excess of 15 kts.
5. Master Switch – OFF

ENGINE FAILURE AFTER TAKEOFF (LOW ALTITUDE)

If the engine fails at low altitude:

1. Immediately adjust nose attitude to maintain airspeed above stall—**must push nose below horizon**
2. Landing Gear Handle:

a. DOWN – Prepared Surface

b. UP – for unprepared surface or water

3. Abbreviated airstart:

a. Fuel Selector – ON

b. Mixture Control – RICH

c. Magnetos – ON

4. Flaps – DOWN when field is made

Prior to impact:

5. Fuel Shutoff – OFF

6. Master Switch – OFF

WARNING: Land straight ahead, changing direction only enough to miss obstacles. Do not try to turn back to the field. Making a forced landing straight ahead with the aircraft under control is much better than turning back and taking the chance of uncontrolled crash. Do not secure electrical power at night. **Placing the prop to Full Decrease will extend the glide appreciably if oil pressure is available.**

INFLIGHT EMERGENCIES

ENGINE FIRE IN FLIGHT

1. Fuel Selector Handle – OFF

2. Mixture Control – IDLE CUTOFF

3. Ignition Switch – OFF

4. Master – OFF

NOTE: When Master Switch is placed in the OFF position, the Landing Gear may droop and most likely the nose gear will extend fully.

WARNING: Do not attempt to restart engine after fire goes out.

5. Follow emergency landing pattern procedures

FUSELAGE FIRE INFLIGHT

If a fuselage fire occurs during flight, proceed as follows:

1. Airspeed – REDUCE IMMEDIATELY
2. Oxygen – USE if smoke enters the cockpit
3. Cockpit Heat – OFF (NON-PRESSURIZED)
4. Pressurization – DUMP
5. Master – OFF

NOTE: When Master switch is placed in the OFF position, it is possible that the landing gear may droop, and most likely the nose gear will extend fully. If fire persists do the following:

6. Fuel – OFF
7. Mixture Control – IDLE CUTOFF
8. Ignition Switch – OFF
9. Land As Soon As Possible
9. FOLLOW EMERGENCY LANDING PATTERN PROCEDURE

WING FIRE IN FLIGHT

If a wing fire occurs, proceed as follows:

1. Master Switch – OFF

NOTE: When Master Switch is placed in the OFF position, it is possible that the landing gear may droop, and most likely the nose gear will extend fully.

3. Strobes, Navigation Lights – OFF
4. Pitot Heat – OFF

5. Strobe and Navigation Light Circuit Breakers – OUT

6. Pitot Heat Circuit Breakers – OUT

7. Master Switch – ON (if necessary)

8. Put the aircraft on the ground immediately. Land As Soon As Possible.

ELECTRICAL FIRE

Circuit breakers protect most electrical circuits and automatically interrupt power to prevent a fire when a short occurs. Do not reset tripped circuit breakers if an electrical fire is suspected or confirmed. If necessary, however, turn MASTER Power Switch OFF to remove power from all electrical equipment, and land as soon as possible. If electrical power is essential, as during an instrument flight, an attempt to identify and isolate the defective system may be possible.

SMOKE/FUMES ELIMINATION

Should smoke or fumes enter the cockpit, proceed as follows:
If originating in cabin:

1. Cockpit Air Control – OPEN

2. Air Outlets – OPEN

3. Windshield and canopy defrost control handle – ON

5. Deflate the door seal

6. O2 mask on --check O2 flow “ON”

If oil/exhaust smell:

1. Air to pressurization – CLOSE

2. Pressurization dump switch – OPEN

3. Deflate the door seal

4. O2 mask on --check O2 flow “ON”

TURBOCHARGER FAILURE

Turbocharger failure will be evidenced by inability of the engine to develop manifold pressure above ambient pressure. The engine will revert to "normal aspirated" and can be operated, but will produce less than its rated horsepower. Readjust mixture as necessary to obtain fuel flow appropriate to manifold pressure and rpm. **WARNING: if turbocharger failure is a result of a loose, disconnected or burned through exhaust, then a serious hazard exists.**

If turbocharger failure occurs before takeoff, DO NOT fly the aircraft.

If failure occurs in-flight, and the choice is made to continue operating the engine proceed as follows:

> **NOTE:** At altitudes above 15,000 feet an **overrich** mixture may result if the turbocharger fails and the engine may quit operating. If this occurs, employ the following procedure:

1. Mixture – IDLE CUTOFF
2. Throttle – FULL OPEN
3. Propeller Control – Normal Cruise RPM
4. Throttle – RETARD TO CRUISE POSITION
5. Mixture – ADVANCE slowly. When the proper mixture ration is reached, the engine will start. Continue to adjust the mixture control unit until the correct fuel flow for the manifold pressure and rpm is obtained.

> **NOTE:** An interruption in fuel flow to the engine can cause engine power loss due to turbocharger "run-down". At high altitude, merely restoring fuel flow may not cause the engine to restart because the mixture will be excessively rich. If the engine does not restart, there will be insufficient mass flow through the exhaust to turn the turbine. This condition may give indications similar to turbocharger failure. If a power loss is experienced followed by surging of rpm, fuel flow, and manifold pressure, the following steps are recommended:

1. Mixture Control – IDLE CUTOFF

2. Auxiliary Fuel Pump – LOW

3. Throttle – NORMAL CRUISE POSITION

4. Propeller – NORMAL CRUISE RPM

5. Mixture – ENRICH SLOWLY FROM IDLE CUTOFF

   Engine starting will be apparent by a surge of power. As the turbocharger begins to operate, manifold pressure will increase and mixture can be adjusted accordingly.

6. Mixture – READJUST IF NECESSARY

   NOTE: If this procedure does not effect a restart, when descending below 15,000 feet, repeat.

HIGH CYLINDER HEAD TEMPERATURE

1. Mixture – ADJUST to proper flow for power being used.

2. Airspeed – INCREASE

If temperature cannot be maintained within limits, reduce power, land as soon as practical and have the malfunction evaluated or repaired if required before further flight.

HIGH OIL TEMPERATURE

> **NOTE:** Prolonged high oil temperature indication will usually be accompanied by a drop in oil pressure. If oil pressure remains normal, a high temperature indication may be caused by a faulty gage or thermocouple. If the oil pressure drops as temperature increases, proceed as follows:

1. Airspeed – INCREASE

2. Power – REDUCE if airspeed increase did not lower oil temperature.

LOW OIL PRESSURE

If the oil pressure drops without apparent reason from normal indication of 30-60 psi, monitor temperature and pressure closely. If oil pressure drops below 30 psi, an engine failure should be anticipated.

ALTERNATOR FAILURE

Reduce electrical load to the minimum required to continue safe flight. If necessary, turn off the battery to conserve power to ensure normal landing gear and flap extension are available for landing.

ENGINE ROUGHNESS

Observe engine for visible damage or evident of smoke or flame. Extreme roughness may be indicative of propeller blade problems. If any of these characteristics are noted, follow these procedures:

1. Mixture Control – ADJUST as appropriate to power setting being used. Do not arbitrarily go to full rich as the roughness may be caused by an overrich mixture.

2. Magnetos – CHECK ON

   If engine roughness does not disappear after the above, the following steps should be taken to evaluate the ignition system:

   a. Throttle – REDUCE power until roughness becomes minimal

   b. Magnetos – OFF, then ON, one at a time. If engine smoothes out while running on a single ignition, adjust power as necessary and continue. Do not operate the engine in this manner any longer than absolutely necessary. The airplane should be landed as soon as practical for engine repairs.

   If no improvement in engine operation is noted while operating on either magneto alone, return all magneto switches to ON OR BOTH as appropriate.

   CAUTION: The engine may quit completely when one magneto is switched off if the other magneto is faulty. If this happens, close throttle to idle and move mixture to idle cutoff before turning magnetos on. This will prevent a severe backfire. When magnetos have been turned back on, advance mixture and throttle to previous setting.

FAILURE OF THE ENGINE-DRIVEN FUEL PUMP

(Characterized by an abnormally low fuel flow)

(This procedure should be memorized and immediately used if the engine fails AFTER takeoff)

1. Fuel Selector – OTHER TANK

2. Throttle – FULL OPEN

3. Mixture Control – FULL RICH
4. Auxiliary Fuel Pump – HIGH

5. Mixture Control – LEAN, if required, until engine starts – then FULL RICH

6. Throttle – RETARD to maintain TIT below 1750F

7. Return and Land as soon as possible

If engine roughness occurs as the throttle is retarded, manually lean the mixture control until smooth engine operation resumes. Do no retard throttle to idle until landing is assured. After throttle is retarded to idle and rpm decays, engine combustion will cease due to over-rich condition preventing a go-around.

FUEL SYSTEM MALFUNCTIONS

If the engine-driven fuel pump fails, the boost pump will supply fuel to the engine. Under most conditions, indicated fuel pressure will remain within the normal range, with no indication of failure. High boost will not cause engine to run over rich when operating at high powers *if the engine fuel system is set up correctly*. If the engine is set up "rich" it may be necessary to reduce mixture / fuel flow to maintain a proper fuel / air mixture and permit the engine to operate.

FUEL TANK DEPLETION

(characterized by an empty indication on the gauge and an abnormally low fuel flow)

1. Fuel Selector Valve – SELECT OTHER TANK

2. Auxiliary Fuel Pump – LOW

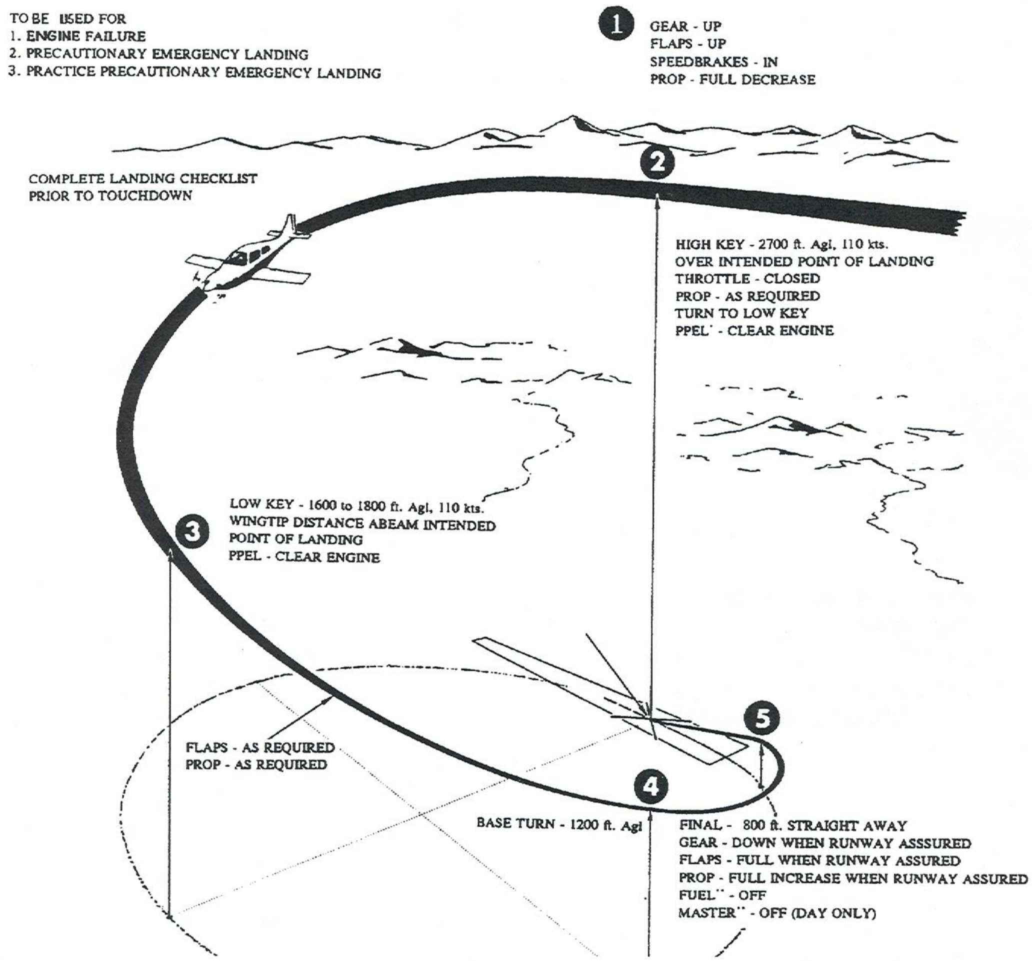
3. Throttle – ½ OPEN

CAUTION: In the event of an engine failure due to fuel starvation, an engine restart is unlikely without an operative auxiliary fuel pump.

ENGINE FAILURE IN FLIGHT (NO RESTART)

Establish a glide of 110-130 kts, landing gear and flaps up, speed brake in. Start toward the selected field, if not already doing so, and perform an air start, altitude permitting. Make a Mayday report.
The pattern to the emergency landing strip, is a 360 degree overhead approach. If we consistently practice this maneuver using the same figures and make adjustments for density altitude and wind, judgment skills will be sharp when the day comes that we have to do it for real.
During descent, vary turns to lose altitude to arrive at high key on heading – airspeed and altitude. Remember that we shallow the turn upwind, steepen the turn downwind, dive into a headwind.
If high at the 90°position, excess altitude can be lost by delaying the final turn, lowering full flaps (if not previously done), extending speed brakes, and/or advancing the propeller control lever to full increase rpm (to increase the drag of the propeller), and slipping on final. The most effective way of losing altitude is the slip. In case of undershooting, sink rate can be decreased by placing propeller control lever to full decrease rpm (if not already there), raising flaps to one-half (above 400 feet), or raising the landing gear. The flaps are the highest drag item. To prevent the normal tendency to undershoot, the high key must be established over the intended point of landing 1/3 – 1/2 way down the runway; the low key must be with 1600-1800 AGL which will appear as a one wing tip distance abeam the intended point of landing.

ENGINE OUT EMERGENCY LANDING PATTERN



PRECAUTIONARY EMERGENCY LANDING

When indications point to a possible engine failure or when reliability of the engine is questionable, a precautionary emergency landing may be made. An extremely rough running engine, loss of oil pressure, excessive cylinder head temperature under normal flight conditions, loss of manifold pressure, or fluctuating rpm are indications that a failure may occur. If any of these conditions occur, carry out the following procedure:

1. Mixture Control – RICH
2. Throttle – 21 to 23 in. Hg. MANIFOLD PRESSURE (If possible, maintain 120-140 kts)
3. Prop Control Lever – 2500 rpm
4. Cockpit – Systematic check to determine probable cause and functional status of aircraft systems.

IN-FLIGHT RESTARTING

The following procedure is recommended for in-flight restarting:

1. Mixture Control – ADVANCE TO ¾ RICH
2. Fuel Selector – ON
3. Fuel Boost Pump – LOW
4. Magneto Switches – ON BOTH
5. Throttle – START POSITION 1” OPEN
6. Propeller – HIGH RPM
   a. Start Switch – START (IF PROP STOPPED)
   b. Oil Pressure – WITHIN LIMITS
   c. Throttle – ADJUST

PROPELLER GOVERNOR FAILURE

The propeller may fail to the low pitch (high rpm) stop, resulting in a runaway propeller. Prompt corrective action is essential. This may be the first sign of the oil system leaking. Suspect oil quantity to be less than one quart. Check oil pressure-temperature.

1. Throttle – RETARD to maintain below 2700 rpm
2. Climb to load the propeller
3. Prop Control Lever – Manipulate to restore governing
4. Land as soon as possible

EMERGENCY DESCENT

1. Throttle – CLOSED
2. Propeller – 2700 rpm
3. Speed brakes-- deploy
3. Airspeed – Vne or Vno as appropriate

EMERGENCY COMMUNICATIONS

Anytime a pilot is in urgent distress he will transmit the following information, as time permits:

1. Mayday, Mayday, Mayday
2. Identification
3. Position (geographical or bearing and distance from a fixed point)
4. Altitude
5. Nature of emergency
6. Intended actions

7. Squawk – 7700

LOST – INADVERTENT FLIGHT INTO INSTRUMENT METEOROLOGICAL CONDITIONS

The primary requirements when lost or encountering IMC conditions when flying VFR are as follows:

1. Climb
2. Communicate
3. Confess
4. Conform
5. Conserve

LANDING EMERGENCIES

LANDING GEAR UNSAFE

1. Remain below 130 kts
2. Test landing gear down indicators
3. Pull landing gear relay circuit breaker (Pump relay or power C/B's)
4. Reposition landing gear selector valve to down
5. Hand pump gear down until down and locked is indicated
6. If a three down and locked indication cannot be obtained, yaw the aircraft and increase positive "Gs" on the aircraft.

LANDING WITH GEAR RETRACTED

If the gear fails to extend, a wheels-up landing can be made on either hard or soft ground as follows:

1. Establish a normal flaps-down approach
2. Flare out as in a normal landing
3. Shut down engine just before touchdown
4. When aircraft stops, get out immediately

ONE MAIN WHEEL RETRACTED

A wheels-up landing is preferable to a landing with one main wheel retracted. However, if such a landing cannot be avoided, proceed as follows:

1. Make a normal flaps-down approach with wing low on extended gear side
2. Touchdown on extended main wheel. Use ailerons to hold up wing with retracted gear.
3. Shut down engine
4. When wing tip strikes ground, apply maximum opposite brake pressure

NOSE WHEEL RETRACTED

If the nose wheel fails to extend, proceed as follows:

1. Make a normal landing
2. Secure engine at touchdown
3. Hold a nose-high attitude to allow speed and engine rpm to diminish
4. Trim elevator full aft

NOSE GEAR TIRE FAILED

If nose wheel tire is flat, make a normal landing and hold nose off as long as possible. Use brakes sparingly after nose wheel is on the ground.

MAIN GEAR TIRE FAILED

1. If a main wheel tire is flat, land on the side of the runway nearest the inflated tire. Hold flat tire off as long as possible. If brakes are necessary, brake mainly with the wheel that has the inflated tire.
2. If both main tires are flat, make normal landing in center of runway.

EMERGENCIES AND IRREGULARITIES AT HIGH ALTITUDES

CABIN DECOMPRESSION

Cabin decompression is defined as the inability of the aircraft's pressurization system to maintain its designed pressure schedule. Decompression can be caused by a malfunction of the system itself or by structural damage to the aircraft. Decompression will often result in cabin fog because of the rapid drop in temperature and the change in relative humidity. Decompression will also affect the human body. Air will escape from the lungs through the nose and mouth because of a sudden lower pressure outside of the lungs. Differential air pressure on either side of the eardrum should clear automatically. Exposure to windblast and extremely cold temperatures are hazards the human body may face with a decompression.

WINDOW FAILURE---DECOMPRESSION OF A SMALL CABIN VOLUME PRESSURIZED AIRCRAFT

Decompression of a small cabin volume pressurized aircraft is more critical than a large one, given the same size hole or conditions, primarily because of the difference in cabin volumes. Actual decompression times are difficult to calculate due to many variables involved (e.g., the type of failure, differential pressure, cabin volume, etc) However, it is more probable that the crew of the small aircraft will have less time in which to take lifesaving actions. There have been several pilot door window failures related to improper builder window installations.

(1) An explosive decompression is a change in cabin pressure faster than the lungs can decompress. Most authorities consider a decompression that occurs in less than 0.5 seconds as explosive and potentially dangerous. This type of decompression is more likely to occur in small volume pressurized aircraft than in large pressurized aircraft, and often results in lung damage. To avoid potentially dangerous flying debris in the event of an explosive decompression, all loose items such as baggage and oxygen cylinders should be properly secured.

(2) A rapid change in cabin pressure is where the lungs can decompress faster than the cabin. The risk of lung damage is significantly reduced in this decompression as compared with an explosive decompression.

(3) Gradual or slow decompression is dangerous because it may not be detected. Automatic visual and aural warning systems generally provide an indication of a slow decompression.

(4) Recovery from all types of decompression is similar. Oxygen masks should be donned, and a rapid descent initiated as soon as possible to avoid the onset of hypoxia. The time allowed to make a recovery to a safe altitude before loss of useful consciousness is, of course, much less with an explosive than with a gradual decompression.

LOSS OF CABIN PRESSURIZATION

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

1. Don oxygen mask, check O2 flow (100%) inform passengers.

2. Inform ATC of the problem and request lower altitude.

3. Make normal descent, keeping turbos at maximum output, consistent with descent rate and airspeed limitations.

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

If cabin pressure loss is rapid:

1. Don oxygen mask check O2 flow (100%), inform passengers.
2. Auto pilot off or alternatively program autopilot for descent as necessary to below 10,000’.
3. Turn 90 degrees from airway course, if flying airways.
4. Inform ATC/ declare emergency.
5. Reduce power to minimum.
6. Configure aircraft for maximum sink rate.
   (1) Consider aircraft structure. If sound:
   (2) Increase pitch down until reaching maximum allowable airspeed.
   (3) 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.
      (3) Consider use of speed brakes.

OIL TEMPERATURE, OIL PRESSURE, MANIFOLD PRESSURE IRREGULARITIES

Increased oil temperature, decreased oil pressure, and a drop in manifold pressure indicate a turbocharger malfunction or a partial or complete turbocharger failure. The consequences of such a malfunction or failure are twofold. The airplane would not be capable of sustaining altitude without the additional power supplied by the turbocharging system. The loss in altitude in itself would not create a significant problem, weather and terrain permitting, but ATC must be notified of the descent. A more serious problem associated with a failed turbocharger would be loss of cabin pressurization if the pressurization system were dependent on the turbocharger compressor. Careful monitoring of pressurization levels is essential during the descent to avoid the onset of hypoxia from a slow decompression.

POTENTIAL PROBLEM WITH TURBOCHARGERS

Another potential problem associated with turbochargers is fuel vaporization. Engine-driven pumps pulling fuel into the injector system are susceptible to vapor lock at high altitudes. The Continental TSIO 550 requires that low fuel boost be used to feed fuel to the engine driven pump under positive pressure above 12,000 feet. The pump should be turned on if fuel starvation occurs as a result of vapor lock. If an intake pipe or turbo connector should come loose at high altitude, the fuel mixture would become extremely RICH for the resultant ambient air/pressure. Conditioned response of mixture “full rich” if the engine begins to run rough must be retrained for high altitude flight.

COMBUSTIBILITY OF OXYGEN

Because of the highly combustible composition of oxygen, an immediate descent to an altitude where oxygen in not required should be initiated if a fire breaks out during a flight at high altitude. The procedures in the Airplane Flight Manual should be closely adhered to.

THUNDERSTORM ACTIVITY OR SEVERE TURBULENCE

Flight through thunderstorm activity or known sever turbulence must be avoided, at all costs. When flight through severe turbulence is anticipated and/or unavoidable, the following procedures are highly recommended:

(1) Airspeed is critical for any type of turbulent air penetration. Use the Airplane Flight Manual recommended turbulence penetration target speed (170 IAS) or, if unknown, airspeed below maneuvering speed. Use of high airspeeds can result in structural damage and injury to passengers and crewmembers. Severe gusts may cause large and rapid variations in indicated airspeed. Do not chase airspeed.

(2) Penetration should be at an altitude that provides adequate maneuvering margins in case severe turbulence is encountered to avoid the potential for catastrophic upset.

(3) If severe turbulence is penetrated with the autopilot on, the altitude hold mode should be turned off. If the autopilot has an attitude hold mode, it should be engaged. The autopilot attitude hold mode can usually maintain attitude more successfully than a pilot under stress.

(5) Keep wings level and maintain the desired pitch attitude and approximate heading. Use smooth, moderate control movements to resist changes in attitude. If large attitude changes occur, avoid abrupt or large control inputs. Avoid, as much as possible, use of the stabilizer trim in controlling pitch attitudes. Do not chase altitude.

Emergencies Quiz

1. The most important task a pilot has in any emergency is:
    a. Flying the airplane
    b. Looking for a landing site
    c. Talking to ATC
2. In the event of a window failure or rapid decompression you should:
    1.
    2.
    3.
    4.
    5.
    6.

        (4) Consider aircraft structure. If sound:

        (5)

        (6) If aircraft structure has sustained damage:

            (1)

            (2)

            (3)

3. In the event you have an engine failure on takeoff below 1000' AGL you should:

If the engine fails at low altitude:

1. Immediately adjust nose attitude to
2. Landing Gear Handle:
    a. DOWN –
    b. UP –
3. Abbreviated airstart:

a.
b.
c.

4.

Prior to impact:

5.

6.

WARNING:

4. Describe the procedure for an engine failure in flight (no restart is successful)

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 FAR's that apply to normally certificated aircraft do not apply experimental/ amateur built aircraft. This is not true with one exception.

Section 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. If something is broken or inoperative you may fly the aircraft on the condition that the maintenance is properly deferred. Again, no exceptions for experimental. 14 CFR 91.213(d) 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 91.403 states: § 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:

Section 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.

§ 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.

(iv) 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 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 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.

PHASE I FLIGHT TESTING.

a. Flight Tests. Section 91.319(b) requires you to show your aircraft is controllable at all its normal speeds during all the maneuvers you might expect to execute. You must also show it 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 the following table for specific requirements. The FAA inspector may decide you need additional hours of flight testing beyond those shown in the table to comply with § 91.319(b).

Aircraft Characteristics Required Flight Testing

Type-certificated engine/propeller combination 25 hours

Non-type-certificated engine/propeller combination 40 hours

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 under the guidelines in 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 maintenance record (logbook) 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 make sure you thoroughly understand each one.

14. 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 must follow the operating limitations issued with the aircraft airworthiness certificate.

b. You may not operate your aircraft without the airworthiness certificate and operating limitations aboard. If you lose the operating limitations or they are mutilated or no longer legible, contact your local FAA office for guidance or contact AFS-750 (see appendix 7 for the address) to obtain a copy of the operating limitations. If you cannot get a copy, ask your local FAA office to issue a replacement FAA Form 8130-7 and operating limitations. If you can document that the aircraft has completed the flight test requirements (through logbook entries), we may issue new operating limitations without initial flight test operating limitations.

c. You should be aware of the responsibilities

16. BECOMING A REPAIRMAN OF YOUR AMATEUR-BUILT AIRCRAFT. You can get a repairman certificate under certain circumstances. However, the only privilege this certificate gives you under § 65.104 is to do the annual condition inspection. The certificate will be valid only for a specific person and a specific aircraft. Aircraft Builders), for application information. You can get a certificate if you are—

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

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, must be installed and operable. In addition, these operating limitations may state flight test areas 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 must 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 must 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).

During the preflight inspection, the pilot recognizes inoperative instruments or equipment.		
↓		
Is the equipment required by the aircraft's equipment list or the kinds of equipment list? (FAR § 91.213(d)(2)(ii).)	→	If **YES**, the aircraft is unairworthy and maintenance is required.
↓		
If **NO**, is the equipment required by the VFR-day type certificate requirements prescribed in the airworthiness certification regulations? (FAR § 91.213(d)(2)(ii).) See appendix 1 of this AC.	→	If **YES**, the aircraft is unairworthy and maintenance is required.
↓		
If **NO**, is the equipment required by AD? (FAR § 91.213(d)(2)(iv).)	→	If **YES**, the aircraft is unairworthy and maintenance is required.
↓		
If **NO**, is the equipment required by FAR §§ 91.205, 91.207, etc.? (FAR § 91.213(d)(2)(iii).)	→	If **YES**, the aircraft is unairworthy and maintenance is required.
↓		
If **NO**, the inoperative equipment must be removed from the aircraft (FAR § 91.213(d)(3)(i)) or deactivated (FAR § 91.213(d)(3)(ii)) and placarded as inoperative.		

↓ ↓ ↓ ↓ ↓

At this point the pilot shall make a final determination to confirm that the inoperative instrument/equipment does not constitute a hazard under the anticipated operational conditions before release for departure.

Figure 2. Pilot Decision Sequence When Operating Without An MEL

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

3. You must have what other inspections performed on the aircraft to be legal to fly IFR?

4. 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.

5. The altimeter does not work properly. Can you operate the aircraft? Explain.

6. You converted your aircraft to a turbine. Must you make a record entry and do anything else before you carry passengers? Explain