Skywriter

Monthly Newsletter of the Calgary Ultralight Flying Club

February 1992

View From Above

by Paul Hemingson

At the January meeting, the guest speaker was Jamie Roth, Civil Aviation Inspector in the Flight Training Standards group of Transport Canada (Calgary). Jamie started with a quiz hand-out for us about stalls and such. Most of the answers were acceptable, but a few answers showed that some of us are unclear on the correct recovery concept.

Jamie's main topic was pilot decision making (PDM). His words and videos introduced us to what it is all about. The video showed that ordinarily excellent pilots are sometimes overcome by Sudden Loss of Judgement or SLOJ phenomenon. Numerous examples exist under inflight conditions. False Assumptions, Stree, Getting Down, Having done it before and got away with it and Pushing-on are all factors that contribute to the making of poor judgements. So are hazardous behavioral factors like machoism, impulsivity, resignation, invulnerability and anti-authority. It is obvious we are all vulnerable. Knowing your thinking faults is better than faulty thinking. A safe pilot will get hold of the 14 page PDM manual and study it. Another element of decision making is Situational Awareness.

Situational Awareness, is simply PhD jargon for the situation whereby a pilot asks himself, "What am I Doing? Why? Is everything OK?" The preventative measure is to use the "Fingers Test". In this test, the pilot uses his four fingers to satisfy himself that: 1) the Machine is worthy, 2) the Man is worthy, 3) the Weather (Medium) is OK, and 4) the Mission (flight) objective outweighs the risks. If you find that one or more of the criteria (fingers) is not acceptable then a "Thumbs Down" is indicated to the flight. Give your intended flight the "finger" if everything (Man, Machine, Medium and Mission) does not check out. Pilot decision making now forms a significant portion of the private pilot license and it fits well with Ultralight Flying.

Gord Keegan volunteered to organize our participation in the February 16-17 public exhibit that the Calgary Aerospace group is organizing. It was nice to see members Bill Clark, Doug Ward, Don Rodgers, Chris Kirkman and Ivan Myslachuk step forward to help out. Howie Bowie is going to build us a better photoboard and Doug Ward is getting our Club advertisement into a local magazine at no charge. Larry Everett has researched the RCAF Association query for funds and made a motion that results in the Club donating $100 to the RCAF Association.

Stu Simpson and Todd McArthur updated the meeting on the plans for the Abbotsford flight. They have written the Abbotsford authorities to see if they are welcome. Stu has also had his Red Deer Airshow story published in the "Canadian Flight" magazine, a supplement to Canadian General Aviation News. Good work Stu. I also remember a few months ago, an article in the same paper that was written by Stu, but his name was not used in the credit. Keep on writing Stu, and I encourage other members to put stories in Skywriter...some of them will be noticed by the editor of CGAN and may be published. Their circulation is 22,000 copies.

This month, the Safety Corner article is about stalls. The piloting force for me was the two recent crashes in the Calgary area involving light planes. I felt the urge to vent myself on this topic, hoping that it might save one pilot, or even myself, by reviewing why this happens to better pilots than me.

That is why I chose to write the article. We must learn something from these terrible accidents. Harping about safety is better than listening to harps! Those pilots who have paid the ultimate price, have left a legacy of learning for the rest of us. Let us listen to their advice.

Book Review

by Stu Simpson

"CW2" by Lane Heath

The term "CW2" does not refer to a chemical formula. Nor does it denote a new stealth airplane. It refers to the US Army rank of Chief Warrant Officer, 2nd Grade.

During the Viet Nam war, the US Army found itself short of helicopter pilots. So, Army brass decided to offer pilot's wings to the your men it needed, even if they didn't have college educations. However, though these men would be flying for Uncle Sam, they would not be commissioned officers like the rest of the Army's aviators were. They would be warrant officers, the most senior rank of non-commissioned officers.

Such is Billy Roark, the main character in Lane Heath's book, "CW2".

The story documents Roark's experiences as a helicopter pilot flying combat missions in the last couple of years of the Viet Nam war.

There is certainly no shortage of combat memoirs vying for space on the book store shelves. But few are able to accurately describe the day-in and day-out activity of flying choppers in a combat zone. "CW2" is a book that can do just that.

Through Roark, the reader gets an excellent feel for the way these pilots lived and died. Heath takes us into the briefing rooms, the jungles, the hootches and the cockpits that were part of every chopper pilot's life.

We are invited along on routine supply flights, training hops and harrowing combat missions that will leave you wondering how anyone ever survived. Heath gives us an inkling of what its like to be flying along with a good friend sitting beside you one minute, and to have him suddenly dead from an unseen bullet the next.

We see there is little glory in war, especially in Roark's war. He not only has to fight the Viet Cong and North Vietnamese, but he locks horns with a superior officer whose incompetence regularly endangers hundreds of lives. And as if that weren't enough, his door gunner may be trying to kill him.

A little far-fetched you think? Not the way Heath tells it. His style is gritty and honest, taking the reader along as though he were in the co-pilot's seat.

The most amazing thing about "CW2" is the way Heath handles the transformation of Billy Roark, farm-boy, to Billy Roark, cold- blooded killer. The ending of the book is one of the best you'll ever read.

There is an ancient proverb that states: Beware, ye who fight the beast, lest ye become it. It seems to be a proverb Lane Heath truly understands.

Dues!

Don't forget to pay your 1992 club dues soon. The club needs your support and you need this newsletter. $15.00

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Meetings of the Calgary Ultralight Flying Club are held the first Wednesday of every month at 7:30pm at

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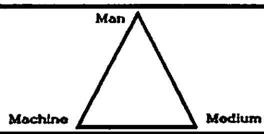
Safety Corner

by Paul Hemingson



Stall, Spin, Flash....~~Splash~~ Crash

It has been said that when a man is confronted with a life threatening situationm his whole life flashes before him in rapid, kaleidoscopic fashion.

When I see the front page of the local newspaper with the pjoto of an aircraft that has augered into the ground, my heart goes out to the pilot involved. Can you imagine what the final seconds of his life were like? Fourty or more years are telescoped into an eye-blink. In many cases he may know what is happening, and yet be helpless to remedy it. Running out of altitude and time to execute the antidote, the final utterance in resignation may be "Oh ____".

One moment he was flying along and the next moment he is pointed nose-down at 60 or 70 degrees with only a few seconds to take corrective action. The farmfields below were swirling around in hypnotic fashion, and the ground coming up quickly. With this view through your windscreen it goes against human instinct to push the stick ahead and stop the rotation. These pilots were good men, with more hours than most of us. Would any of us have done anything different? Would we have had the foresight or the time to do what we know needs doing? The value of hindsight is not that we are smarter, but that we can learn from the legacy of those who went before. Hindsight tells us where we have been, and there are some places a guy just doesn't want to revisit.

If we eliminate mechanical failure, there are only two ways an aircraft can go into the ground nose first at greater than 60 degrees. One is suicide. Lets rule that out, since pilots love life. The second is a stall-spin accident. When you see an aircraft wreckage with the tail section intact, and the front section compressed from spinner to seat belt, you're likely dealing with a stall-spin accident.

Now, you might be sitting there saying, "Stalls?", where is this guy coming from? We all know that ultralights mush, more than stall. It is true that the large positive dihedral and other characteristics of many ultralights make them quite forgiving and not prone to spinning. However, with the new crop of higher performance ultralights it is just a metter of time before these types of accidents start showing up. Many of the newer ultralights will spin. And they will spin very nicely, nore down, and winding up like an Olympic Figure Skater. Couple this characteristic with the typical lower altitudes flown by ultralight pilots and you're setting up an accident situation.

Stalls happen. Every month the accident record suggests a number of stall related accidents. The most insidious is the departure or turning stall. Here is the usual senario. Witnesses often say the aircraft was last seen at low altitude (<700agl) and stated a turn, or climbing turn. The aircraft was then observed to quickly fall off on one wing, and kept turning until it hit the ground. This is classis sin-airio, for your basic spin-airio!

Spin recovery is seldom taught and most pilots are not "current" on recovery. It is one thing to go out and practice stalls and spins. It is another thing when it happens when you don't expect it. (Do not go out and practice spins unless your aircraft is approved for it, consult your manufacturer first).

In the practice session you usually climb to 3000 or 4000 feet agl and then commonly force the aircraft to spin by slowing it up to stall-speed, then kicking in a boot-full of rudder (the ailerons are ineffective at stall-speed) and over it goes in the direction of applied and so you control the direction of the spin. Recovery procedure is usually power-off, stick ahead slightly to unstall the wing, opposite rudder to stop the spin and then a cautious pullout to normal straight and level attitude, adding power as required.

In the non-practice spin, conditions for successful recovery are less favourable. The aircraft is usually at low altitude and the spin direction is not consciously controlled by the pilot. In fact, he doesn't even know it's coming. To complicate things the spin direction may be in the opposite direction to the bank. Are you confused? So is the pilot who is unaware that a spin lies in his immediate future.

Here is how it happens. The risk of my superficial analysis outweighs the depth of shallow excuses for being technically perfect.

The spin at low altitude happens in two common flight configurations. One is shortly after takeoff, when a pilot decides to make a moderate to steep climbing turn, and secondly (again at low altitude) when a pilot is flying low and slow and decides to circle or make a climbing turn.

Let's say in both cases the pilot makes a climbing left-hand turn. The pilot is casually looking down at something that attracts his attention. The outside, or right wing, is meeting the relative airflow at a steeper angle of attack than the left, or lower wing, and stalls. It stands to reason then, that the high right wing is also the first to lose its lift and drop. As quickly as you read this line the aircraft goes from a 45 degree left bank, up and over to the opposite bank and the nose drops simultaneously. The pilot is no longer looking casually out the window. Chances are he has both feet pushing the rudder pedals to the firewall. Whoa! What's going on? Now all he sees is a rotating kaleidoscope patchwork of farm fields. He might not even be sure which way the aircraft is spinning. Note that the aircraft may also commonly stall and roll off or spin towards the down wing, depending on the position of the ailerons, rudder adn actions of the pilot. A spin in any direction at low altitude will get your attention.

You have about three microseconds to decide what action is appropriate, assuming you recognize immediately that you are in a spin. Even a speed-reader would be pressed for time to consult the Pilot Decision Manual. You must have a conditioned reflex to pull the power, stick ahead slightly, opposite rudder to stop the spin and pull out. Can you do it with less than 1000 feet of altitude? I doubt I could. Even in a controlled spin situation, I have lost 1000 feet of altitude. If, as pilot, you don't instantly recognize what just happened, it is unlikely you will recover. The accident records show this to be true.

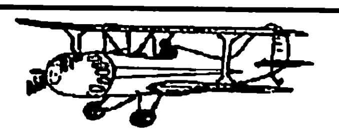
But, maybe there is a better answer.

The answer is Prevention. Simply, don't get yourself into the conditions where a stall-spin can happen. Recognize those phases of flight where the stall and subsequent spin are most hazardous (situational awareness) and avoid doing the things that encourage the phenomenon. The pilot aware of the stall need not beware the stall. This way you don't have to be current in spin recovery. In fact, you are likely

(continued on page 4)

One Pilot's Opinion

by Bob Kirkby



A "PDM" Moment

We've heard a lot lately about Pilot Decision Making. I'll abbreviate this to PDM even thought, if there is one thing we don't need in aviation its another acronym. Anyway, all this talk about PDM got me thinking about some of my flying experiences. One in particular involved a number of PDM iterations in the space of about one minute, so I thought I would tell you about it here. Afterwards you can have a great time picking apart my particular decisions.

I had two engine failures in my old Mirage some years ago, both due to a faulty fuel pump, which was rectified by replacing the fuel pump. Neither incident did much to ruffle my feathers, one occured over a nice, smooth open field and the other occured on take off with lots of runway left on which to make my forced landing (ever since I have used the entire runway on take off). I also did lots of deadstick landings in my Mirage just for the fun of it. Since building my Renegade, however, I had not experienced a forced landing, although I practiced a number. That is, not until last September, which is what this story is about.

In my last article I told you about the testing I had done with Paul Hemingson's three-blade Warp Drive Prop. Well, I had installed the prop, run it up with the tail tied to my truck, and set the pitch based on static tests. Once I had it were I thought it should be, I jumped in for a flight test. I did not realize, yet, that the large size of the hub would restrict the airflow into my engine cowling too much. I taxied to the north end of my runway and sat there for many minute playing with the throttle. I was trying to get a feel for the lag-time in response due to the higher inertia and angular momentum of this heavier, three-blade prop. During this time the engine temp got up to full operating temperature, which seemed a bit quick, but it was not going beyond, so I didn't give it another thought.

Satisfied with the feel of the prop, I gave it full throttle and rolled down the runway. I rotated and began climbing out at a moderate rate. The prop seemed to be performing well so I started a climbing left turn to the cross-wind leg, intent on doing a circuit. At about 300 feet I turned left again onto down-wind, still in a bit of a climb, and was just about to level off when the engine stopped dead. No sputter or cough, just instantaneous, deathly silence. Without a second thought I immediately lowered the nose and levelled the wings. (Now I'm glad I did all those deadstick landings in the Mirage!) This reaction was not PDM, this was conditioned response. But here's were my first PDM loop starts.

As soon as my nose was down I checked my airspeed and estimated an attitude that would give me about 50 mph. I then looked out at the ground ahead... I was pointing north. The wind sock had been limp when I took off a minute ago so I discounted the wind as a consideration for landing direction. I was looking towards an open field, but one which I knew to be very rough indeed. If I deadsticked into that I would most definitely have to buy Paul's prop from him, although I would never get to use it again. I chose to turn left and land across my runway instead, this would be much smoother and there should be plenty of room for rollout. This was the end of PDM iteration number 1.

I increased my speed slightly with more forward stick and started a smooth left turn with about a 30 degree bank. While turning I focused on the ground where I should touch down and suddenly spotted, to my horror, the power line leading away from my house to the north. It was right where I estimated I would have to touch down. I didn't think I could make it over the line and there was only about 40 feet between a fence and the first power pole, which meant I would have to touch down under the line in between the fence and the pole. Not too appealing without power. Perhaps a navy pilot would have felt right at home, but I missed carrier landing practice, so I decided to look a little further. End of PDM iteration number 2.

Now I was getting pretty low, about 150' above the weeds. I looked further left where there was lots of good open field to land in. The only problem was, I would have to make another 90 degree turn, and a tight one at that, otherwise I would end up over my house and hanger. I very quickly considered what alternatives were left and decided to go for it, only because I was certain I could make the turn in time. I was just completing the last turn and was still banked at 30 degrees, but I knew I had to go over harder so I dropped the nose again to get the aircraft up to 65 mph where I felt comfortable making a 45 degree bank.

Now this is where one has to have faith in the integrity of one's aircraft. Looking at the ground coming up at 65 mph (that's a 66 foot per second vertical decent rate at a 45 degree approach angle, which is about how I was approaching !) and deliberately pushing that stick forward against a reactive tendency to pull back, takes a very conscious effort. By the time I was pointed in the right direction I had about 30' of altitude left. Just enough time to level the wings and start my round out. The rest of the forced landing was uneventful, and actually turned out to be one of my smoother ones. End of PDM iteration number 3. My final PDM iteration of the afternoon ended in success.

The engine started easily a few minutes later. I believe the problem was due to an excessive build up of heat under the cowling before I took off and on climbout. It probably caused a vapour lock or something similar. A though examination found nothing abnormal and the engine has run fine since.

This story should provide a basis for some interesting discussions on PDM and what not to do. Although the story sounds a bit hair-raising, it really wasn't. The text book response to such an engine failure is to land straight ahead, even if it means landing into trees. This response has to be weighed with the circumstances (i.e. altitude, wind, available alternatives, aircraft capability and pilot capability).

What one finally does will depend on how much in control of the situation one feels. The amount of control you have over an emergency situation depends, to a very large extent, on how much practice you have had. If you are going to feel at one with your aircraft and know what you and it can and cannot do together, you must practice. If all you've done since flying school is straight and level flight and you haven't done lots of deadsticks from peculiar positions, strange attitude manueovers and simulated control surface failures then you had better stick to the text book response and head for the trees.

I invite your comments.

In response to a number of requests, I am reprinting my radio installation articles.

Radio Installations

by Bob Kirkby

With the cost of VHF radios coming down many of us are now installing portable transcievers in our airplanes. These installations have met with varying degrees of success and I know some of you are very frustrated with the poor quality of reception after spending hundreds of dollars and hours of installation time.

In this article I will go over some of the basics and try to give you a picture of where the problems are and suggest solutions to these problems. There are two fundamental concerns that need to be addressed. These will lead into secondary concerns as we proceed. Right off the bat, I must emphasize that getting the most out of your radio installation is an art rather than a science. I cannot give you a set of procedures to follow that will produce the same results in every case. In addressing these problems I will give you suggested solutions, and as you implement these solutions you will find that some are very effective and others aren't. Each installation will be different. It is a matter of trying one thing after another until the results are acceptable to you for the use to which you will put your radio.

The first concern is that we want to maximize the capabilities of the radio that we purchased by providing it with the most efficient transmission and reception facility that our pocket book and imagination will allow. What I am talking about here is the antenna "system". Any radio is useless without the proper antenna. Notice I said antenna system. There is much more to installing an antenna than simply connecting it to the radio. A poorly installed antenna can easily reduce the radio's efficiency by 50%. This may not matter, or even be noticable, when you are only 2 miles away from the station you are communicating with, but at 40 or 50 miles it can mean the difference between communicating and not communicating.

By tuning our antenna system to peak performance, our radio will be able to get most of its transmit power out into the air, thus sending our signal as far as possible and it will also be able to receive desired incoming signals as strongly as possible.

The second concern is that we want to minimize the reception of background signals or noise that make it difficult to understand the desired signal. We usually call this noise RF interference (RF standing for Radio Frequency). We are constantly being bombarded by RF radiation from thousands of different sources. What we are concerned with is radiation that is at the same frequency, or in the same frequency range, that we are using. In the case of VHF radios we are using frequencies in the range of 118 to 135 Mhz.

We have no control over RF interference from sources outside of our airplane. But we can control, or try to control, the RF interference that is radiating from sources within our airplane. As we all know, the major source of this interference is from the ignition system of our engine. We will discuss ways of minimizing this radiation. By doing so we will improve the singal-to-noise ratio of the received singnal and make listening to someone else's transmissions a whole lot easier. Generally speaking, attacking this problem improves our reception but does nothing for our transmission. When we come to it, I will point out one case where transmissions will benefit.

Antenna Installation

The installation of the "antenna system" is a very important part of the overall radio installation in your airplane. Your radio talks to the outside world throught its antenna, so lets see how we can give your radio a fighting chance.

The first thing we need to do is understand the relationship between frequency and wavelength. We are going to "tune" our antenna to work best at the radio frequency we have chosen to operate at. These principles are the same no matter what kind of radio we are using. They apply equally to VHF and CB radios; transmitters, receivers and transceivers. In this article we will only consider VHF since most of us it.

The frequency that our VHF transceivers operate at is in the range of 118 to 135 Mhz (million cycles per second). This is the frequency of the carrier signal onto which our voice signal is modulated. Even though our radio will operate over a range of frequencies, we will have to choose just one to tuned the antenna to. Most VHF antennas are tuned to 121 Mhz. This is approximately mid-way in the most-used range of channels. A channel is simply a discete frequency setting. VHF radios have channel increments of .5 Mhz or .05 Mhz, depending on vintage. We will tuned our antenna to 121.00 Mhz.

In order to do this we have to calculate the wavelength of the radio waves at this frequency. The wavelength of any wave is equal to the velocity of propogation of the wave divided by the frequency (w=v/f). The velocity of propogation is simply the speed of light. After all, light is electromagnetic radiation just like our radio waves are. This is approximately equal to 300,000,000 meters per second. Therefore, the wavelength at 121.00 Mhz is:

$$\frac{300{,}000{,}000 \text{ mps}}{121{,}000{,}000 \text{ cps}} = 2.5 \text{ meters}$$

Now that we know this, what do we do?

Well, to start with we need the antenna. We can either make our own or buy one. The antenna is nothing more than a conducting rod or wire of the correct length. The ideal antenna length is 1/2 of one wavelength. The antenna will pick up many millions of radio waves of different frequencies that strike it all the time. What we want it to do is pick up the frequency we are interested in better than any others. By making it exactly 1/2 wavelength the antenna will resonate at the frequency we want. By doing so, it will pick up the desired frequency much better than any other.

On an airplane, 1/2 of 2.5 meters (1.25 meters) is a bit long. By using a proper ground plane we can achieve almost the same results by making the antenna only 1/4 wavelength (I will explain how this works shortly). The difference in amplitude of the signal received is small and the antenna is much easier to handle, so normally we will make our antennas 1/4 wavelength in length. The important thing is to make the length as close to 1/4 wavelength as possible. In our case that is 0.625 meters (1.91 feet or 1'-10 & 15/16").

If you wish to make your own, select a suitably weather impervious conducting rod, stainless steel or brass, and cut it to 0.625 meters. From an electronics parts store you can pick up an insulated mount so that you can mount it to the airframe without an electrical connection to the surrounding surface. Drill and tap a small hole in the base of the rod and attach a solder lug with a machine screw. Our lead-in cable can then be soldered to this lug. Personally, I just bought an antenna for $35.00 from Aviall. They can be ordered from cataloque shops like Aircraft Spruce or Wag Aero for about the same price.

Before drilling a hole and mounting the antenna we need to consider location and a ground plane. The ground plane is a conductive reflecting surface, ideally metal, at the base of the antenna, but insulated from it. The electromagnetic signal which strikes the antenna gets converted to an electrical signal conducted by the antenna. The ground plane gives us a reference ground for this electrical signal. If you think back to your basic electricity in high school, you will remember that in order to measure a voltage difference you must measure between two points. Usually a "hot" contact and a ground. It's the same basic principle here. A metal ground plan will also reflect the electromagnetic radiation which hits it. This has the effect of doubling the length of the antenna to 1/2 wavelength. That's why we can get away with only a 1/4 wavelength antenna. To understand how this works, visualize a mirror lying horizontal and a stick extending vertically up from the mirror. When you look at it you can see the reflection of the stick in the mirror, as well as the stick itself, such that the stick actually looks twice as long as it really is. The light waves are acting in the same way that radios waves will act when we have our antenna positioned vertical to the ground plane.

On a conventional airplane the skin is usually aluminum which provides a natural ground plane. With ultralights or homebuilts the skin is usually fabric, maybe with some fiberglass or wood in spots. On some ultralight there is no skin (except the wings - we hope). So select a suitable hard-surface location. If you don't have one, you will have to make one between tubes. On my airplane I have a fiberglass turtle-deck running the full length of the fuselage, which is perfect. Once you select the location, make a ground plane out of lightweight aluminum or a fine mesh. Make the groundplane at least 1/4 wavelength in diameter. It doesn't have to be round as long as it is at least this large. Fasten it to the underside of the hard surface with glue and drill a hole through the hard surface and the groundplane large enough to accomodate the insulated base of the antenna, then mount the antenna through this hole (see Figure 1).

I've put the cart before the horse here since we haven't selected the ideal location yet. Here's how to do this, and hopefully you will find a hard surface right where the ideal location is! Firstly, we want the antenna to be as far away from the engine as possible. This is because we want to put some distance between our "ears" and the major source of RF interference in the airplane. If your engine is in front the best location will be on the back part of the fuselage. If your engine is a mid-ship pusher, you may be better off locating it at the front of the inter-wing gap or on the nose, if you have a cowling (see Figure 2). The antenna must be vertical for best reception and transmission. Note the radiation pattern in Figure 1. If the antenna were horizontal you can see that reception from forward and aft of the airpane would not be good. In the vertical orientation we will not have good reception from directly below, but this is not important since, if our target station were directly below us, it would only be a few hundred feet away!

Commercially available antennas are generally bent backwards at about 30 degrees to the vertical. This reduces drag and also prevents the antenna from bending under the air blast. If you are making your own, bend the rod about 3 inches above the mount. Do not bend it more than about 30 degrees. (This also makes your airplane look pretty hot!)

The next consideration is the vertical stabalizer, if we are locating the antenna on the aft fuselage. The antenna should be at least 1/4 wavelength in front of the vertical stab (.0625 meters). This will reduce the width of the "shadow" cast by the stabilizer from the rear and also will reduce reflections from the vertical stab. Remember what happens when your TV antenna picks up reflections? That's right, you get ghosting. The same thing can happen with audio signals which results in a blurred reception. Now that you have finally selected the ideal location, go ahead and drill that hole.

But we're not finished yet. Now we need to get the signal from the antenna to the radio. We do this with a length of Coaxial cable. Not just any Coax cable! It must have the correct characteristic impedance to match the radio input impedance. I won't go into explaining impedance, it will suffice to say that most radios have an input impedance of 50 ohms (consult your manual to verify this). The correct Coax to use is called RG58 which has a characteristic impedance of 50 ohms. If you were to use the wrong one, for example 75 ohm Coax which is used for TV's, you would have an impedance mismatch between your lead-in cable and your radio. This would result in attenuation (reduction) and distortion of the signal. So use the right one. Next, cut it to the correct length. The lead-in cable must be in increments of 1/2 wavelength (1.25 meters). If 1.25 meters is too short to reach from your antenna to your radio, then make the cable 2.5 meters long. This should be long enough, but if not make it 3.75 meters, etc. Got the picture?

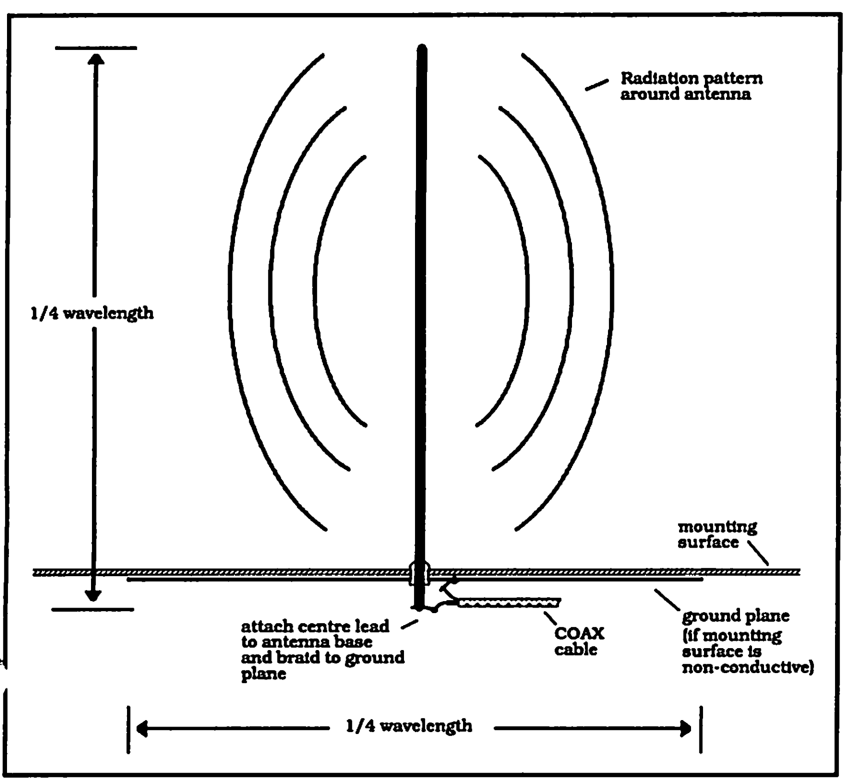


Figure 1. Antenna mounting detail.

Finally, you have to terminate the lead-in cable. Most radios use a BNC type connector for the antenna input. This can be obtained from the same place you got your RG58 wire. Terminate the radio-end with this connector. At the antenna end, solder the inner conductor of the Coax to the solder lug at the base of the antenna. Attach the braid of the Coax to the groundplane. This is most easily done by soldering the braid to another lug and attaching the lug to the groundplane with a small bolt and nut. If you bought a more expensive antenna than the $35.00 one I did, it may come with a BNC connector at the base. If so, you simply have to terminate the antenna-end with a BNC connector as well. A good termination is important, so don't do a sloppy soldering job or a sloppy crimping job on the BNC. A bad connection will result in reflections and attenuation.

If you follow all these rules you will have an ideal antenna installation, under the circumstances. Locating an antenna several hundred, or thousand, feet above the earth is far less than ideal. But, if we are going to fly our airplanes, we have to make the best of it. Remember what I said, each of these steps will result in a little better reception or transmission of the signal. It may be hard to tell the effect of any one step, but the accumulated effect of all these steps will make a significant difference to the distance over which you can communicate.

RF Shielding

Once you have tuned you antenna, your radio is transmitting its signal and receiving the desired incoming signal as well as it can. There is one more serious problem that we have to attend to, however, if we are going to get the most out of our radio installation.

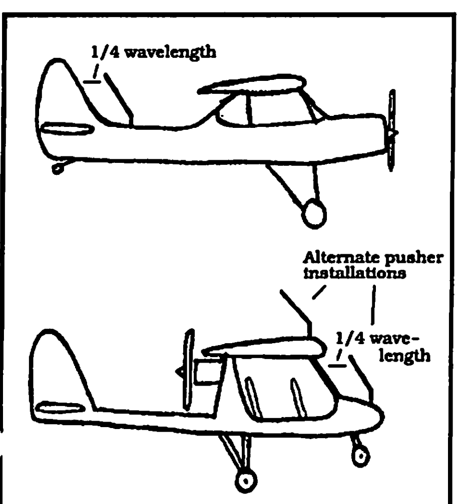


Figure 2. Suggested antenna locations

This problem is RF (radio frequency) interference from the ignition system in our airplane. First I will explain why an engine generates RF radiation, then I will discuss how to suppress it.

In a typical two cycle ignition system there is a magnet embedded in the flywheel and a coil of wire mounted next to the flywheel for each ignition circuit (spark plug). As the flywheel turns and the magnet approaches "it's" coil, an electric current is gradually built up in the primary circuit (see Figure 4). The primary circuit includes the points and the primary side of the ignition coil or transformer. As this current gradually builds so does a magnetic field in the ignition coil. As this magnetic field builds a voltage is also built up on the secondary side of the coil (the spark plug side). The voltage reached is proportional to the rate of change of the magnetic field. At exactly the right moment, as determined by ignition timing, the points open and the current suddenly stops flowing in the primary circuit. Without a current to sustain it, the magnetic field in the ignition coil suddenly collapses. This sudden collapse induces a very high voltage in the secondary side of the coil and causes a spark to jump across the gap in the spark plug. This in turn results in a very sudden and high current flow in the secondary circuit.

It is this very sudden and brief current flow through the secondary circuit that generates the RF radiation. The spark plug wire, coil and spark plug itself are acting as an antenna to radiate this energy. Because the secondary side is the high voltage side of the circuit, it radiates most of the energy. However, the sudden collapse of the current in the primary circuit will also cause some radiation from all of the elements in this circuit. This will include the wires between the ignition coil and the flywheel coil as well as the "kill switch" wires.

The radiation from the secondary circuit is of very high energy for a very short duration. It is omni-directional and chromatic in nature, so we know it is going to hit our antenna, and we can be sure that some of the radiation will be on the frequency our radio is tuned to. The result is a very short blip in our earphones. A 2 cylinder, 2 cycle engine turning at 5500 RPM is going to generate 183 of these "blips" per second. Add these up and instead of hearing a "blip" we hear a continuous "buzz".

Because this radiation is chromatic (covering all frequencies), it will actually dissipate rapidly and therefore will not travel very far. At a hundred meters or so away from the engine we would hardly notice it. This means that it will only interfere with the incoming, received signal and will not affect the transmitted signal. The station we are transmitting to will not "hear" our engine interference at all. So you don't have to be embarassed thinking that the receiving station can detect your poor shielding job, only you can hear it.

Now that we know were it is coming from, how do we get rid of it? As with antenna tuning, we will start at the point of greatest benefit and continuing making smaller and smaller improvements until we are satisfied with the results. The majority of RF radiation comes directly from the secondary circuit which includes the spark plug, spark plug wire and ignition coil. The single biggest improvement comes from installing resistor spark plug caps. These have a resistor built right into the cap. On Rotax engines the resistor should be about 5000 ohms. My Rotax 532 came with them already installed. The brand is NGK and the part number is LB05EZ. If you are not sure if you have them or not, take an ohm meter and measure the resistance through the cap. It should be 5000 ohms + or - 10%. These caps can be obtained from a Rotax dealer or most motorcycle. If you have a different engine, check the manual or the manufacturer for the recommended resistor size.

I do not recommend inserting resistors into the spark plug wire itself (automotive shops have these) because this adds another point of possible bad connections and failure to the circuit. We don't need any more potential for ignition failure than we already have!

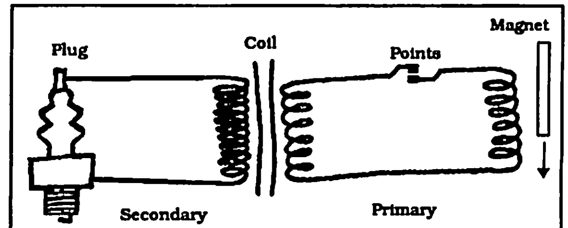


Figure 3. Engine ignition circuit.

The resistance will reduce the current flow and increase the duration which results in lower radiated energy. If you do not exceed the recommended resistor size it will not affect the potency of the spark. This should reduce the noise in your earphones by about 50%. A boone to communications and longer lasting eardrums. This, however, will probably not be satisfactory. The next step is to start shielding. A shield is a metal conductor placed between the radiating antenna, in this case the ignition circuit, and the receiving antenna. This shield will absorb the unwanted radiation and, if it is grounded properly, it will drain the energy away to ground.

To start with, the metal structure of the airplane will provide some shielding, particularly if you have a metal firewall between the engine and your antenna. To make sure this is effective we must have a good ground connection between the engine and the airframe. You might think you already have one but don't forget that the engine is probably mounted on rubber lord mounts. So install a 16 or 18 AWG ground wire between a point on the engine and a bolt on the airframe. I use one of the bolts mounting a coil to the engine and a non-structural bolt on the airframe. Terminate the wire with proper spade or ring terminals to insure a trouble free connection. Do not use a structural bolt because even very minute currents in this conductor can produce galvanic corrosive action under humid or wet conditions.

Next we will provide a direct shield around the secondary ignition circuit, where most of the radiation is coming from. The spark plug wire can be shielded with a tinned copper braid shield, available from most electronic supply shops. It is best if this has an inner PVC tube to provide an extra layer of insulation between the shield and the spark plug wire. If not, be sure your wire and plug cap do not have any nicks or cracks. This would result in electrical leakage from the conductor to the shield and eventual ignition failure. I install the braid shield completely over the wire and cap from the coil to the base of the spark plug (see Figure 4). Around the spark plug I expand the shield to fit the base of the plug and then cover about 2 inches of the braid with a layer of solder. This results in a firm cylindrical shape around the plug that is exactly the right size to make a snug fit at the plug base. The plug base provides an electrical ground contact for the shield at one end but at the other end we must attach a ground wire between the shield and a bolt on the engine. Again I use a 16 AWG wire soldered to the shield and going to a ring terminal, which is anchored to a coil mounting bolt. It is very important that the shield cover the entire circuit and that both ends are grounded. If you prefer, you can buy aluminum sleeves to fit over the spark plugs which will then make contact with the braid wire shield at the top of the cap. If you use these, be sure you have a good electrical contact between the sleeve and the braid, with not gaps.

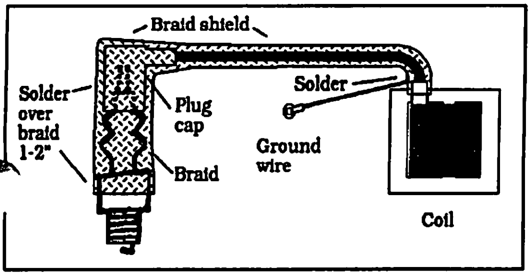


Figure 4. Shielding spark plug & wire.

You should now have taken care of 60 or 70% of the problem. To test the results so far, sit in your airplane and tune the radio to the local tower frequency. Listen for chatter from air traffic, not the tower. Because you're not in the air you won't receive the tower well at all. Set the volume and squelch for normal listening and then start your engine. If the engine interference is strong enough to break the squelch, you still have a major problem, but it shouldn't be. Wait for more chatter from air traffic and pay attention to the background engine noise while you are receiving a transmission. Now rev your engine up and listen again. Decide whether the noise level is acceptable or not. If it is not then try more shielding, as follows.

The next most beneficial step is to shield the ignition coils. The secondary side of the coil contains a lot of wire which is part of the spark plug circuit. The best material to use here is a thin copper sheet. This may be hard to obtain, so aluminum will do. You will have to design this yourself since the location and orientation of the coil(s) varies from engine to engine. The idea is to make a box around the coil that will stop RF radiation from propogating away from the coil. It is not necessary to carry this around between the coil and the engine since the engine will stop any radiation in that direction. Bend the copper or aluminum into shape leaving two or more tabs that you can drill holes in to mount the box, using the coil mounting bolts. This will also provide the necessary electrical grounding contact to the engine. Cut out a slot or hole through which the spark plug wire and primary circuit wires can pass. Be sure to smooth all edges that might wear through the wires. After doing this you may want to do another test to decide whether or not to carry on.

The next step in shielding is to attack the primary circuit elements. This consists of shielding the wires between the coil(s) and the entrance to the bell housing. Also included in this is shielding the kill switch wires which run to the cockpit. The wires to the bell housing can be shielded using the braid again. Remember to solder a ground wire to both ends of the shield and attach them to a convenient bolt on the engine. Rather then run a shield over the kill switch wires, it is easier to replace them with a two-conductor shielded cable. The cable will have a drain wire running through it, in contact with the shield, which is used to ground the shield at both ends of the cable. One end on the engine and the other on the airframe.

You have now done all you can to come between the RF radiation from your ignition system and your antenna. You should now find the level of interference quite acceptable. There are, however, two more things to keep in mind when hooking up the radio. There are two cables connected to your radio that we have thus far ignored. These are the push-to-talk switch cable and the headset cable. Both must be made with shielded wire with the shield properly grounded through the connector into the radio. If not, they will pick up what little radiation is left floating around and "pipe" it directly into the radio. This can not only cause reception interference, but it can also interfere with your transmissions. If you buy a PTO switch it should come with shielded wire, but if you make your own, watch out for this.

I started this article with the statement that installing your radio is an art rather than a science. All I can suggest is to try these steps in order of importance, which is the order in which they are presented. Stop when you are satisfied with the results.

Feel free to give me a call if you have any questions or if you need a place to get then materials mentioned.

Good communication is the key to success!

Abbotsford Adventure Update

by Stu Simpson

Well, things are progressing nicely as we plan our flight to the coast this summer. McArthur and I have had several meetings and done a fair bit of planning. But it's time to get more people involved in the planning process. We've been meeting every Tuesday or second Tuesday were possible and as necessary. Anyone is welcome!

Also, we are going to need a better meeting place than my dining room table. Any ideas out there?

The most important item to pass on is that we need a firm list of participants by March 4th. We have a CUFC meeting that night so we can finalize the list then. We don't mean to ask for a commitment cast in stone, but we do need to get an idea of the numbers involved. If you do commit and later have to drop out, we'll understand. But our list on March 4th will only include those who have a solid commitment to make the hop.

We have set the dates for our mountain familiarization flights. The first trip will be to Banff on the weekend of May 9/10 with the remaining weekends in May as rain dates.

The trip to Radium does June 12/13/14 with rain dates, again, the remaining weekends in June. These dates are open to change.

We've also started writing and assembling an information package for ground crew and pilots. The package will include info on mountain flying, historical weather data for the points en route, airshow info, accomodations, route and schedule info and a procedures manual.

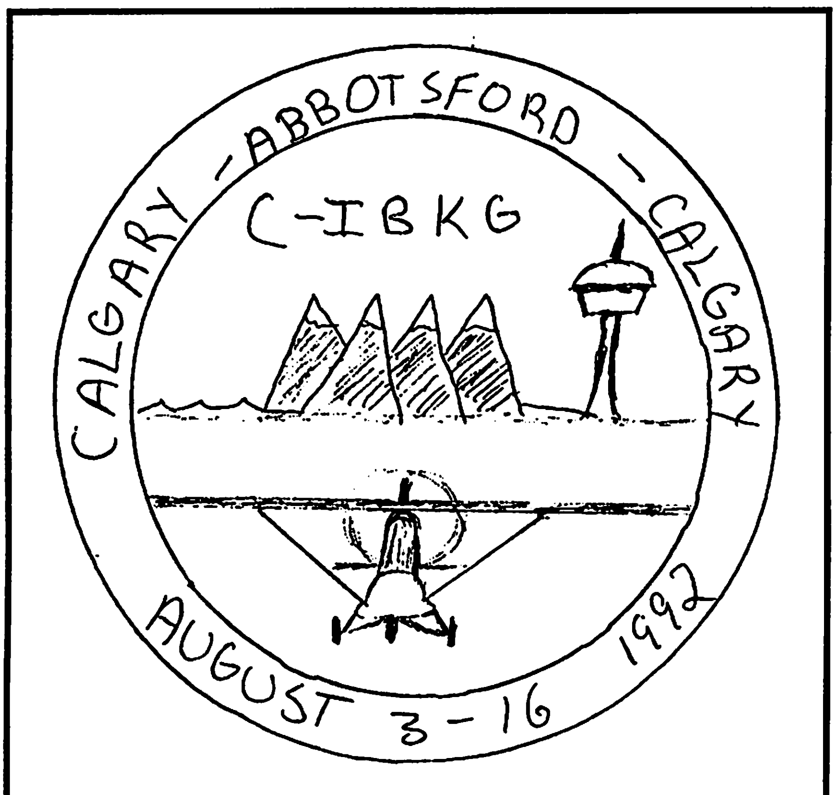
The procedures manual, which is now about half written, will have info on procedures for ground crew, take off, en route, landing, communications and emergencies.

The info package will also include photocopies from the flight supplement of each en route airport and each spot's pertinent information.

We haven't heard from the Abbotsford Airshow people yet, but we'll keep you informed.

Finally, we have come up with a design for a patch for ground crew and pilots. We've included the rough sketch here. Wadda ya think??

If anyone has any questions or suggestions about the trip, please cal me at 249-0235 or 249-7701, or Todd McArthur at 229-1367. We look forward to hearing from you.



Classified

Lazair - three engine, complete with trailer $3200. Will also sell separately.

Chinook - 2 place (1987), Rotax 503 with electric starter, $7200.

Call Don Rogers for details on these two airplanes - 242-6549.

Shielding - ignition shielding material, COAX cable and connectors are available from Bob Kirkby - 569-9541 or 291-5560.

***Thanks** to Patrick Rudiger for sending a $15.00 donation along with his $15.00 membership fee for 1992. This kind of extra support from our membership is greatly appreciated.*

Patrick lives in Leduc and flies a Chinook.

- Editor

The Magazine Library is taken care of by Bernie Kespe. If you would like to look at any UL Magazines contact Bernie at a meeting or at 255-7419.We have 10 years worth!