publication agreement number 40050880

Issue 3, 2018

Recreational RFlyer

Recreational Aircraft Association Canada www.raa.ca
The Voice of Canadian Amateur Aircraft Builders $6.95

RAA
RECREATIONAL AIRCRAFT ASSOCIATION
RÉSEAU AÉRONEFS AMATEUR CANADA

From The President's Desk

Gary Wolf RAA 7379

George Gregory

This issue has been produced by George Gregory of Chapter 85 in Delta BC. George has been creating the Rec Flyer artwork and layout since the early 2000's. For the next few issues I must step back from editing duties because of an increased time requirement to work with Transport Canada. You may continue to send articles to either George (gregdesign@telus.net)or myself. Contributors to this issue are :

Mike Davenport
Janet Trudeau
Joe Sircelj
Bill Husa
Mac Mazurek
Barry Meeks
George Gregory

RAA and COPA Cooperation with Transport Canada

In the late 90's COPA removed all of the smaller associations from its board but now that Bernard Gervais is president and JC Audet is Ops Manager, COPA has returned to being a true umbrella organization for Canadian aviation. Each Saturday JC and I have a meeting to discuss the past week's concerns, and this has been very productive.

Lately Transport Canada has been concerned with the safety stats for Basic and Advanced UL aircraft but because most of their staff are not familiar with these categories RAA has been supplying background information, and together with COPA we have been making recommendations.

Two stroke engines continue to have a significant failure rate, possibly from alcohol fuels or from lack of maintenance. Since the UL category is not required to have a logbook there can be a disconnect between maintenance performed and the memory of when it was done. Simply maintaining a record of time and maintenance would be beneficial to current and subsequent owners of an aircraft.

Powered Parachutes continue to invade controlled airspace and to have accidents. Some pilots of Powered parachutes appear to consider registration and training to be optional, unfairly skewing the accident and occurrence stats for fixed wing UL aircraft. Separating these aircraft into their own category would provide more accurate information when assessing safety.

RAA Canada dealt with these and other issues in the mid-2000's when we participated for 18 months in the Working Group that was set up at that time. Unfortunately the final report was shelved and forgotten so it is time to begin another round of working with Ottawa to ensure that the regulations remain beneficial to the builders and pilots of non certified aircraft.

TRANSPORT SAFETY BOARD

Most non certified aircraft accidents are investigated at Level 5 which deals with observations such as time of day, weather, location, type of aircraft, but no conclusions are drawn from these investigations. Occasionally the TSB does a full-on Level 3 investigation that can involve a comprehensive analysis of for example a structural failure, with conclusions drawn and recommendations made. The cost of such an investigation means that TSB must choose when to devote resources to reap the maximum benefit for the aviation community.

Recently TSB has for some occurrences taken a new course, a Level 4 investigation. A Level 4 investigation goes into more detail of the failure mode but stops short of drawing conclusions. Because these investigations are less expensive it is reasonable

continued on page 33

The Recreational Aircraft Association Canada

22-4881 Fountain St. North
Breslau RR2 Ontario N0B 1M0
Telephone: 519-648-3030
Member's Toll Free line:
1-800-387-1028

Emails can be sent to President Gary Wolf at: garywolf@rogers.com and George Gregory at gregdesign@telus.net.

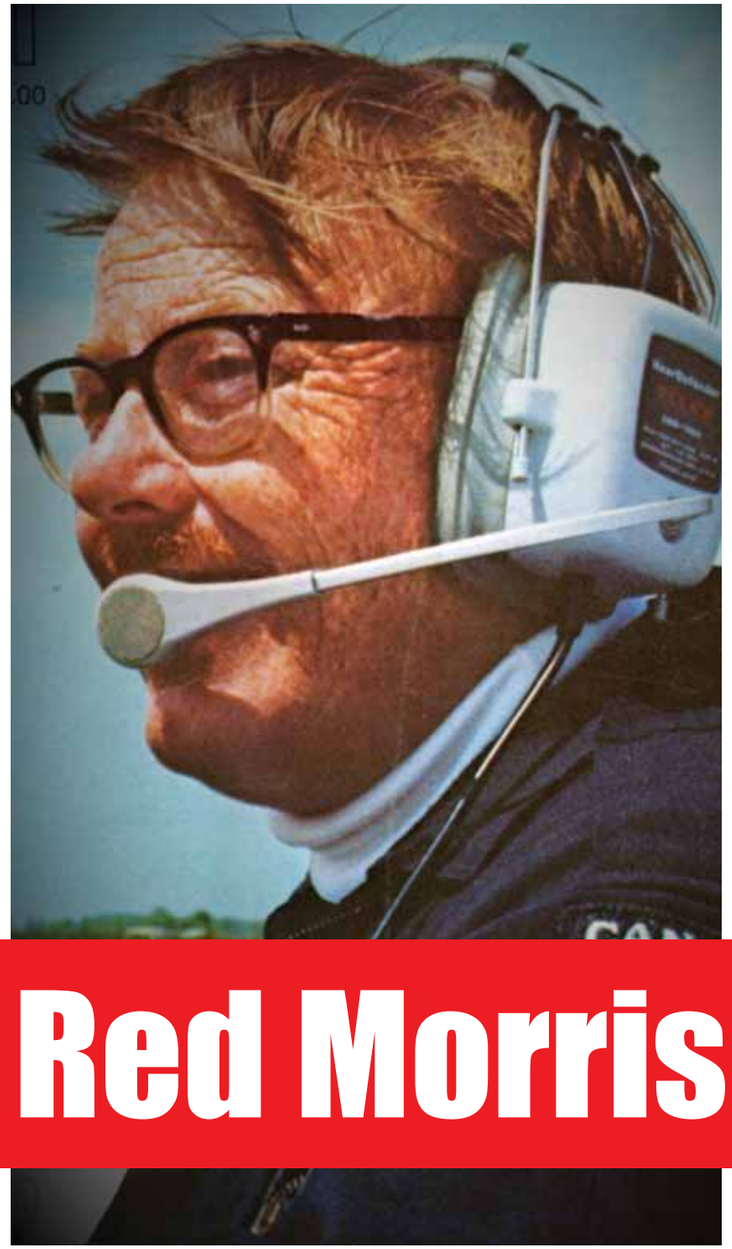
The Recreational Flyer is published bi-monthly by the Recreational Aircraft Association Publishing Company, Waterloo Airport, Breslau, ON N0B 1M0. The Recreational Flyer is devoted to the aerospace sciences. The intention of the magazine is to promote education and safety through its members to the general public. Opinions expressed in articles and letters do not necessarily reflect those of the Recreational Aircraft Association Canada. Accuracy of the material presented is solely the responsibility of the author or contributor.

features

columns

George Gregory

Above: A P-40 and P-47 taxi past the showline at Arlington, 2018.
On the cover: Kiting paragliders at Harrison Mills, BC.George Gregory photo.



Red Morris AND HIS AMAZING CROSS-CANADA FLIGHT

by Mike Davenport

I RECENTLY GAVE IN to the pressure to review the contents of some boxes in the basement. What she actually said was – get rid of that junk down there. For the record, I don't have junk, I have neat stuff; she's the one with junk.

In one of those boxes I came across a file with a copy of Canadian Homebuilt Aircraft, a 1978 magazine that had a feature story on Red Morris. Included in the file were letters from EAA Canada, the RCFCA and my notes from his record establishing flight on July 1, 1978.

Robin (Red) Morris was born in England in 1930 and migrated to Canada with his family at the age of three. He joined the RCAF at age 19 and did his training on Harvards at RCAF Station Centralia, Ontario that spring and then moved on to Cha-

On Canada Day 1978, Red undertook a challenge that few but he clearly understood.

tham, New Brunswick flying Vampires and Sabres.

He was later posted to England and while based at North Luffenham, continued to fly the Sabre. He was selected in 1953 to fly in the mass flypast of 640 aircraft to celebrate the coronation of Queen Elizabeth.

As the story goes, all went well during practices until shortly before the event when a new CO who had not been involved in the lead up practices decided to fly lead. During a turn with this very large formation of 60 planes the CO cut it too short with the result that F/O Morris, flying on the inside of that turn and attempting to stay in position, stalled his Sabre and spun down through another formation, at one point found himself canopy to canopy with another Sabre and narrowly missing several other aircraft. Military protocol required an investigation and Red ultimately received a rebuke for loss of control and failing to hold his position in the formation. On the actual day however, all went well.

Another moment of excitement occurred when Red got into a fur ball with a couple of British Vampires when one of them clipped the other and broke up resulting in a nylon descent for the pilot and no harm other than to the airplane.

He carried on with his career with no other significant dramas and subsequently retired after 25 years of service with over 6000 hours in 50 different aircraft. He was active in COPA and EAA and served as a director of Aerobatics Canada. He owned a variety of aircraft ranging from a J3 Cub to a Fieseler Storch. Somehow though, all of this was not quite enough. There were still some things he needed to do.

On Canada Day 1978, Red undertook a challenge that few but he clearly understood.

I met Red in 1978 for the first time when he arrived in Vancouver for the attempt to fly 3,000 miles nonstop across Canada; something that had never been done. Period. Not even by the airlines or the military. Red was planning to do this in a homebuilt aircraft; a Zenith CH300. This early kit built aircraft was the largest of Chris

continued on page 34

Feature

FEAR FACTOR

Janet Trudeau

Fear can be such a crippling emotion. It can prevent people from taking chances, following dreams.

My two daughters and I accompanied some of our Girl Guide friends to the recent Women in Aviation Day. Congratulations on another top notch event at Lyncrest!

I would like to take a moment to share with you a success story. In 2012, my oldest daughter, then 9, joined friends from her Guide unit at a Women in Flight event, where we were trying to set a record for the number of women in the air in one day. That day fundamentally changed my child!

It was a lovely day. The weather was great and so was the mood around the airport. We had fun seeing all the planes coming and going, learning about all the different parts, meeting pilots and touring hangars.

We met a gentleman that my daughter still remembers fondly. Mr. Bert graciously welcomed our girls into his hangar – his personal sanctuary. He took such care sharing his time, his treasures and stories with us! He was so genuine in the attention he paid us, that he will remain a special part of that day forever.

When the time came to actually get into a plane, my daughter froze. Even though she wanted to, she couldn't allow herself to get beyond the fear.

Fear can be such a crippling emotion. It can prevent people from taking chances, following dreams. My daughter had never been in a plane before and wanted to know what it was like but nothing we could say or do would make her get in a plane that day.

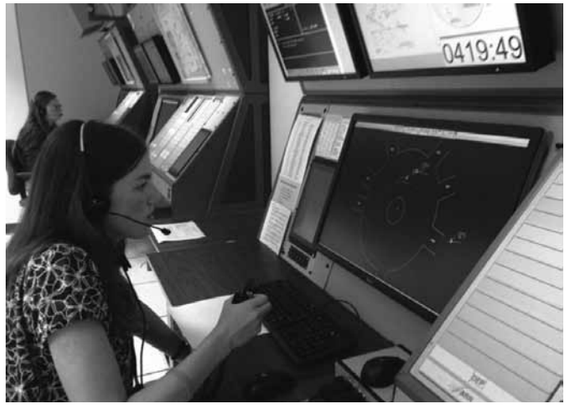
Fear won.

As a mother, it broke my heart a little to see my child losing out on such an incredible opportunity, something she wanted to experience for herself but couldn't because of fear. But incredibly, the very next weekend Lyncrest hosted a COPA for Kids day, and a friend offered to come with her once again. Throughout the week, we tried to identify what exactly was scaring her and we talked about what she could expect. It became so much bigger than a plane ride. Our faith tells us that "God does not give us a spirit of fear, but of strength, courage and sound mind."

Nervously she agreed to come and we met a pilot by the name of Buddy. Buddy was great! Not only did he take her up for a wonderful ride, he let her fly the plane - something she still talks about years later!!! The only plane she has even been in, and she got to fly it!! The attached picture of Buddy and my daughter in his plane is still on her wall - as a reminder that fear doesn't need to hold us back.

I am grateful to all those pilots who gave their time, talent and resources so we could look fear in the eye and conquer it. These events offer children such an incredible opportunity – something I am unable to offer my child. Seeds were planted in my daughter that day. About two years after that flight, she started saying she wants to be an air traffic controller when she grows up. She is the only thirteen year girl I have known, that can recite the phonetic alphabet!

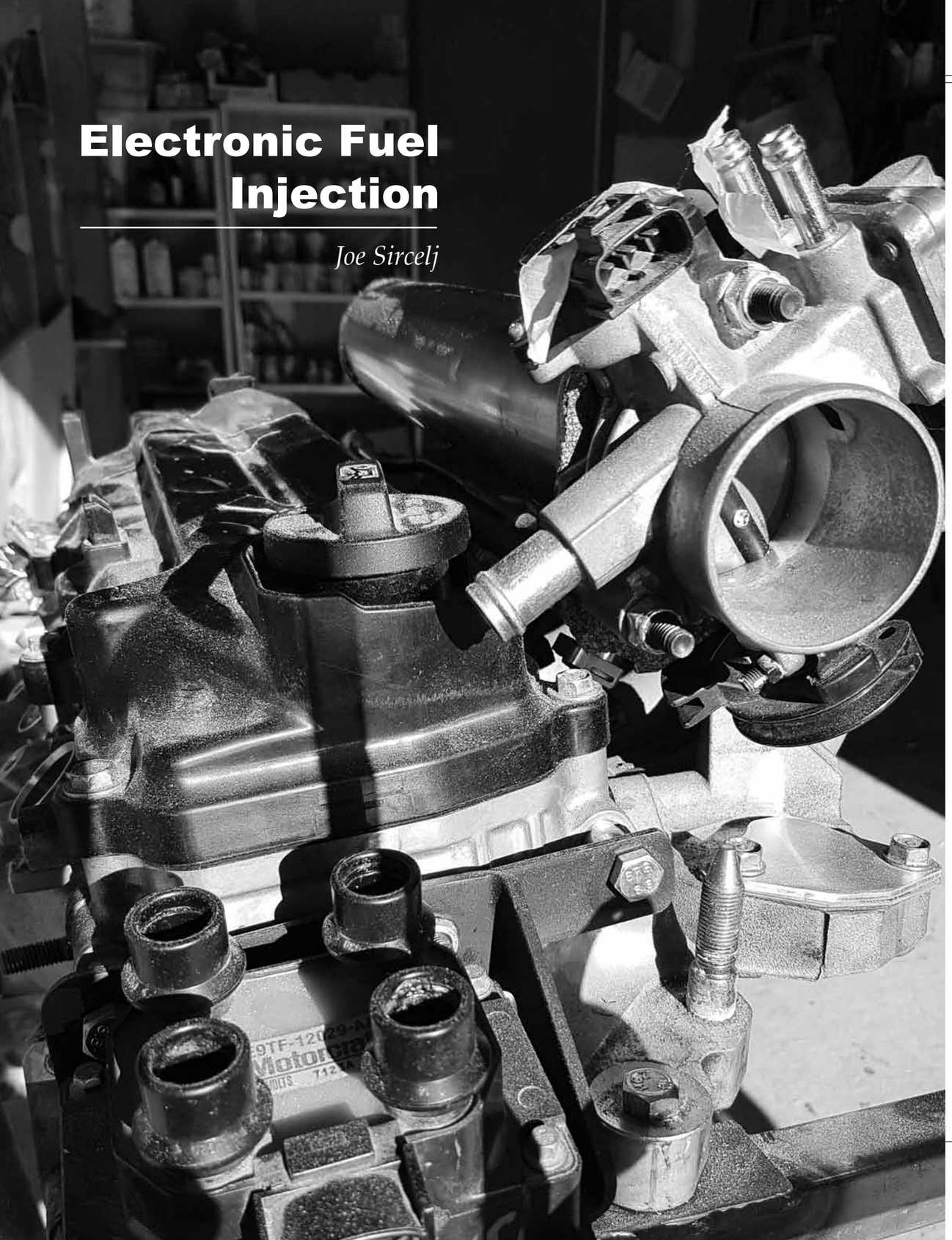
Please know that there are people who are grateful for all of your dedication and passion!



Janet's oldest daughter at the Nav Canada camp: in the cockpit and seeing how the good folks at ATC do their job. Opposite: Buddy with his young co-pilot, in the process of defeating fear.

Electronic Fuel Injection

Joe Sircelj



Fuel pump on, mixture full rich, prime, a quick plea to the Deity of your choosing, " CLEAR PROP" then start cranking while listening for the sputtering, the first signs of life. If successful, you then monitor pressures, temps, do a run-up check mixture, mags, carb heat, alternate air….you're off, you're flying, you're….wait a minute, fuel pump off, pull the power back a bit, check EGT…lean out the mixture…. enough already, you get the picture.

Back on the ground, the lack of emergency lights flashing or recovery vehicles means you've had a good flight, you carefully put away your pride and joy, or, as in my case, callously toss the keys back to the rental counter, paperwork and we're done, pretty standard stuff. It's what happens next that is truly amazing.

As You get in your car, wondering things like " did I remember to shut the fuel valve off" or " what was I supposed to stop and get for dinner", put the key in the ignition (yes, they have proximity keys now,,,) and in less than the blink of an eye your car's computer has done everything mentioned in the first paragraph, with the exception of the Deity thing, and off you go, never giving a second thought to engine management. No need to, its all done for you, and done very well, constantly optimizing for best performance and efficiency. Pretty amazing stuff.

So why can't we have it for our airplane engines? Well…we can, and do.

Many of us of the auto conversion can have and are indeed using EFI for our engine management needs, though it needs to be mentioned that you cannot simply go to the wreckers and get a whole system from a car and transplant it. There are strategies in the car computers (ECM) that are designed to save the manufacturers millions of dollars, should something go wrong whilst under warranty. Some of you may have experienced the dreaded CHECK ENGINE LAMP and associated power loss (limp home mode). This would not be prudent, as has unfortunately been realized, for example, on take-off. What is needed is a very simplified version of that which provides us with reliable operation every day without concern or mention.

Similar to the early automotive systems of the late 70's, early 80's (hardly a new technology), *speed density* refers to the ECM's strategy of knowing what

the speed of the engine is (RPM) and the intake manifold pressure and temperature. By calculating how much air is going through the engine (displacement) the ECM provides the precise amount of fuel for each cylinder. To this you can add a back-up ECM for redundancy, closed loop operation for those running on MoGas, for even better efficiency, Electronic ignition, real time engine information on your smart phone…wow. It's like Christmas day all over again.

Now don't' go turning the page just yet, you traditional aircraft engine folks, there's hope for you too. There are more and more retrofit systems available, easier to install than overhauling your Marvel Schleber Carburetor. The very same principles apply; the computer doesn't know or particularly care what engine it's managing—air cooled, liquid cooled, 2, 3, 4, 6 cylinders, inline, opposed. In fact, there is an advantage for the conventional aircraft engines. What is becoming more and more common is to have one bank of plugs running on the traditional MAG, the other bank running Electronic ignition—the best of both worlds.

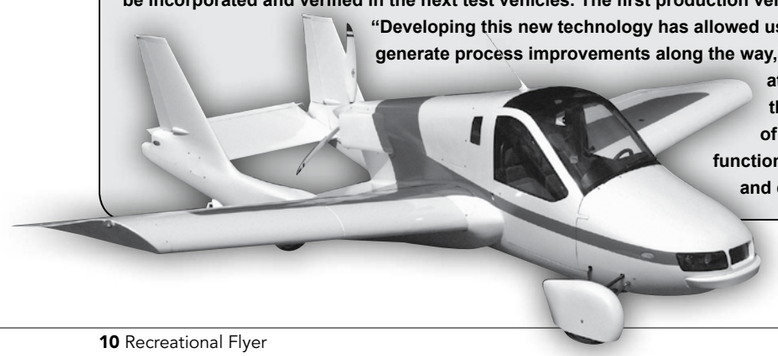
OK, confession time. It's not all pink elephants and polka dots. There are certain requirements critical for EFI operation. Unlike mags and carburetors that do not need battery power, EFI is wholly battery dependant. Also required are electric fuel pump(s). Depending on the system, you may be required to provide 20 to 30 amp. of additional current. Can your charging system provide it reliably? Should it fail, do you need a back-up battery capable of running the systems long enough to get safely on the ground? One would think so. There is also the issue of higher fuel pressure required, nominally around 40 PSI: your lines and fittings should be appropriately rated. High pressure fuel leaks are bad.

And I would like to at this time dispel a common myth. You DO NOT require a fuel return line in a properly configured system! Costs you ask? There are STC'd systems costing millions of dollars for you certified folks (maybe not millions...) There's an awesome company in Calgary, Simple Digital Systems, who have lots of info and options. I believe they have a retrofit system for the ubiquitous O-200, as well as many components for the do it yourselfers. Depending on your creativity level and economics (flying's not supposed to be cheap!) a system can be had for all budgets…. Lots to think about.

Joe Sircelj *is a member of Chapter 85 (Vancouver) and is working on a Zenith 701 to be powered by a converted motorcycle engine.*

TERRAFUGIA TRANSITION SLATED FOR 2019 PRODUCTION WITH NEW FEATURES

July 17, 2018 Terrafugia, Inc. announced new features in the Transition production vehicle, a two-seat auto and aircraft, including updates to the interior, safety systems, motor, and flight instrumentation. The latest features and systems will be incorporated and verified in the next test vehicles. The first production vehicles will come to market in 2019.



"Developing this new technology has allowed us to test several different mechanisms and generate process improvements along the way," said Terrafugia CEO Chris Jaran. "We are at the critical point where we can implement the best design features based on years of flight and drive testing. This will improve function, safety and aesthetics for the optimal flying and driving experience."

REDUCTION DRIVES: AN ENGINEERING PERSPECTIVE

By Bill Husa

With the nearly ridiculous prices most of us are forced to pay for aircraft engines, fuel and engine components, it is only natural for the consumer to be looking for alternatives. About two years ago our company conducted a market survey of this industry to see what the current demands are and what future trends might evolve. Although we were primarily looking at aircraft configurations, the survey did touch upon powerplant options.

The results were interesting in that they pointed out a number of unexpected values the aviation buyer seems to hold dear. Although there was a significant interest in the development of alternative powerplants for aircraft, the average aircraft buyer or builder still preferred the conservative Lycoming or Continental, even if he had to pay through the nose to get it. This was especially interesting since most of those questioned seemed to consider both engines outdated, inefficient, overpriced, and mechanically poor in design.

The key to the popularity of those engines today seems to be that of perception, the feeling being that since the designs have been flying for more than four decades with relatively good performance and safety, that's what most want to stick with. Over the years a number of developers have come out with promising new engines or engine configurations only to fail within a very short time, wondering why the aviation world hasn't beat a path to their door. The answer of course is simple; the aviation engine is not a mousetrap.

Too much rides on the selection of an engine, namely your life. Again the idea of perception comes in. A new engine or reduction drive is often viewed as an item of interest or in some cases as an interesting oddity, but hardly what one would want to install into his or her airplane, not until it's proven anyway. Only when the items have been installed into an airplane, have demonstrated safe and dependable operation and have been exposed to the market in a professional and responsible way, only then will the aviation buyer consider the new product a viable option. But unfortunately even all that is not a guarantee.

The supplier or designer must also be able to demonstrate technical and engineering know-how or the credibility of the design is nothing more than meaningless arm waving; this is where I find quite a large number of the reduction drives offered today fall short. They are designed and/or fabricated by individuals who may be mechanical craftsmen, or may have a bit of technical background and an impressive array of machining tools, producing gear-trains that look to be works of art, but on closer examination I've often found the advertised performance values questionable.

So what designs the components of a gearbox? I was amazed at the number of different and imaginative answers I received in doing our survey. Through our experience in the arena we've developed the following partial list of considerations that need to be addressed in designing a reduction drive suitable for aircraft applications:

1) Propeller size

2) Flight conditions

3) Torsional vibration characteristics

4) Power (Torque and RPM)

5) Environmental effects

6) Material endurance properties

7) Lubrication

8) Engine selection

Notice what's at the top. In designing a reduction drive one must consider all the possible forces that the structure may see in its life. Some of these are a function of power, but the most significant loads are flight related. Lets take a look at a brief calculation using a prop similar to that used on a Lycoming O-360: Propeller of 72" dia., weighing just about thirty pounds (fixed pitch) and turning 3,000 rpm (over-speed condition). What we're looking for is the gyroscopic moment generated by the spinning prop when the airframe is momentarily acted upon by a gust or control input resulting in a momentary pitching or yawing condition. For the sake of this calculation we will assume that the instantaneous rate of pitch or yaw will be 360 degrees per second (this may sound high but is easily achievable in moderate turbulence or

during aerobatics). The equation (in vector form) governing this condition is:

$$M = I0 (øi \times ßj)$$

where M is the resulting gyroscopic moment in ft-lbs; I0 is the propeller's mass moment of inertia; øi is the propeller rpm expressed in radians per second; and ßj is the rate of pitch or yaw, again in radians per second.

The propellers' mass moment of inertia, a function of weight and diameter, can be approximated by the following equation (for a two blade prop):

$$Io = .66667(m)(l)2$$

where "m" is the propeller's mass (weight divided by 32.17) and "l" is the length of the blade from the output shaft's center-line to the tip of the blade (propeller's radius). (This is extremely conservative - the designer should use numbers supplied by the propeller manufacturer.)

Substituting all the appropriate values we get an applied moment of over 11,000 ft-lbs to the end of that gearbox. If the output shaft supports are about six inches apart, this moment translates to a radial bearing load of over 22,000 pounds!!

Granted, this is momentary and a worst case condition, but in the life of an aircraft loads of similar magnitude will occur quite often due to turbulence or control input (the latter is especially true if flying aerobatic maneuvers). The condition is critical in selection of the bearings and design of the case, especially if the latter is fabricated from an aluminum casting (very low endurance limit - on the order of 4,000 psi for rough or grooved material).

The supplier or designer must also be able to demonstrate technical and engineering know-how

The second design consideration on our list, flight conditions, is nearly self explanatory in that the service environment, the flight quality, the type of flying, etc. will contribute to many of the factors used in the overall design. If all your flying is in nice calm conditions your design constraints will not be as critical as those for flying in areas of significant turbulence or rough operating conditions such as flying in the bush.

The third item, torsional vibration, is an interesting characteristic in that it is almost more important that any of the other considerations if not accounted for in the design of the coupling (joining the crankshaft to the reduction drive) or other mechanism, yet it is the one least addressed and least known about. A good example of this phenomenon is again a Lycoming O-360 idling at about 600 rpm or so, or just after you shut it down. The vibration (about a 9.0 on the Richter scale?) that occurs is a result of torsional feedback.

To explain without going into a lengthy engineering dissertation, the propeller is a form of spring, being acted upon by the ignition impulses of the engine (compression impulses at shut-down). As the impulse strikes, the propeller bends back (loads up like a compressed spring), then swings forward (unloads) past neutral position, momentarily accelerating the output shaft, then swings back past neutral, gets further loaded by the next impulse, swings forward again, etc. If the system is operating at an rpm where the next impulse comes in just as the prop swings backward past neutral again, additional energy is added to the system and the deflections grow. The timing of the oscillations at that instance is the natural frequency of the system.

As the reactions feed on themselves and the deflections grow, the magnitude of the torsional feedback (torque) also grows, sometimes much higher than even the worst case design condition for normal operation. Since the load application is quite sudden, the effect also acts similarly to an impact loading, again needing higher service factors for safe design.

How high can these loads go? As much as twenty five times the operational load, although theoretically, given enough time, the magnitude can be virtually infinite. The actual value depends on how much dampening there is within the system, and how long the condition is allowed to persist.

Looking at a practical case and assuming no dampening, the natural frequency for the O-360 occurs near idle, say for the sake of argument, around 600 rpm. At that speed the engine transfers about ten percent of its rated torque to the prop, or about 33 ft-lbs. If the system resonates the

continued on page 30

HELICAL DRIVE GEAR ISSUE

By Mac Mazurek

BACK IN 2015 I had an off airport landing in my scale Spitfire due to an engine malfunction during climb-out resulting in substantial damage. Originally I had put it down to carb ice as the atmospheric conditions were favourable to that particular problem. I only had 20 seconds from engine failure to touchdown. On subsequent teardown it has been determined that the real cause was the failure of the helical gear that turns the distributor and internal oil pump.

Turns out this problem is not uncommon with small block Ford and Chev engines operated at sustained higher RPMs. Wish I had known this sooner! Issue #1 is that there is very little actual gear tooth contact between the helical gears. As they must drive the distributor (at very little load) and the oil pump (at very heavy load with cold oil) insufficient lubrication is available from the engine oil system. The addition of an extra oil squirt hole helps but it is not enough. Issue #2 is the removal of much of the ZDDP from modern oils reducing the lubrication film strength in high contact pressure conditions such as these gears and flat tappet cams.

Issue #3 is that the roller cams are made of billet material (in my FORD

based V-8) as is the distributor gear. The distributor gear is slightly softer than the very hard camshaft gear and is intended to wear into the cam gear pattern. Lubricating two hard surfaces in contact is extremely difficult. There are no pores to hold oil and EP additives as with cast gearsets.

Picture 1 shows the actual distributor. It has 2 separate ignition modules operating 2 separate ignition coils for redundancy. Unfortunately there is a single failure point, namely the gear. Picture 2 shows the distributor gear worn out after only 25 hours run time. Picture 3 shows how the two gears mesh.

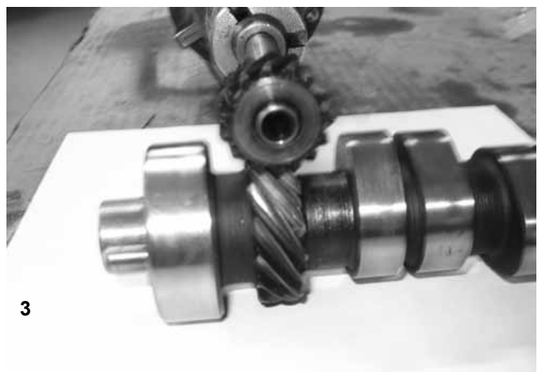
The wear on the distributor gear also damaged the camshaft gear and allowed the distributor timing to jump a tooth under load causing instant ignition mismatch and subsequent engine failure.

The engine now has an external oil pump driven at 72% engine RPM by a dedicated 6V serpentine belt. That has been a development exercise out of all proportion to the simple system that it should be and could entertain an article in its own right! Unfortunately the belt drive is now the potential failure point. However I have never had a serpentine belt failure in any vehicle so perhaps the risk is low. Anyway the system works OK at present and the aircraft is ready to fly again. The distributor gear now just turns the distributor at a very light load. I have added supplemental ZDDP to the oil as the original engines used a much higher percentage of it than current standard oils contain.

Picture #4 (previous page) shows the revised engine oil system undergoing testing in July, 2018.


1


2


3

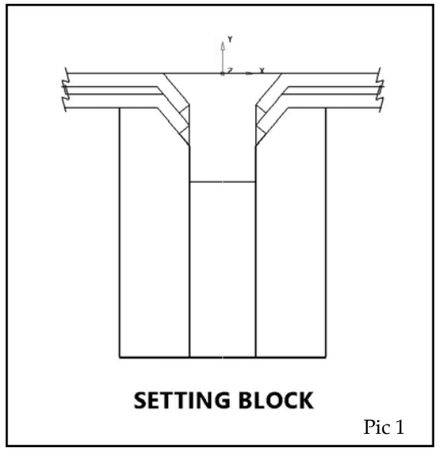
1: the Distributor features 2 separate iginition coils for redundancy; 2, the distrubor gear wore out after only 25 hours of running time. 3: how the gears mesh.

Rivet Hats

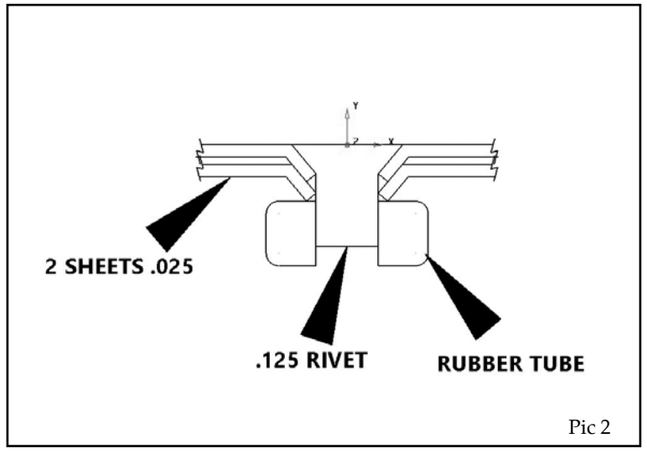
By Mac Mazurek

PULLED CHERRY CC stainless steel rivets of various lengths are used in my Sonerai and other aircraft to attach skins to ribs. When these sheets and ribs are dimpled the hole grows slightly in size reducing the grip provided by the rivet. When overloaded, in almost every case, the upset end will be pulled through the rivet hole stack-up at a much lower level than the rivet shear values suggest. With .025 skin and ribs my testing showed pull through when the sheets are in shear at under 200 lbs. for 1/8 diameter rivets. The edges of the sheets curl, elongate the hole, and the rivet shop heads pull through. The rivet shear strength is listed at some 600 lbs for the 1/8 rivet. The rivet body does not expand to fill the hole either thus relies on its own poor clamping to keep the sheets attached to each other.

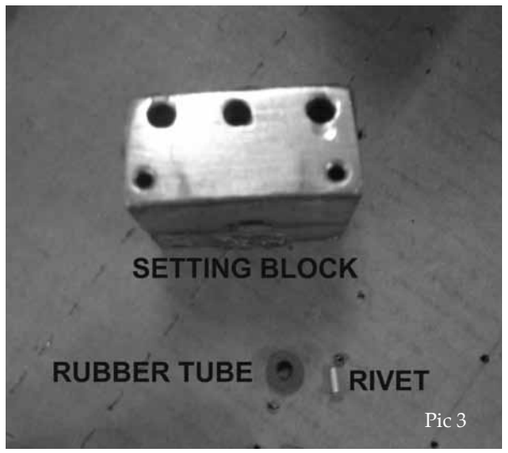
If both sheets are dimpled so that one nests in the other very high strength joints can be attained. The requirement is to ensure that the rivet tightly clamps the sheets together without pulling through. My experience has been that creating dimpled "hats" that cover the shop side of the riveted assembly spreads out the clamping force so that double the strength is available before the sheets slide on one another. Of course this holds true for dimpled joints using



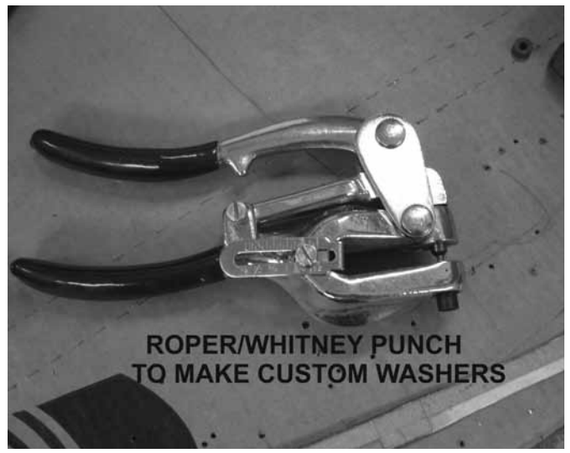
Pic 1



Pic 2



Pic 3



Most aluminium skin dimples are not perfect and rely on a fully upset shop head to clamp the sheets together tightly. This is usually cured using a setting block as in picture #1. Picture 2: In most cases using a simple piece of rubber tube the same inside diameter as the rivet and slightly longer than the rivet as shown in picture 2 does a better job as the sheets are compressed together Picture #3 shows a setting block with various holes and a rubber tube.

standard solid rivets as well. The dimple is what provides the additional shear resisting force.

I use stainless washers and dimple them to match the shop side of the dimpled assembly.

The "hats" look similar to countersink washers. The standard #4 (AN960C4) stainless washer works well for 1/8 rivets and is dimpled the same way as the skins. The finished internal diameter is just a few thousandths over the rivet diameter.

Using creativity these "hats" can be placed in very tight areas on the protruding unset rivet body. A small amount of mastic on a thin stick with a hole in it can place the "hat" through a 1/8 inch gap. I used this method to place CC rivets in my scale Spitfire wing where I could not use solid rivets. The resulting joint is certainly as strong as when using solid rivets and even stronger in some cases. The rivets set in this way do not "smoke" after extended usage as they do not lose their grip due to the large contact area against the sheets and the stainless steel to stainless steel contact area between the rivet and the "hat".

Of course when using stainless steel against aluminium a barrier of primer is required.

RUBBER TUBE CLAMP

Most aluminium skin dimples are not perfect and rely on a fully upset shop head to clamp the sheets together tightly. That usually does not happen due to variation in dimple contour, sheet temperature difference between dimpling and rivet setting and simple misalignment.

This is usually cured using a setting block as in picture #1. The setting block surrounds the rivet and its countersunk area squeezes the sheets together with one or 2 bumps by the riveting gun which also closes the dimple around the rivet gripping it. The setting block is then removed and the rivet is bucked normally. Often this works just fine but sometimes the dimpled sheets move apart again before or while the rivet expands when bucking leaving a gap between the sheets.

In most cases using a simple piece of rubber tube the same inside diameter as the rivet and slightly longer than the rivet as shown in picture 2 does a better job as the sheets are compressed together during the bucking action. The rubber tube can be used after setting dimples as in picture #1 on thicker sheets or on its own on thinner sheets. I use surgical rubber tubing cut to various lengths to do the job but automotive rubber vacuum lines work just as well.

Note that the 2 dimples shown are exactly the same but that the hole edges do not fully contact the rivet and the sheets do not contact each other. Most of the final shear strength is thus created by the friction between the dimples. A perfect joint would have the holes drilled well undersize, the dimples formed and set, the holes reamed to size, and finally, the rivet is upset.

Picture #3 shows a setting block with various holes and a rubber tube. I apologize for the poor quality of the photo. Mild steel works just fine for a setting block as it is easy to drill and countersink and only has to do a few thousand holes. If damaged, mild steel is easily resurfaced.

***Mac Mazurek** is a Past President of RAA Chapter 4975 and is the current chapter Secretary, He is a technical resource for his chapter and has built a self-designed 3/4 scale Spitfire powered by a Ford.*

Opener Announces Silicon Valley Luminary Backing

Palo Alto, July 12, 2018 -- OPENER, Inc., a pioneer of aerial vehicles for consumer travel, today announced Larry Page is one of the company's strategic backers. This news comes on the heels of today's introduction of OPENER's BlackFly, the world's first ultralight all-electric fixed-wing vertical take-off and landing (VTOL) aircraft. BlackFly is a single-seat Personal Aerial Vehicle (PAV) designed and built for a new world of three-dimensional transportation.

About OPENER: On Oct 5, 2011, history quietly was made near the small town of Warkworth, Ontario, Canada. That day saw the first manned flight of a fixed wing all-electric VTOL aircraft. This event prompted the formation of a stealth company with the sole purpose of pursuing the development of this new unique technology. In September of 2014, the Company reorganized as OPENER and relocated the majority of its operations to Silicon Valley in California to pursue an unencumbered and accelerated development timeline.

Find videos and more information at https://opener.aero.

National Museum of the U.S. Air Force Public Domain

MANY THOUSANDS OF GOOD AIRPLANES and pilots were lost in the air war over Europe during World War two. History books are full of heroics of survival and escapes from POW camps too. This is an account of an American pilot with amazing determination who escaped the Germans after being shot down and captured in early 1944.

"Robert" was born in Nashville, Tennessee in 1922. His infatuation with aviation began at five years old with Charles Lindbergh's transatlantic flight. He read everything he could about aviation and flight dynamics, and educated himself in theories of aerobatics. At fifteen, he was able to pay for flying lessons in a Piper Cub by working at a grocery store near his home.

Joining the military

Robert graduated from high school and on his eighteenth birthday, he joined the Tennessee Air National Guard. Although he was a tail-gunner trainee, some of the officers let him fly the Douglas O-38s, which had dual controls. Pilot training in the Air Corps flying school wasn't an option as he was not yet twenty one and didn't have the two years of college required by the military.

By 1940, the war in Europe had broken out. A change in regulations was Roberts answer to his dream of going to combat. The air force lowered the age to become a pilot from 21 to 18, and in short order, he was assigned to military flight training. On his first orientation flight, the instructor did a roll, and then asked him to try. When Robert completed a perfect one, then did a four, eight and 16-point roll, as well as other advanced maneuvers. The instructor soon informed the commanding officer that he had an exceptionally gifted and talented student.

By December of that same year, 1942, Robert was flying Spitfires out of a base in England, and was placed in charge of sixty seven pilots. However, combat flying was still a long way off. He was sent to North Africa to test the various aircraft that were intended for use against the enemy. He gained experience in many different planes including the P-40, the P-39, P-38, and tested Spitfires and Hurricanes. Then, nearing his twenty-second birthday, Robert joined the 52nd Fighter Group in September 1943. He was promoted to flight leader before the end of that year, and flew 58 missions without being hit by enemy fire. But on the next one, his luck ran out. His Spitfire was attacked by four German FW-190's. A mechanical malfunction prevented him from dumping the drop tank, and he was shot down into the ocean where a German patrol boat eventually picked him up.

The STALAG

StalagLuft1 would be Roberts new home for the next sixteen months, until his successful escape near the end of the war. The Stalag was on the north coast of Germany, on a strip of barren land jutting into the Baltic Sea about 100 miles northwest of Berlin. Two miles south of the main gate was the village of Barth. A forest bordered the west side of the camp and the cold North Sea was less than a mile to the east and north of the barbed wire fences. Two 10-foot tall fences four feet apart surrounded the compound. Guard towers with powerful spotlights were placed every hundred yards to keep watch on prisoners. POWs were aware that if they crossed a "warning wire," they would be shot. The guards boasted that no one had ever successfully escaped from their camp, but it didn't stop prisoners from trying. Robert himself tried at least two dozen times, only to be caught and thrown in solitary confinement for punishment.

...they came across a Luftwaffe air base, deserted except for a few ground crewmembers. There were several broken down and shot up aircraft on the field

Stalag 1 eventually housed between 7,000 and 10,000 POW's. Most were air crews and pilots from the U.S., Britain, Canada and a few other allied countries. Conditions were crowded, but in general the camp functioned quite well for a POW camp. Prisoners suffered from hunger. Their worst fears however, were of what they didn't know, what they were not told, and what their futures held in store. The Germans occasionally shot POW's who were attempting to escape. Some of the men went mad with fear and uncertainty. It was truly an emotionally stressful period. Robert and many others still kept devising ways to escape. In his words, "I was on an escape committee. We'd been trying for so long that all I lived for was to get out. We were dedicated, digging tunnels and running at the fence. I once got caught hanging on the barbed wire. Dogs were nipping at my feet; I really was scared. But I'd been working so hard at it, I wasn't about to quit."

The ESCAPE

In the spring of 1945, believing the war was almost over, Allied Supreme Commander Dwight Eisenhower issued orders to POWs that they were not to attempt an escape. But in April of that year, some prisoners at Stalag 1 made another attempt to get out. At that time, many German guards were deserting as the Russians were closing in from the east. While other prisoners started a fight to

distract the guards, Robert and two others ran out from under a building, threw a plank over the top of the fence and climbed out.

One of the three escapees departed on his own, while Robert & his partner stole two bicycles in a small village and headed west, right into the Russian lines. The Germans were being brutally murdered by the victorious Russians by that point, but the two POW's stayed alive by virtue of the fact they were Americans, and told the Russians they were downed pilots trying to get back to their lines. They pushed west for some time, and just before reaching Holland, they came across a Luftwaffe air base, deserted except for a few ground crewmembers. There were several broken down and shot up aircraft on the field, and eventually Robert found one that appeared flyable. It was a Focke-Wulf 190, the same type that had shot him down some eighteen months earlier.

The German fighter was riddled with bullet holes, and Robert could not read the labels on the panel. They had obtained a gun and forced one of the Germans to start the engine. Once it was running, Robert's partner was too afraid to climb on board with him, and they parted company! He made his escape on foot while Robert blasted across the grass and got his stolen plane in the air.

Only then did his next problem occur to him. He was flying a fighter with a swastika on the side of it and was heading for allied territory! There was nothing he could do about it except climb up close to the cloud base, keep a lookout for American and British airplanes, and head north until he hit the North Sea. He had no charts, or maps … not even a parachute. He decided that when he got to the Sea he would head west, followed the shoreline and hoped to see windmills, which meant he would be in safe territory.

Robert knew that the Germans had placed mines on many of the airfields in Holland, and he was afraid to land at any that appeared deserted. Eventually, he found a farmers' field that looked safe, and with the fuel gauge reading empty, he picked a spot and landed. There was a ditch unseen across his landing path, and when the 190 struck it, the gear was torn off the plane. Robert was not injured. However several farmers had spotted him by that time, and thinking he was German, armed themselves with pitchforks and surrounded him. Fortunately, he was able to communicate well enough to explain he was an American pilot.

Robert detailed the whole story once safely back with the allies. He later stated that people exaggerated his story and made it sound like the great escape. Stealing a German fighter and flying back to Holland was quite a feat, but in Roberts words, "It wasn't very smart. Without the guards deserting at the POW Stalag, the escape could not have happened. Before then, no one had escaped. If they did get beyond the wire, the Germans were waiting, and prisoners were quickly recaptured. Stealing the airplane was a spur-of-the-moment idea, an opportunity rather than a plan".

In the last two weeks before the Americans took the camp, most of the guards had deserted and over 200 POWs actually got away. But Eisenhower was right. Robert admitted he would have been much safer to stay there, and the escape was probably the dumbest thing he'd done in his life!

Of all the POWs who escaped from German camps in WWll, none except Robert A. "Bob" Hoover flew an enemy fighter out of the country. R

Robert admitted he would have been much safer to stay there, and the escape was probably the dumbest thing he'd done in his life

San Diego Air and Space Museum

North American Aviation test pilots, 1957. He's bottom row second from right. Below, left, with some of his fellow inmates at Stalag 1, front row, fourth from right.

Airport Journals

***Barry Meek** is a commercial pilot who flies summer contracts for various operators in western Canada. He is a retired ambulance paramedic, mountain bike guide and broadcaster. His articles have appeared in the COPA Flight, The Aviation News Journal and the Recreational Flyer. He now resides in Vernon, B.C. and in Lake Havasu City, Arizona.*

PURE FLIGHT

Photos and story by George Gregory

"Take a few steps forward".

A cool breeze breathes past my face as I look at the valley below. It's a long way down. "Look past me: at the island, not at your feet". Jim pauses, turns and faces the wind. He seems satisfied, and again turns to face me. "Arms low…okay. Take a step forward. Keep coming… feel the wing coming up. Looking good. Run! Runrunrun! Bird position! Don't bury the brakes… a short pause. He's already a hundred yards behind me on the hillside, and the radio crackles: "Good launch. Enjoy the flight".

Adventure awaits: the wing and harness laid out and ready for flight. A gentle tug on each riser (obviously not done in this picture!) confirms they are free of tangles and ready for flight.

IT'S DAY THREE of paragliding training. The ground drops rapidly away and in a few seconds I'm a thousand feet above the lodgepole pine beneath me, drifting southwest at a leisurely rate. The wind is in my ears, but Jim remains on the walkie-talkie to guide me to the landing field. I don't think I've ever been so aware of my altitude; it's one thing to be surrounded by the comfortable, car-like familiarity of a cockpit, and quite another to be hanging from a cloth chair a thousand feet or more above the earth.

"A little to the left. Aim for the maple tree, and do some figure eights to lose some altitude". Satisfied that I'm managing, he turns his attention to a few of the other students that are likewise airborne and I'm left alone to soak in the experience: engaging all my senses, aware of every little bump of lift, the silence, the air itself.

A few minutes later he returns: "Look at the windsock. Plan your approach… turn into the field *now*. Ninety degrees to the right". The ground, so distant for what seems so long a time, is now approaching quickly. I pull on the brakes… too high. I relax, airspeed is regained, and I'm still flying when I flare: my first landing, and on my feet at that, with only a few steps. Subsequent landings were not as good. Practice, practice, practice.

I first encountered FlyBC in 2011 when I decided to take a tandem paragliding flight: it was sort of a bucket list thing. I thoroughly enjoyed the experience, but a lot of life, including layoffs, a move to a new town and a career change occurred in the meantime. But in the summer of 2016 we moved to Chilliwack - scant minutes by air from

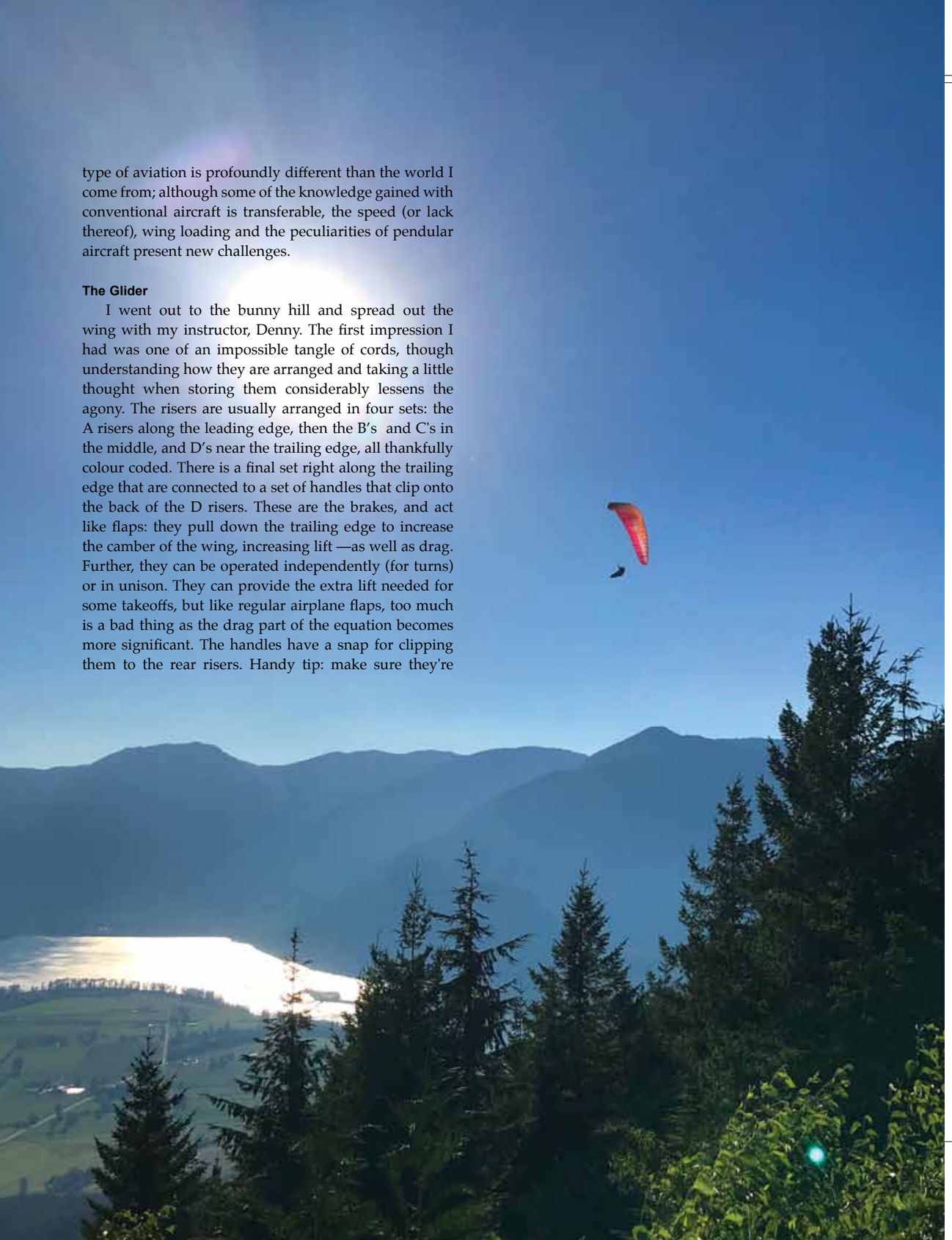
where I had done my tandem ride, and with the launch site on Mt. Woodside visible from my front yard: a not-so-distant reminder of my earlier adventure.

And then there's YouTube, a veritable treasure trove for any information on nearly anything that tickles one's fancy. Paramotoring seemed particularly attractive, and the advent of GoPro cameras (long favoured by those in adventure sports, including anything that flies) further stoked my imagination. Combine that with an affordable aircraft you could literally fit in the trunk of your car, and the promise of a pure, elemental version of flight… *well*. I decided to investigate further.

I met Jim with a group of budding would be aviators at Eagle Ranch, an acreage run by Jim and his wife Colleen. A large field, mowed short, offers plenty of landing space and features a bunny hill for neophytes to get a feel for their wings. There's a converted barn for a classroom and meeting area, a loft to hang harnesses from to practice turns (the "simulator") and room for plenty of paraglider bags. As it happens, the good folks at FlyBC want you to be conversant with gliding flight before they give you a motor, so it was off to paragliding lessons first.

I had some concerns that I was looking into a young person's sport. I'm 62. But I was heartened to see a a couple of other middle aged men there, as well as a forty-something housewife I'd met on the first day. This sport is not restricted to the young, and the students I met were a pretty good mix of what society generally looks like. Some old, some young, some fit, some not so much. Like myself, some are already licensed pilots; for others this is their first exposure to the world of flight. But this

Top left: learning how to handle the wing in the wind—kiting—is an important part of learning the ropes. And speaking of ropes, the multitude of risers (above) can be somewhat intimidating. Careful attention and good habits can prevent most of the unpleasantness. Happily, the lines are colour coded, which helps immensely.



type of aviation is profoundly different than the world I come from; although some of the knowledge gained with conventional aircraft is transferable, the speed (or lack thereof), wing loading and the peculiarities of pendular aircraft present new challenges.

The Glider

I went out to the bunny hill and spread out the wing with my instructor, Denny. The first impression I had was one of an impossible tangle of cords, though understanding how they are arranged and taking a little thought when storing them considerably lessens the agony. The risers are usually arranged in four sets: the A risers along the leading edge, then the B's and C's in the middle, and D's near the trailing edge, all thankfully colour coded. There is a final set right along the trailing edge that are connected to a set of handles that clip onto the back of the D risers. These are the brakes, and act like flaps: they pull down the trailing edge to increase the camber of the wing, increasing lift —as well as drag. Further, they can be operated independently (for turns) or in unison. They can provide the extra lift needed for some takeoffs, but like regular airplane flaps, too much is a bad thing as the drag part of the equation becomes more significant. The handles have a snap for clipping them to the rear risers. Handy tip: make sure they're clipped there when not in use. It makes tangling far less likely.

The risers all fasten onto a very stout looking set of caribiners that clip onto the harness the pilot straps into. Each riser starts as one or two cords at the attach points on the harness and branches out upwards to the wing so that there are dozens of connections onto the underside of the wing itself, effectively distributing the loads over many attach points and affording a considerable degree of control.

The leading edge is open along its span; wind inflates the wing, and the fabric ribs that determine the wing's airfoil also have holes in their sides so that air can inflate the wing spanwise evenly. Pretty neat.

Practice

The first thing taught was what was called "building the wall". With the pilot facing the wing and his back to the wind, the wing is laid out with the leading edge up; a light tug on the A risers will fill the wing and (all other things being equal) the wing will stand up on its trailing edge like a wall. At this point, it's easy to see if the wing is evenly inflated. In any kind of wind, or with a step back and a further tug on the A lines, the wing will kite up overhead. This exercise is considered vital for teaching the proper handling of the wing. This is where paragliding differs the most from other forms of aviation; nothing is rigid, and you rely entirely on aerodynamic forces to keep things in order. If you get a crosswind, or are not positioned properly beneath the wing, it falls off to the side, and lands in a tangled mess of risers and dacron. For a beginner, this can be very frustrating.

This is flight in its purest, most elemental and least practical form. It is good for nothing... but sheer fun

It was close to 90 degrees on the August afternoon that I started kiting. The winds at the field are fickle and switchy in late summer, so it was hard to get steady inflations to practice with—though I did get a lot of practice untangling the risers, and I guess that's part of the education too. I'm sure I sweated off a few pounds. Learning to handle the wing on the ground can't be overemphasized. It's vital to safe operation, to getting the feel of things, especially since a properly inflated wing is key to a successful launch.

My days typically started kiting, followed by a couple of flights off the mountain, a late lunch, more kiting (too gusty in the hot afternoon at the launch site) and then a flight in the early evening when the winds settled down.

For the newbie, launching is a stressful moment but once the basics are mastered, confidence is gained and it (thankfully) becomes more routine. I remember when taking powered lessons, the ability to land in one piece was the mental barrier to overcome; here—at least for me—it's the ability to take off safely. I was surprised that students often make their first flight on day one or two of training. The hill (not a cliff, mind you) is quite steep. A failed takeoff will not result in a fatal plunge, but is more likely to result in scratches and bruises, and there are trees to catch you a hundred feet past the launch if things really go haywire. Once airborne, however, you are a thousand feet AGL in a matter of seconds. I really made (and make) a point of checking and double checking my harness for security.

In stable conditions (and they don't let students fly in less than ideal winds) the paraglider in flight seemed reasonably idiot proof.

And so, on day two, I flew.

The standard, independent launch is called a reverse launch. While clipped in, the pilot faces the wing (meaning the risers are crossed) and kites the wing up so the pilot can inspect it for proper inflation before committing. But the technique requires some experience and coordination (my own attempts while kiting were particularly inept); new pilots usually start with a spotter and a forward launch. Moving forward into the wind, a gentle tug on the A risers brings the wing up and overhead and the pilot assumes what is called the "bird" position: leaning well forward into the harness, hands back and up holding the brake handles, you start running—hard—and off you go. Once you are safely away from the hill, you can settle back into a tolerably comfortable seat, slightly reclined, hands on the risers, and enjoy the view.

And what a view. I am hard pressed

to imagine a purer flying experience. The wind in your face, on your legs, your eyes tearing in the breeze. Green mountains and blue sky: unlimited visibility everywhere, the smells of grass and trees and whatever the farmers below happen to be spreading on their fields: your senses are entirely engaged. You are literally flying by the seat of your pants. See some birds circling in a thermal? Go join them. Stay a while. There's lift over a construction site on the mountainside. A few minutes in there and we are higher than the launch site. Turns are ideally accomplished by leaning sideways, looking into the turn, and crossing one's legs in the direction of the turn. A pull on the inside riser can tighten the turn, but adds drag and is (I gather) considered bad form unless aggressive maneuvering is required. Control is positive, but not intuitive for a fixed wing pilot. It takes some getting used to.

Unless you fly into a tree—or perhaps land downwind in a stiff breeze—landings are not as intimidating as the takeoff. Flying speed is between 20 and 30 kph, and it's almost possible to run that fast—not that you'd want to. A deliberate pull on the risers initiates a neat flare close to the ground, and it's possible to land standing up with no run at all. Not that I'm doing so consistently.

Yet.

Planning one's approach is different than powered flight. A pattern of some sort is still a great idea, but the slow speed of the paraglider makes the effect of headwinds far more noticeable. A headwind of 20 km/h can produce a vertical, flying descent; relative wind, always a concern for the aviator, is even more an issue here.

Further, the lack of reference points (no dashboard) I found a bit disorientating. It is perhaps here that fixed-wing experience proves a disadvantage: it is so different that much of the perspective and visual cues have to be relearned.

...if I'm being honest with myself, that's the main reason I fly.

My flights off Mt. Woodside typically lasted about 15 minutes; my last flight was in thermal lift and lasted nearly a half an hour. And any kind of breeze can produce slope lift that can keep a skilled pilot aloft for hours if conditions are right.

At this point, I'm still hankering to strap on a motor, since freedom from the need to drive to a mountain really appeals to me—as does the idea of taking my personal aircraft on driving holidays for further exploration.

This is flight in its purest, most elemental and least practical form. It is good for nothing but sheer fun: slow, and best performed in benign weather, at least for noobs like myself. But if I'm being honest with myself, that's the main reason I fly.

It's heartening to know there are still affordable ways to commit aviation. A nice wing can be bought for around $3.500, and for those who want to try their hand at powered paragliding, motors start at around $7,000. In Canada, paragliding is self regulated by the Hang Gliding and Paragliding Association of Canada; paramotor pilots must be licensed with the appropriate rating with Transport Canada, and paramotors must be registered as ultralight aircraft with the appropriate C-IXXX registration affixed to the frame.

There's a ton of information on the sport online. Youtube has some great videos that help give you an idea of what it's all about (just enter "paragliding" or "paramotoring" in the search field). One of my favourites is a demonstation group called Parabatix. Lots of fun, and quite inspiring, though remember these are expert pilots.

For more information:
HPAC's website is https://www.hpac.ca.
Fly BC's website is http://www.flybc.org

George Gregory *caught the flying bug as a child and hasn't stopped. He built (and crashed) a hang glider as a teenager, but didnt' get around to getting a pilot's licence until his early 30's. He holds private and commercial ratings, but is always scheming for cheaper ways to fly.*

Reduction Drives / cont'd from page 12

torque load will climb with every impulse, potentially exceeding 800 ft-lbs in a very short time: Two and a half times the rated torque of the engine at full power! This results in the need for a very strong crank and output shaft.

If we examine an automotive powerplant application, the reduction drive complicates the problem since each component adds a variable or a set of variables to the system's natural frequency determination, making the overall solution more difficult to achieve.

The bottom line is that in the instance of resonance, the system must either be able to absorb the vibrational energy and not allow the harmonic vibration to build, or be designed beefy enough to handle the loads imposed upon the components. Assuming you want the lightest reduction drive possible, you need to eliminate the vibrational energy. Some of today's solutions are: A flexible drive belt; a conventional clutch plate; a flexible coupling; a torsional coupling; a sprague clutch; and a fluid coupling (torque converter).

Originally applied to aircraft more than twenty years ago, the belt reduction drive has an inherent capability to absorb the feedback energy and eliminate much of the problem. Absorbed vibrational energy however manifests itself as heat; if too much energy is dissipated deterioration of the belt can occur. In early applications it was not uncommon to get belt lives of only fifteen hours or so. Today's systems are similar except that the belts are much larger per horsepower and can absorb more energy before showing signs of wear. Most of the current manufacturers recommend that the belts be replaced at about 500 hours. One note though: Most belt manufacturers are adamantly set against providing their products to the aviation arena and may revoke the license of any distributor caught selling to reduction drive manufacturers or other aircraft applications.

The second common system in reduction drives joins the crankshaft to the reduction drive's input shaft by bolting a standard automotive clutch plate to the flywheel, depending on the springs within the plate's assembly to absorb the relative shaft motion. This installation demonstrates a clear misunderstanding of the phenomenon. The springs in the plate only change the natural frequency of the vibration (changes the system's spring constant), the configuration has no ability to absorb and dissipate the vibrational energy. Eventual catastrophic failure can still occur if the magnitude of relative motion builds past the point where the springs are able to absorb it.

Flexible shaft couplings also demonstrate a misunderstanding of the problem in that they are usually applied to areas misalignment, not relative rotational motion. Couplings that allow some relative motion (couplings with rubber doughnuts or other types of flexible components) are better but in most instances are still not designed to handle the types of load encountered in aviation applications.

The torsional coupling on the other hand seems to show the most promise as a simple yet durable solution to the problem. Usually constructed in a manner that allows relative motion yet with visco-elastic properties, this type of shaft joining would in my opinion result in the safest and most dependable configuration. For those of you unfamiliar with the term, a good example of visco-elasticity is your car's suspension: The springs are the elastic, allowing motion as a result of loading or driving conditions yet always returning the suspension to its neutral position. The viscous property is like your shock absorber, absorbing the energy of bumps or pot-holes without sending your car bouncing down the road or tearing out the transaxle.

In the reduction drive coupling this property allows some relative shaft motion while at the same time damping the energy of the vibration. Generally these systems are simple, light, and have no catastrophic failure modes. In the rare case where something unexpected does happen, there is usually a secondary load path built in which would allow the aircraft to continue to its destination or alternate field.

My current concern however is that these couplings are usually designed for diesel operation; I have seen only a handful which are capable of operating past 3,500 rpm. Since our baseline reduction drive configuration uses this type of coupling we are currently exploring this avenue with a West coast distributor of a number of German designs, hoping to use one of the smaller models up to about 5,500 rpm.

The fifth option, a sprague (or over-running) clutch, is not necessarily a coupling for the reduction drive; the few applications of this I'm familiar with use the clutch on the output shaft as a preventative measure. The configuration of this clutch is something similar to a ball bearing in that it has an inner race and an outer race, separated by the inner members (spragues). When the input shaft rotates one way, the spragues (which look something like out-of-round cylinders) jam between the inner and outer race, rigidly connecting the input and output shafts together.

In the case of torsional feedback, when the output shaft wants to turn ahead of the input shaft, the spragues unlock and allow the motion. Since the clutch lets go, the vibration isn't allowed to build past the first cycle. Since no energy is generated, none has to be dissipated, allowing the system to operate in a continuously relatively benign environment. I know of at least two manufacturers that are using this system with good success, although both applications are below 100 hp.

Will any sprague clutch work? No. The system has to be designed for the load and for the frequency that the system is expected to vibrate at. Surprisingly enough though, some off the shelf clutches are applicable to a wide range of variables. The best positioning of the clutch seems to be on the output shaft, the slower rate of rotation resulting in lower hoop and locking stresses and allowing the separation of the prop flight loads from the gear train.

The sprague clutch however adds complexity to the reduction drive, driving up parts count and cost. Furthermore, since the mechanism depends on metal-to-metal friction contact, the potential exists for wear and contamination of the gear-train by small metal particles.

Operationally there is also concern since the propeller freewheels when the throttle is pulled back, causing a significant increase in drag and reduction of the glide ratio. If you're on final and take this drag increase into consideration the consequences are minimal however in the case where the engine fails enroute, the reduced glide performance can be the difference between a safe landing and one not quite so. One manufacturer has an option for a disk brake but this of course adds weight and further complexity to the system.

Careful selection must be made of the engine and its associated components before installation into an aircraft can be made safely

The sixth option is the fluid coupling, or in common terms, the torque converter. From the standpoint of operational simplicity, benign operation and failure mode, this seems to be a very good solution although some questions do arise: Where does the fluid come from; how is the fluid cooled; how much lag is in the system from the onset of power to the full engagement of the prop; what is the weight penalty; how much slippage is in the system; and how efficient is the coupling. Although over the years I've read about a few companies trying the fluid coupling, I have yet to see one fly.

One promising torque converter design is a configuration being developed locally for application to the rotary engine by Hayes Rotary Engineering of Redmond, Wa. The Mazda's automatic transmission uses engine oil for the torque converter, so the oil pumping, cooling and scavenging system is already built in. If the system works it'll solve much of the problems associated with the application of rotary engines to aircraft although the added weight may be of some concern.

Finally, lets look at the reduction drive system designed to withstand the loads without the use of any torsional dampening system. This obviously is the simplest goal but in many instances a weight penalty may be associated with the beefier construction. Personally I wouldn't even try it with a geared system since generally the minimal amount of tooth contact only invites catastrophic failure. The only configuration I would be willing to seriously examine is the silent chain. Capable of high loads and high speeds while operating smoothly and quitely, this product has over the years proven durable and very reliable in applications ranging from agriculture to mining to automotive. An excellent reduction drive should be able to be put together with off the shelf components for a reasonable cost.

The only question then in this case is can the engine's crankshaft withstand the torsional loads transmitted through the chain?

But back to the list of design considerations. Torque and RPM should be self explanatory: Both drive the design of the gears, couplings, bearings and of course the shafts. Careful attention must be paid to areas of shaft diameter changes, key-ways or splines, and snap ring grooves; all being sources of stress concentrations and areas of potential failure.

Don't take the manufacturers' company line and pretty brochures as gospel; do some digging to see whether enough substantiation has been done to assure the highest level of safety.

Environment is most critical to reduction drives that have the components open to the surroundings. Entrance of foreign matter, be it sand or dirt, oil, loose tools, etc. will have eventual effect on the performance and life of the critical components. On the other hand too much enclosure could limit access for inspection or even more importantly, block off cooling air.

Material endurance properties should probably be nearer the top of the list in that this more than anything else will determine the life of the drive. Although in many instances the drive is designed for ultimate loads, its the day-to-day operations that affect the wear, fatigue, and ultimately, the longevity of the components. The fatigue characteristics of many materials are very sensitive to material condition, the service environment and even finish. A good example is aluminum. A standard endurance limit (stress level the material can withstand for 500,000,000 cycles - also used as infinite life criteria) for smooth 2024-T3 is almost 20,000 psi; for 6061-T6, over 12,000 psi; while for casting alloys the endurance limit is less than 8,500 psi. Effects of snap ring grooves or other stress risers such as surface roughness due to sand casting, can drop the endurance limit by more than 50%. If these conditions are not taken into account when designing the case or other critical components, failure could occur even during mild loading conditions. Our reduction drive case for instance is machined from 6061-T6 billet rather than cast. Yes, it's a bit more expensive but it gives us the highest control over material quality, surface finish and overall strength.

Lubrication seems obvious but a few folks miss the secondary function of the oil: To carry away the excess heat. There is no gear, chain or friction drive that is 100% efficient. A spur gear generally loses 1.5% to 5% per mesh; a chain 2% to 8%; a traction drive 3% to 12%. What this means is that if you input 100 hp into your gear box (assume a single spur reduction for simplicity), on the average you have about three horsepower equivalent of heat generated. Over time this could of course destroy your drive system so therefore the need for oil to lubricate and cool the components. If the hot oil is not taken care of properly it will eventually deteriorate, leave deposits and again damage the components.

In simple systems the heat exchanger can be the housing, transferring heat to the surrounding air in the engine compartment. In more complex systems a pump is used to circulate the oil not only through the gearbox but also to an external heat exchanger. If you're using engine oil for the drive, you must remember to increase the size of the oil cooler to account for the additional energy.

As far as the engine is concerned, usually you have made the selection before choosing the gear drive, so you must make sure that the reduction components can withstand the environment which the engine will generate. If the reduction drive and its coupling is designed for an eight cylinder engine but you put it on a four or six (or vice-versa), you will have to make sure that the operating conditions match the components so you don't run into the aforementioned vibration problems, cooling complications, etc. Even more critical is the application of Wankel engines as they produce a different mode of torsional vibration from that generated by conventional piston configurations. The coupling, even one designed for a bigger engine, may not be able to handle the vibration feed-back encountered with the rotary.

And finally, a few general comments about automotive engines in aircraft applications. Many seem to be of the opinion that if an engine lasts over 100,000 miles on the road that it will be a good 2,000 hour engine for an airplane. Well, maybe, but keep in mind that the aircraft application has much more severe load conditions than the engine ever sees in a car. Installed in a car the engine is generally operated at only a fraction of its rated power. Taking a 100 hp powerplant, let's say in a Honda CRX, for most of the 100,000 miles the engine operates on residential roads or on the freeway. For the CRX it only takes on the order of 18 horsepower to maintain 60 mph on a level highway, and about the same or less is used in the city, so for most of its expected life the engine operates at only about 20% of its rated power with only brief excursions to eighty or ninety percent for acceleration or hill climbs.

In an aircraft however, the engine will be expected to operate between seventy and ninety percent of the rated power for its entire life, or almost four times that of a road application. Furthermore, other factors also enter into the equation, the chief of which I talked about earlier, gyroscopic loads. Most automotive engines need to be turning quite fast to generate the higher power levels, that's why we need reduction drives. As with the prop, couple this crank rotation with a sudden pitching or yawing of the aircraft and you get a gyroscopic moment maybe even an order of magnitude higher than the engine will ever see in a car. This can lead to early bearing wear, fatigue cracking of bearing supports, or even catastrophic crankshaft failure.

Careful selection must be made of the engine and its associated components before installation into an aircraft can be made safely and successfully enough to give the same perception as Lycomings or Continentals do today. Some serious engineering and testing will need to be done, especially on the smaller, lighter automotive engines (Honda, Subaru, etc.), to determine their ultimate suitability for flight application. This is not to imply that automotive engines cannot or should not be modified for aircraft use; all I mean to say is that the buyer must make a careful selection of the engine(s) and reduction drive to his or her airplane and expected flight conditions. Don't take the manufacturers' company line and pretty brochures as gospel; do some digging to see whether enough substantiation has been done to assure the highest level of safety. Have the components been tested under all flight conditions or has the test pilot just hopped around for forty hours or so in mostly level flight with calm air? Have the tests been flown in your airplane or just a slow moving ultralight or light plane?

Ask for the hard data and design assumptions. If you don't have the background, ask someone to represent you. If the company refuses to give this information out, go somewhere else. Remember, your life depends on your choice.

Bill Husa *lives in the Pacific Northwest and has contributed articles to various aviation publications including the Recreational Flyer over the years.*

Presidents Message / cont'd from page 2

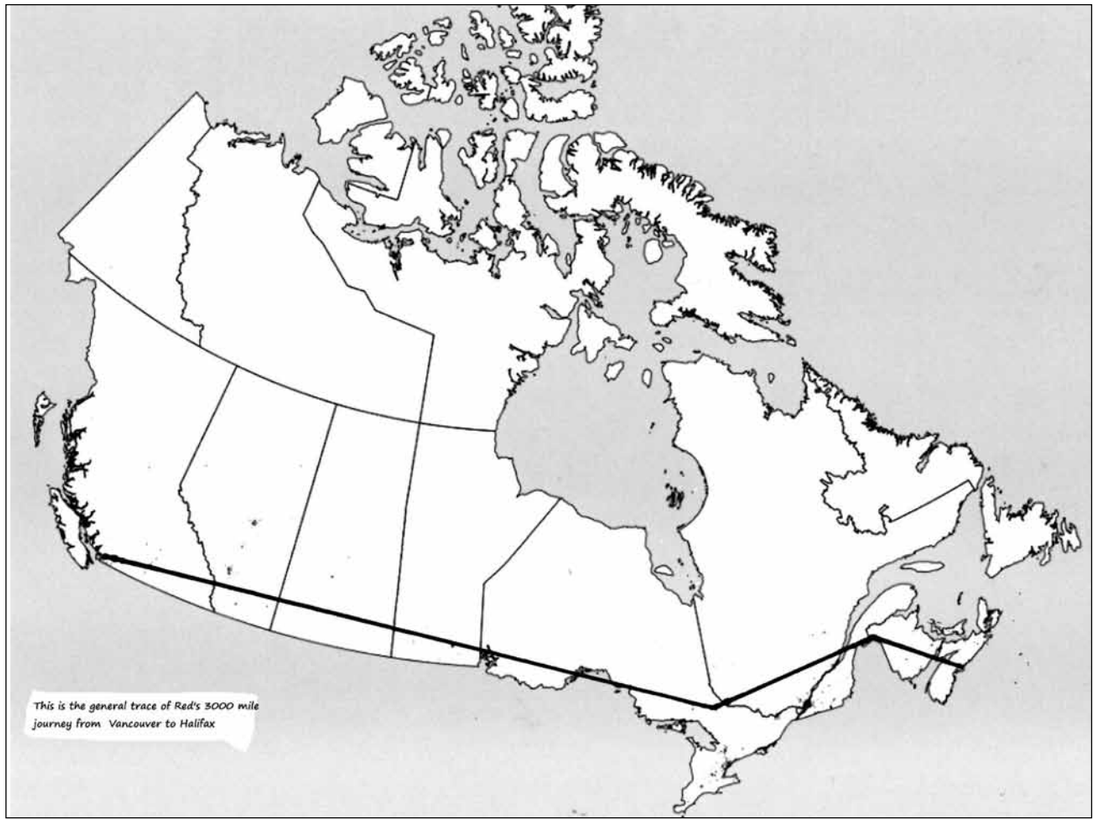
to expect that they would become more common. The dissemination of the information derived from these investigations would greatly benefit the community of pilots and builders of non certified aircraft.

WWW.ROTAXOWNER.COM

Every owner and pilot of a Rotax powered aircraft should subscribe to www.rotaxowner.com. The website has a wealth of service and other information on Rotax 2 and 4 stroke engines. Lately they have supplied a list of stolen engines (yes this happens) so that potential aircraft buyers may check serial numbers before writing the cheque. Recently there have been updates on software for the new injected 4 stroke engines, a video on how to time the rotary valve intake system on the 582, and instructions for removal and installation of a reduction gearbox. No other manufacturer makes available such a comprehensive array of information to the flying public, and all you have to do is subscribe.

CHANGE OF ADDRESS

Please email your address changes to garywolf@rogers.com, preferably before you make the move to a new location. Each month we receive from Canada Post a large envelope with undelivered magazines and a bill for $3.00 each. Canada Post is not particularly prompt in this so sometimes they save them up for nearly a year. We call the member's phone number that we have on file but if it is unreachable the only thing we can so is to temporarily suspend a member's mailings. Eventually the member calls in to see why he has not been receiving his magazines, but to send out the missing issues costs another $3.00 per when sent on a one-off basis. Please remember to notify RAA ahead of time.



Red Morris / continued from page 5

Heinz's designs at that time and with Chris's approval was extensively modified for the trip with a 180 hp engine and 4 additional fuel tanks in the wings and two in the fuselage. This increased the total fuel capacity from 32 to 170 gallons. Significant sponsorship was obtained from Leggat Aircraft, Edo Aire and from the Canadian Pepsi Cola bottlers which explains the red, white and blue paint job and the Pepsi decals.

The Zenith had a design gross weight of 1850 lbs.[1] and as the aircraft came off the scales at 2718 lbs. it would require a waiver for the overweight condition at takeoff. It was also equipped for IFR flight as Red considered that to be necessary as the chances of getting VFR conditions over 3000 miles of Canada were somewhere between slim and nil. IFR flight was also something that was not done in a homebuilt in Canada in 1971 and so this would also require a special waiver from DOT. Both things were not easily obtained but eventually permission was received. These were requested in October with the overweight permit received in January and the IFR permit on March 15th. The overweight permit came with some rather onerous requirements but was eventually granted.

I was a member of the local EAA chapter at the time and along with other members, volunteered to help where needed. I was drafted as the western Federation Aeronautique Internationale (FAI) observer on behalf of the Royal Canadian Flying Clubs Association (RCFCA) and as such was required certify the aircraft's weight and to seal the fuel tanks and barograph. My signatures on the seals would verify that nothing had been added during the flight.

Electrical problems and fuel leaks persisted through the day prior to the takeoff and again when the alternator packed it in over Hope, BC and that necessitated a return to Vancouver for replacement. While this sounds little more than a time consuming problem, the volunteers had to be contacted as they were needed back at the airport with tools. Red had to use his not inconsiderable piloting skill to land the significantly overweight aircraft back at YVR. A new alternator was obtained and installed, refueling completed and the tanks and barograph resealed and after all of that, he was away again in just over an hour. To add to the excitement, his chase plane also had a problem with a significant oil leak. Seems someone had left the oil cap off the right engine requiring a stop at Abbotsford. Troubles, like grapes seem to come in bunches.

The flight proceeded without further incident until near North Bay when the alternator again became an issue forcing him to shut down as many electrical devices as possible including radios, strobes and his wing leveler. The lack of the radios caused a great deal concern for the escort plane as they no longer had any way to contact Red. Once east of Montreal, it became apparent that fuel concerns out ruled any further thoughts of continuing on to Newfoundland and the flight would be ended in Halifax.[2] He also had some doubts that he would even make Halifax and was considering St. John as an alternate. In the end all went well and a very tired and nicotine deprived Red landed in Halifax 22 hours and 45 minutes after takeoff from Vancouver. He later advised me that the FAI had confirmed 3 nonstop world records; including Vancouver to Winnipeg, Vancouver to North Bay and Vancouver to Halifax.

He later flew the Pepsi Special (C-GVOK) back to Vancouver and Delta Airpark where he gave thank-you rides to all of those volunteers who helped make the trip a success.

The record flight CH300 airplane can be seen at the Canadian Aviation and Space Museum in the Ottawa area having been delivered there by Red in 1984.

Footnotes

1 Ken Armstrong - Choosing Your Homebuilt ©1991

2 Sometime later Red obtained a chart of the portion of the flight over northern Ontario from NORAD who had been tracking the flight in its entirety. This chart showed a large approximately one hour 360 degree turn in one segment. Red does recall at about that point in the flight being off heading and realized that he must have dozed off for a time resulting in the circuit and unplanned fuel usage.

...a very tired and nicotine deprived Red landed in Halifax 22 hours and 45 minutes after takeoff from Vancouver. He later advised me that the FAI had confirmed 3 nonstop world records

***Mike Davenport** has been involved with the BC's Lower Mainland aviation scene for decades and has worked with Chapter 85 (Vancouver). He flies a creampuff Stinson 108.*

RAA Chapters and Meetings Across Canada

The following is a list of active RAA Chapters. New members and other interested people are encouraged to contact chapter presidents to confirm meetings as places and times may vary.

ATLANTIC REGION

HAVELOCK NB: Weekly Sunday morning get together year round, all aviation enthusiasts welcome. Havelock Flying Club - 25 mi west of Moncton. Contact Sterling Goddard 506-856-2211 sterling_goddard@hotmail.com

QUEBEC REGION

COTE NORD (BAIE COMEAU): Meeting times to be advised. Contact Pres. Gabriel Chouinard, 418-296-6180.

LES AILES FERMONTOISES (FERMONT): First Sunday 7:30 pm at 24 Iberville, Fermont. Contact Pres. Serge Mihelic, 418-287-3340.

MONTREAL (LONGUEUIL): Chapter 415, Meeting in French second Wednesday at 8 pm, at CEGEP Edouard Montpetit 5555 Place de la Savane, St. Hubert, PQ. Contact president Normand Rioux at NRIOUX@lapresse.ca or J-F Alexandre info@raa415.ca

OUATOUAIS/GATINEAU: Every Saturday 9:00 am to noon at the restaurant l9Aileron in the airport terminal. Contact Ms N.C. Kroft, Gatineau Airport, 819-669-0164.

ASSOC DES CONSTRUCTUERS D'AVIONS EXPERIMENTAUX DE QUEBEC (QUEBEC): Third Monday 7:30 pm at Les Ailes Quebecoises, Quebec City Airport.

ASSOC AEROSPORTIVE DE RIMOUSKI: First Saturday at 9:00 am, La Cage aux Sports, Rimouski. Contact Pres. Bruno Albert, 418-735-5324.

ASSOC DES PILOTES ET CONSTRUCTEURS DU SAGUENAY-LAC ST JEAN: Third Wednesday 7:00 pm at Exact Air, St Honore Airport, CYRC. Contact Marc Tremblay, 418-548-3660

SHERBROOKE LES FAUCHEURS de MARGUERITES. Contact Real Paquette 819-878-3998 lesfaucheurs@hotmail.com

ONTARIO

BARRIE/ORILLIA CHAPTER 4th Monday of the month at 6:00 PM at the Lake Simcoe Regional Airport for the months of June, July & August (BBQ nights) For other months contact Dave Evans at david.evans2@sympatico.ca or 705 728 8742

COBDEN: Third Thursday of the month at the Cobden airfield clubhouse 20:00 hrs. Contact Bob McDonald 613-432-8496 or bobkim.mcdonald@gmail.com

COLLINGWOOD AND DISTRICT; The Collingwood and District RAA, Chapter 4904, meets every first Thursday of every. month, at 7:30 PM except July and August, at the Collingwood Airport or at off-site locations as projects dictate. The January meeting is a club banquet held at a local establishment. For more information contact Pres. Skip Reeves 705-429-5154

FLAMBOROUGH: Second Thursday 8:00 pm at Flamborough Airpark. Contact Pres. Karl Wettlaufer 905 876-2551 or lazykfarm@sympatico.ca

KENT FLYING MACHINES: First Tuesday 7:00 pm at various locations. Contact President Paul Perry 519-351-6251 pkperry@teksavvy.com

KITCHENER-WATERLOO. Meetings are on the second Monday of each month at 7:30pm upstairs at the Air Cadet building at CYKF except during the summer months when we have fly-ins instead.

Please contact Dan Oldridge at kwraa@execulink.com for more information or visit our newly expanded website at http://www.kwraa.net/.

LONDON/ST. THOMAS: First Tuesday 7:30 p.m. At the Air Force Association building at the London Airport. Contact President Bill Weir 519-461-0593 wmiweir@gmail.com

MIDLAND/HURONIA

Meetings: first Tuesday of each month, 7:30 pm, at the Huronia Airport terminal building (CYEE). Contacts: President Rob MacDonald - 705-549-1964, Secretary Ray McNally - 705-717-2399, e-mail - raamidland@gmail.com E-mail – raa.midland@gmail.com .

NIAGARA REGION: Regular meetings occur the second Monday of every month at 7:30pm in the CARES building at St. Catharines Airport (CYSN). During the summer months though, June-September, meetings take place the second Monday of those months at 5:30pm in Hangar #4 at Welland Airport (CNQ3). Contact Elizabeth Murphy at murphage@cogeco.ca, www.raaniagara.ca

OSHAWA DISTRICT: Last Monday at 7:30 p.m. at Oshawa Executive Airport air terminal, ground floor, 1200 Airport Boulevard. Contact President: Jim Morrison, 289-675-0660, jamesmorrison190@msn.com Website raaoshawa.blogspot.ca

OTTAWA/RIDEAU: Kars, Ont. 1st Tuesday. Contact: Secretary, Bill Reed 613-858-7333 bill@ncf.ca

SAUGEEN: Third Saturday for breakfast at Hanover Airport. President: Barry Tschirhart P.O. Box 1238 27 Ridout Street Walkerton, Ontario. Home: 519-881-0305 Cell: 519-881-6020. Meetings are held every second Tuesday evening, at 7:30pm. Location(s) Saugeen Municipal Airport, Kincardine or Port Elgin. All interested pilots are welcome. Email: barry.tschirhart@bell.net

YQG AMATEUR AVIATION GROUP (WINDSOR): Forth Monday, 7:30 pm Windsor Flying Club, Airport Road, Contact: Kris Browne e_kris_browne@hotmail.com

SCARBOROUGH/MARKHAM: Third Thursday 7:30 pm Buttonville Airport, Buttonville Flying Clubhouse. Contact Bob Stobie 416-497-2808 bstobie@pathcom.com

TORONTO: First Monday 7:30 pm at Hangar 41 on north end of Brampton Airport. Contact: President Fred Grootarz - Tel: (905) 212-9333, Cell: (647) 290-9170; e-mail: fred@acronav.com

TORONTO ROTORCRAFT CLUB: Meets 3rd. Friday except July, August, December and holiday weekends at 7:30 pm Etobicoke Civic Centre, 399 The West Mall (at Burnhamthorpe), Toronto. Contact Jerry Forest, Pres. 416 244-4122 or gyro_jerry@hotmail.com.

WIARTON: Bruce Peninsula Chapter #51 breakfast meetings start at 8:30am on the second Saturday of each month in the Gallery of Early CanadianFlight/Roof Top Cafe at Wiarton-Keppel Airport. As there are sometime changes, contact Brian Reis at 519-534-4090 or earlycanflight@symptico.ca

MANITOBA

BRANDON: Brandon Chapter RAA meets on the second Monday of each month at the Commonwealth Air Training Plan Museum at 7:30 PM except in the months of July and August. Contact Pres. John Robinson 204-728-1240.

WINNIPEG: Winnipeg Area Chapter: Third Thursday, 7:30 pm RAA Hangar, Lyncrest Airport or other location as arranged. Contact President Ben Toenders at 204-895-8779 or email raa@mts.net. No meetings June, July & Aug. RAA Winnipeg info also available at Springfield Flying Center website at http://www.lyncrest.org/sfcraac.html.

SASKATCHEWAN

Chapter 4901 North Saskatchewan. Meetings: Second Tuesday of the month 7:30pm Prairie Partners Aero Club Martensville, Sk. info at www.raa4901.com. Brian Caithcart is the chapter president. Contact email: president@raa4901.com.

ALBERTA

CALGARY chapter meets every 4th Monday each month with exception of holiday Mondays and July & August. Meetings from 19:00-21:00 are held at the Southern Alberta Institute of Technologies (SAIT) Training Hangar at the Calgary Airport. Join us for builder discussions, site visits, tech. tips, fly out weekends and more. Contact President Dennis Fox dennis77fox@gmail.com 403-443-8434 or Secretary Bruce Flach o2fly@yahoo.ca

EDMONTON HOMEBUILT AIRCRAFT ASSOCIATION: meets second Monday - Sept. to June. Contact Pres. Roger Smeland - 780-466-9196 or Jim Gallinger 780-242 5424. Website www.ehaa.ca

GRANDE PRAIRIE: Third Tuesday, (September to April), 7:30, 2nd floor boardroom of the Grande Prairie Terminal Building. Summer events on an informal schedule. For more information contact Lee Merlo at 780-518-4254 or e-mail arniesusanmeyer@gmail.com

BRITISH COLUMBIA

DUNCAN: Second Tuesday 7 pm members homes (rotating basis). Contact Pres. Howard Rolston, 250-246-3756.

OKANAGAN VALLEY: First Thursday of every month except July and August (no meetings) at the Mekong Restaurant.1030 Harvey Ave. Dinner at 6:00pm, meeting at 7:30pm Contact President, Cameron Bottrill 250-309-4171 email: Outintheair@yahoo.ca

QUESNEL: First Monday/Month 7:00 p.m. at Old Terminal Building, CYQZ Airport. Contact President Jerry Van Halderen 250-249-5151 email: jjwvanhalderen@shaw.ca

SUNCOAST RAA CHAPTER 580: Second Sunday 13:30 pm Sechelt Airport Clubhouse, sometimes members homes. Contact Pres. Gene Hogan, 604-886-7645

CHAPTER 85 RAA (DELTA): First Tuesday 7:30pm, Delta Heritage Airpark RAA Clubhouse. 4103-104th Street, Delta. Contact President Peter Whittaker pwhitt@telus.net Website www.raa85.ca.

VANCOUVER ISLAND AVIATION SOCIETY (VICTORIA): Third Monday 7:30 pm Victoria Flying Club Lounge. Contact Pres. Roger Damico, 250-744-7472.

THOMPSON VALLEY SPORT AIRCRAFT CLUB: Second Thursday of the month 7:30 pm Knutsford Club, contact President Darren Watt 250-573-3036

ALASKA HIGHWAY: meetings held every third Thursday of every month (except July & August) at the Taylor Fire Hall at 7:30 p.m. For more information call Gerry at 250-782-4707 or Heath at 250-785-4758.

Chapter executives, *please advise of changes as they occur. For further information regarding chapter activities contact RAA Canada, Waterloo Airport, Breslau ON N0B 1M0 Telephone:* 519-648-3030 *Member's Toll Free line: 1-800-387-1028*

Emails can be sent to President Gary Wolf at: **garywolf@rogers.com** *and George Gregory at* **gregdesign@telus.net.**

Classifieds

To submit or delete a classified ad, please send to raa@raa.ca and place "RAA ad" in the subject line.

The Recreational Flyer is pleased to offer you colour advertising within the magazine. Previously limited to the back cover, we have added 4 new colour pages which will be available with limited space for your advertising needs. Our rates for both black and white and colour ads remain very competitive and you reach a captive and qualified audience. Emails can be sent to President Gary Wolf at: garywolf@rogers.com and George Gregory at gregdesign@telus.net

Deadline for submissions is the first of the month preceding date of issue.

Artwork: Rates apply to camera ready artwork. Digital files are preferred and should be sent as email and in .txt format, PDF, JPEG, MS WORD, Photoshop or other common file types. Advertising is payable prior to printing of magazine unless other arrangements have been made. Payment is in Canadian funds. 10% Discount applies to one year (6 issues) insertion paid in advance. Commercial Classified ad rates 1/8 page minimum.

Advertising Policy: The Recreational Flyer Publisher reserves the right to refuse any or all advertising for any reason stated or unstated.

The Recreational Aircraft Association Canada does not assume responsibility for advertisements, but does exercise care to restrict advertising to responsible, reliable individuals.

Please note: Ads running more than 3 issues must be renewed to guarantee continued display in the magazine.

Recreational Aircraft Association Canada
President: Gary Wolf / Treasurer: Wayne Hadath

Recreational Flyer Magazine

Registration Mail Publication No. 09869

Contributing Editors: Gary Wolf, Don Dutton, George Gregory, Wayne Hadath, Tom Martin
Art Director and Layout: George Gregory.
Printed by Rose Printing Orillia, ON

The Recreational Flyer is published bi-monthly by the Recreational Aircraft Association Publishing Company, RAA Canada 22-4881 Fountain St. North Breslau RR2 Ontario N0B 1M0 . Toll Free line: 1-800-387 1028

Purchased separately, membership in RAA Canada is $35.00 per year, subscription to Rec Flyer is $35.00 per year; subscribers are elegible for reduced membership fees of $15.00 per year. Rec Flyer to have a single issue price is $6.95.

The Recreational Flyer is devoted to the aerospace sciences. The intention of the magazine is to promote education and safety through its members to the general public. Material in the Flyer is contributed by aerospace engineers, designers, builders and restorers of aviation devices and vehicles, used in an amateur capacity, as well as by other interested persons, publications and organizations. Contributions to the Recreational Flyer are voluntary and without remuneration. Opinions expressed in articles and letters do not necessarily reflect those of the Recreational Aircraft Association Canada. Accuracy of the material presented is solely the responsibility of the author or contributor. The Recreational Aircraft Association Canada does not guarantee or endorse any product offered through articles or advertising. The Flyer and its publisher welcomes constructive criticism and reports of inferior merchandise or services offered through advertising in the publication.

BELITE FUEL PROBE SYSTEM 1/8" A.S # 10-05866 never used $180; Sky Tec Solenoid A.S, # 07-03562 never used $50. Aerovoltz battery charger $80 Ask about 16 cell Aerovoltz lithium battery + shipping
Mike 519-762-3910 or mtyit@start.ca

BASIC ULTRALIGHT PROJECT for sale, all metal low wing tail wheel, not registered. Asking $8000.00 OBO, also have an EA-81 with belt redrive, willing to take trades, 701 or 750 Project or side by side 4 wheeler. Email billdonig@hotmail.com 705-842-0801.

CLEANING THE HANGAR - SELLING AS A PACKAGE.
1. Maranda project on gear, at precover stage with all woodwork completed to a high standard. This is a spacious STOL aircraft with folding wings. FREE to someone who will finish the project.
2. Brand new unused Fleet Canuck fuselage on gear, registered with MD-RA
3. Another Canuck fuselage with data plate and logbook
4. Lycoming O-320 E2D engine
5. New panel instruments in their boxes, plus a supply of AN hardware
This is being sold as a package only, $15K CDN. OBO. 519-806-8560, Brian

BOWERS FLY-BABY for sale , asking $5,500 CDN. No Engine. Needs some Instruments. Test flight time has been flown off. TTAF 29.8 Hrs, built in 1970. The wings are off and it has been stored inside. B.C. Canada. bill.clifford@hotmail.com

AVIATION HEADSETS, 2 Pilot, 2 Flightcom, $100 each OBO. Also old Bendix turn and bank (air driven) and altimeter, best offer. 416-822-0438 or 905-787-0017 or 416-456-8411 or 416-221-2392

E.A.A. BIPLANE, Ron Riley's first homebuilt, airframe only, includes cowlings, motor mount, flying wires from Acro 1, N.O.S. canopy, fabric & other covering materials, wood etc. Dismantled," sold as is, where is" $3500. G Trimble 519 461 1665 ijtrimble@gmail.com

ANDERSON KINGFISHER C-FBQF, a 2 seat amphib flying boat with a 2016 Aerotech overhauled 160 Lycoming. All new instruments and accessories. Maiden flight was October 2017. Asking $48,000. Contact Guy at gmlefebvre@outlook.com

1946 PIPER PA-12, rebuilt as Owner Maintenance in 2000. Lycoming 160 hp with 270 hours. New 2250 floats and rigging by Ed Peck Aero in 2016. Useful load 1000 lb. Long range tanks and all attributes and goodies required of a perfect bush plane. Overall condition is 9/10. $100K gmlerfebvre@outlook.com

WANTED - LYCOMING 360 running engine or core for rebuilding, will consider carbureted or injected. bwelfred@rogers.com (Ontario)

1938 110 CLIP WING MONOCOUPE project. Custom built, not from plans. No engine, no instruments. Wings, ailerons, full tail group and fuselage, all wood, not covered. $5000, make an offer or trade. Email for pictures tisr@golden.net

AVIAT HUSKY PROJECT. Salvaged fuselage repaired, on gear, header tank, tail wheel, tail feathers, new wings built, have fuel tanks, no panel, controls installed. Was built according to the 51% rule. No engine. $23000 or make an offer. Email for pictures. tisr@golden.net

FOR SALE - Flightcom Model 403 Panel mount Intercom, New in box never used. Paid $240 ...sell for $150 or best offer. bwkirk@mts.net

FOR SALE - Four lengths of spar grade sitka spruce. 7/8" x 6 1/4" rough, x 20 ft. This will plane down to 3/4" x 6". Located in Kenora, Ontario. I will box and wrap and carry to a shipping depot. Buyer pays shipping, or my ship costs will be added to purchase price. Cost for this material, planed, at Aircraft Spruce Canada is $14/ft, I am selling for $600 CDN. Call 807-468-4764, or email pjohnson@kmts.ca.

FOR SALE - Complete Ivoprop Magnum in flight adjustable pitch prop for sale. 4 3/4" Bolt pitch Dia. 37 hrs. on a V6 260hp Engine. (Spitfire MK 26B). Asking $2,000.00 CAD. Please contact Bob Poole at Aerostructural Inc 416-844-9440,

Partial kit for Zenair CH 640 See my Facebook photo album for progress (George Lowes). I've lost my medical. See Zenair web page for specs.
http://www.zenair640.info/standard-ch-640-kits.html
Kits List Price in $US: Rudder Tail 590.00, Tail (Manual Trim) 1,995.00, Wings 7,995.00, Fuel System 1,495.00, Extended Range Auxiliary Fuel Tanks 2 X 46 USgal 900.00, Nav/Strobe/Position Lights (Incandescent NOT LED) 828.00. Total List Price 13,803.00 $US. Many air tools are also available. $10,000 OBO. George Lowes 705-843-0826

FOR SALE: 2 Vintage Aircraft: Looking for an amazing aviation project or two?
1946 Aeronca Champ CF-GIA mostly flown by little old lady on Sundays… seriously…Fuselage needs to be covered-have sleeve and head liner-rest of airframe ready for new paint if desired TTAF 1831.4 hours. Total Engine Time since overhaul 2.0 hours. Owner maintenance category.
1946 Aeronca Champ CF-DBK, new fabric and paint, needs struts, control cables and windshield installed (have windshield). TTAF: 4731.0, 0 time overhauled engine Owner maintenance category.
All logbooks and records intact ASKING: $12 500 each, $23 000 for both. Please contact Donna Loretto at flightnote@hotmail.com or call 613-675-2301

BX-1000 Black Max brakes, wheels and tires. 6 inches, axles 5/8" Brand new. 575.00 OBO. Lmistor@hotmail.com 289 838-9588, 905 469-2198

Vans RV-6A with 160 HP 0-320 engine build by Reliable Horsepower about 350 hrs. on plane and engine, prop. Dual brakes, Altitude hold, Electric flaps, Dynon DEK 180 4 cyl head, 4 egt., electronic 6 pack, amps, volts , oil temp, pressure, time , timers, g meter, fuel, fuel pressure, etc. etc. Narco Solid state transponder, mode C - AT165 TSO, Avmap EKP IV, ICom Radio - CI A210 flip, flop.
Mechanical air speed, also121.5 elt, Metal prop, Tip up canopy, Strobes on wings tips. No paint. This plane flies well and has full logs. Asking $55,000 CDN. All parts were new at time of build. Don Kingsley 519 372 1383 we3kingers@yahoo.ca

Maranda Amateur Built for sale. I lost my medical and can't fly. Last flew in June 2018. Yearly inspection has not been renewed. Just disassembled first week of Sept and stored in building. Flew average 20 to 25 hours yearly and was kept in a hanger. Low time on Leavens rebuilt engine and metal seaplane propeller. Asking $12000 OBO to set up a viewing or info please call 705-941-8033 or email billdonig@hotmail.com

Ads run for a maximum three issues depending on space available and then must be renewed for continued display. Please direct all classified inquiries and ad cancellations to: garywolf@rogers.com and place "RAA ad" in the subject line.

Support Canadian Sport Flying

The Recreational Flyer is only as good as the content supplied to us. We rely on the input from members who are willing to share their expertise, stories, completed projects and what their chapters are doing.

Contact George Gregory at gregdesign@telus. net or Gary Wolf at garywolf@rogers.com. ***Send your contributions in today!***

Classifieds On The Internet:
http://tvsac.net/BS1.html - more ads from our Kamloops chapter

Across Canada

RAA Chapters in Action

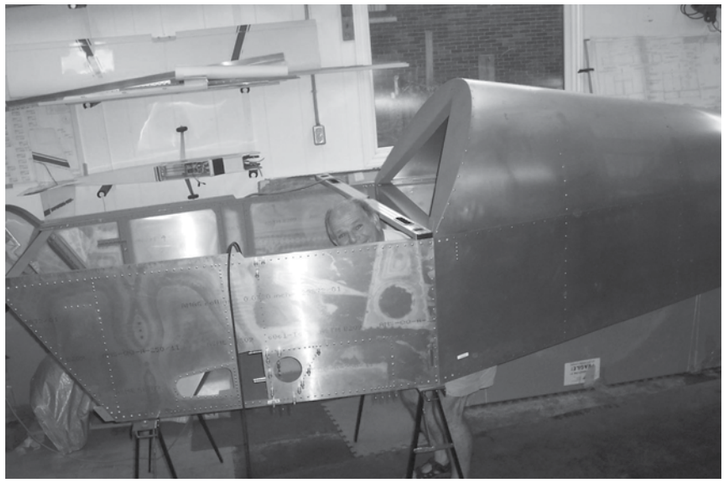
Tim Novak

RAA London - St. Thomas

There are no formal minutes for the July meeting as it was the Club's annual picnic. Bill Weir hosted the event at his place. Weather was great, though a little gusty for those that flew in. Special guests included Sharon and Richard Moon, former owners of Aero Academy and long-time aviation supporters. This was a catered event so all were able to enjoy the event without having to prepare a meal ahead of time.

Special thanks needs to be expressed to Bill's daughter Nancy, and Bill's grounds keeper Brooke who made the event possible.

Phil Hicks reports he's back working on his Sonex after vacationing in Nepal. He writes: "My thoughts are on my instrument panel For the past year or so, I have been pondering using the MGL stack of instrumnets but have recently been considering the use of the Talos Avionis Tablet enabled unit. This is now equipped with ADS-B as well These devices allow you to use the tablet of your choice (Android or iPad) and present all flight and navigation information on it".



Phil Hicks peeks up through the floor of his Sonex project. Below, unexpected visitors to Chapt'er 85's Show and Shine was a wedding party. Obviously the newlyweds are starting off on the right foot! Opposite, chapter 85 members looking over the nearly complete chapter aircraft, and more pictures from the chapter's Show and Shine.

RAA Vancouver

The September membership meeting is marked by the Annual Show & Shine for Chapter 85. This is based on an informal BBQ meeting, hopefully with good weather and is an event where members can bring out their aircraft and trade building notes and flying stories.

This years September meeting (September 4th) had clear skies and for once, a light breeze was aimed straight down runway 25 instead of perpendicular to it. This was the last clear day before a major weather pattern shift was forecast to arrive by Environment Canada and which would see cold and wet fall weather move in 3 weeks before normal.

Jim and Connie Stunden did a great job of organizing food and running the BBQ (Fig.1) with members bringing in a collection of salads and snack items. Chairs were lined up outside (Fig.2) and everyone gathered around for spicy Italian sausages, bratwust and smokies. Eric Munzer arrived in his beautifully restored Dornier Do-27 and Peter Whittaker brought in his scratch-built Zenith 601 HDS (Fig.3). A newly restored C-152 by John Smith was wheeled out from the RAA hangar for the event (Fig.4) and Cyril Henderson taxied over with his immaculate C-120 (Fig.6, page 42).

An unexpected but momentous event took place in the afternoon. The Chapter 85 Round House had been rented out to the friend of a member for the friends wedding. The groom flew in for the ceremony in his RV-6 which was still in the stage of flying off the required 25 hours before having restrictions removed from the Special Certificate of Airworthiness. The bride and her parents approached from the Boundary Bay side of Delta Airpark and to shelter from the wind

Fig 5
Peter Whittaker

Fig 1 / Peter Whittaker

Fig 2 / Peter Whittaker

Fig 3 / Tim Novak

Fig 4 / Peter Whittaker

until the appropriate moment, asked to stay in the Chapter 85 workshop (Fig.5, page 40). The bride was also very interested in the 750 Cruzer project and we scruffy builders had a good opportunity to explain the project to the bride and her parents. This appears to be a truly aviation-oriented couple.

Since the last President's Message in July, summer took full effect and building activities on the 750 Cruzer slowed down a bit as people went off on summer vacations. In addition to that, there was no general membership meeting for July which is the usual summer break. The August membership meeting hosted guest speaker Chris Georgas who was the founder of Pacific Rim Aviation at Pitt Meadows airport. Chris gave a captivating and animated talk on the development of the first air mail network across the USA. This network initially consisted of large concrete arrows, painted yellow, which were later illuminated for night navigation. At spacings of approximately 10 miles, they were visible from open cockpits and formed a chain of navigation aids from New York City to San Francisco (Figure 7).

Chris was presented with a Certificate of Appreciation by past president John Macready (Figure 8). Chris was also given a Chapter 85 ball cap.

The main event for the 750 Cruzer project was the first engine start. The Cruzer was wheeled outside and the main gear were firmly chocked. Pre-oiling had been done earlier and the next step was to do a short runup of just a few minutes. The propeller was the 72" Whirlwind prop that we acquired together with the engine. The O-200 started instantly and then it was discovered that it could not be shut down using the ignition – live mags! The engine was shut off using mixture and the problem is being worked on.

Concern amongst builders over propeller clearance, which is barely 6", has led to a decision to replace the 5.00-5 wheels on the Cruzer with larger wheels that are used on the 750 STOL. Once these are installed, which give a propeller clearance of 12", the next engine runup will be done.

Fig 6 Photo by Peter Whittaker

Fig 7 / Peter Whittaker

Fig 8 / Peter Whittaker

Figur 6 : Cyril Henderson and his immaculate C-120. Figure 7. Concrete arrows, painted yellow, and illuminated at night were used as early navigations aids in the 1920's for US Postal Service air mail flights. Many of these are still maintained and in use. Photo courtesy of Chris Georgas. Figure 8. John Macready (right) presented Chris Georgas (left) with a Certificate of Appreciation on behalf of Chapter 85 for his presentation "Concrete Arrows". Chris was also the lucky recipient of a red Chapter 85 ball cap!

AIRCRAFT SPRUCE

AIRCRAFT SPRUCE IS YOUR ONE STOP SHOP FOR PARTS & PILOT SUPPLIES - SINCE 1965

BUILDING MATERIALS & KITS

Composite Materials • Covering Supplies
Electrical • Hardware • Metals & Plastics
Tools • Wood Products • Kits & Plans

AIRCRAFT PARTS

Airframe Parts • Electrical • Engine Parts
Landing Gear • Hardware

AVIONICS & INSTRUMENTS

GPS • EFIS • Panel Transceivers
Audio Panels • Attitude Indicators

PILOT SUPPLIES

iPad/iPhone & Android • Apps • Mounts
Flight Bags • GPS Accessories

FREE CATALOG!

Aircraft Spruce & Specialty Co. SINCE 1965

LOWEST PRICE 100% GUARANTEED

AIRCRAFT SPRUCE TRANSPORT CANADA APPROVED

ASK FOR YOUR STAMP!

(877) 795-2278

www.aircraftspruce.ca