EXPERIMENTAL AIRCRAFT ASSOCIATION 245 OTTAWA

Carb Heat

NEWSLETTER

Hot Air and Flying Rumours
Vol 27 No. 3

Published by EAA Chapter 245 (Ottawa) P.O. Box 24149 Hazeldean R.P.O., Kanata, Ontario, Canada, K2M 2C3
e-mail adouma@ftn.net

March 1997

Next Meeting: Thursday 20th March 2000hrs
Bush Theatre
National Aviation Museum

Program: **Regular monthly business**

Inside:
- **Presidents Page by Gary Palmer**
- **Listing of EAA Chapter 245 Officers from 1970 to the present**
- **The Jug Jungle Part 3 by Mike Busch (mbusch@avweb.com)**

Guest Speaker: **-Wolfgang Weichert will discuss the building and test flying of his recently completed RV-6**

Winter maintains its grip on the National Capitol Region as we seem to be paying for the late arrival of winter with regular March snowfalls. Checking my logbook for the last three years, it seems that I was able to get airborne by the end of March. Judging from the snow on the ground this year, mid April seems more likely.

Mazda Rotary Status

Les Staples, continues to amaze us with his steady progress on his ambitious **Mazda Rotary** Conversion project. Since I last reported, he has completed the stainless steel exhaust system. This was fabricated completely from raw materials, from the Headers, right down to the Muffler. As usual, the welding is flawless, leaving us mere mortals in awe of Les's ability.

The intake manifold is complete, being a blend of aluminum, and composite construction. The 4 Mikuni motorcycle Carbs have been modified to ensure that they will return to full throttle in the event of a throttle cable failure.

The throttle and choke linkage is an innovative concentric shaft arrangement designed by Les himself.

Most of the work on the reduction drive, is complete, with the hub having been splined to fit the output shaft from the transmission. Les is leaving this assembly to the end, as first runs will be without the drive.

Les also made a nice large 5 inch aluminum pulley for his alternator. Under his careful tutelage, I renewed my acquaintance with a lathe, and turned out a respectable facsimile for my own alternator. In both cases, we are using the small 30 amp Nippon-Denso alternator from a Chevy Sprint. A real nice choice for a home-built.

Les has a beautiful Aluminum radiator from a Volkswagen Jetta for the cooling system which will be jury rigged on the test stand for the initial test runs. Les is in the home stretch, and I still expect first smoke before the snow departs, or certainly before my own bird takes to the air for the first time in 1997.

If you drop out to the club house on weekends you will generally find Les more than willing to share a bit of time and display his pride and joy. I continue to dream of all that smooth power in my Lancair someday.

Carp Airport Status

Transfer of ownership of the airport from Transport Canada to the RMOC should have been completed by the time you read this newsletter. The latest news however, leaves things still very much in a state of limbo as far as leadership is concerned.

At a meeting of the Regional Economic development Committee last week, a proposal was tabled that would see windup of the existing Airport Authority.

In its place the airport would be managed by regional staff, although the specifics of this are unknown at this time. The longer term proposal is to have Carp managed under contract by the same private corporation that runs Ottawa International. Only time will tell whether this is a move in the right direction or not.

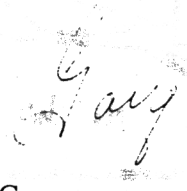
In the meantime, it is business as usual until the region get their act together.

February highlights

Unfortunately, our scheduled speaker, Roger Grant, could not make the meeting. In his place, Luc DeSadeleer provided an interesting video; "**Taming the Tail-dragger**". For those of us who learned to fly with "training wheels" this was an interesting video. It was nice to know that Carp is not the only airport blessed with perpetual cross-winds.

Mar. 20th Mtg. at NAM:

Our next meeting will feature **Wolfgang Weichert** who will discuss his building, and test flying experiences with his recently completed RV-6. For those who have been fortunate enough to see this finely crafted machine, it will be an inside look at the trials and tribulations that precede the joy of the first flight. For those still evaluating different options, it will be invaluable input on the merit of Richard Van Grunsven's designs. Wolfgang will be illustrating the project with Video that covers the building and test flight. Included in the video, is also some interesting spins in a Katana. Sounds like fun, so I look forward to seeing you on Thursday March 20th at the **Aviation Museum**, 8:00 PM sharp start.



Gary

Editors Notes

You may have noticed on the masthead that I've started to include a volume and number. I have gone through the Chapter archival material and discovered that the first issue of Carb Heat came out in 1970. That makes this the Chapters 27th year of existence. For interest sake I have produced a listing of Chapter officers from past to present in this issue.

I wish to announce that I will be stepping down from the Editors position as of the next AGM. I am hoping that some enterprising individual will come forward to assist and learn the process of cranking out this here newsletter. I have it running quite smoothly now but I feel it is time for a new approach and some new energy. I have been involved with the Chapter since 1981 when we were still meeting at the NRC. I have been Secretary, I've done Membership, Tool Crib and I'v been producing membership lists and front pages since the mid '80s. Time for some fresh blood.

Its been fun, thanks to all the help I received along the way. AGD

The Jug Jungle

Whether you're approaching major overhaul or just dealing with one jug with a mid-life crisis, you face a bewildering array of cylinder choices: factory new, oversize, rebarrel, nitrided, through-hardened, channel chrome, Cermicrome, Nu-Chrome, Cermisteel, IFR, Freedom, and now CermiNil and Millennium cylinders...whew! Here is our survival guide for sorting through this maze and choosing replacement cylinders wisely. **This originally appeared in The Aviation Consumer.**

by Mike Busch (mbusch@avweb.com)

Part 3

Anatomy of a Factory Cylinder

Piston aircraft engine cylinders are more complicated than you might expect, both in their construction and their metallurgy. In evaluating cylinder reconditioning options, it's helpful to have a good understanding of how a factory-new cylinder is created.

Each cylinder starts out with the cylinder head, a very elaborate finned sand-casting of aluminum alloy. The raw casting undergoes a complex series of precise numerically-controlled milling, boring and tapping operations that create holes for the spark plugs, injector or primer nozzle, CHT probe, valve guides, valve seats, rocker shafts, pushrod tubes, intake and exhaust port studs, plus threads for the head-to-barrel joint.

The cylinder barrel is machined from a large forged steel billet. The billet is bored to the required inside diameter and turned to create the base flange, barrel fins, and head-to-barrel threads.

The inside of the barrel is then hardened using a nitriding process in which the barrel is placed in an oven, heated to about 1000 F, and exposed to ammonia gas. The ammonia liberates nitrogen which impregnates the surface of steel barrel bore and hardens it. Nitriding creates a very hard and durable wear surface five to fifteen thousandths of an inch thick.

Nitrided steel barrels were adopted by both Continental and Lycoming in the early 1970s. They were instrumental in the extension of TBOs from 1200-1500 hours in the `60s to 1600-2000 hours today. (Improved valves, guides, and cams helped, too.)

After nitriding, the steel barrel is mated to the cast aluminum head. This is accomplished by heating the head in an oven, chilling the barrel in a refrigerator, and then quickly screwing them together. As they return to equal temperatures, the head contracts and the barrel expands to create a tight interference fit. After the head and barrel have been mated, the cylinder base flange mounting holes are drilled.

The next step is to grind and hone the cylinder bore to its final fit and finish. The bore must be exactly the proper diameter and perfectly round, within less than a thousandth of an inch of new specifications.

The bore is not precisely cylindrical--it is tapered in the top two inches of piston ring travel, usually by .003" to .007". This choke is used to compensate for the fact that when the cylinder is at operating temperature, the top of the barrel is considerably hotter than its base, and therefore it expands more. If the cylinder

were not adequately choked at room temperature, the piston-to-cylinder clearance at top-dead-center would become loose and sloppy as the cylinder heats up, and the rings would flex excessively.

Finishing Touches

Once the cylinder dimensions are precisely correct, the cylinder bore is honed to create a very fine crosshatch pattern of scratches, typically 25 microinches deep and at a 35 angle. This microfinish is crucial to ensure proper break- in, cylinder lubrication, and ring rotation. A perfectly smooth cylinder wall won't hold an oil film, while an overly rough one will result in accelerated wear and poor ring sealing.

At this point, the cylinder is complete except for valves. This is known in the trade as a stud assembly.

Valve guides and seats are press-fit into the cylinder head (after heating it). The guides are normally reamed and honed in place to ensure perfect concentricity with the seats as well as a close-tolerance fit with the valve stems. Then the valves, valve springs, valve retainers and rotators, rocker arms and rocker shafts are installed. At this point, we have what is known as a valve assembly.

Add a piston, piston pin, and a set of rings (two compression rings, an oil control ring, and sometimes a scraper ring) and you have a complete power assembly. Replacement cylinders are most often ordered in this form.

Whew! Is it any wonder that new cylinders ain't cheap?

All About Reconditioned Cylinders

Back in the bad old days when factory-new jugs were both exorbitantly priced and in short supply, the industry developed (and the FAA approved) a variety of reconditioning techniques to permit old worn-out cylinders to be given a new lease on life. Today, factory cylinders are far less costly and far more available, but reconditioned jugs still abound and most overhaul shops still use them unless you specify that you want new cylinders.

The cheapest way to recondition a cylinder is to bore it oversize and fit it with oversize pistons and rings. Continental offers pistons and rings in .010" and .015" oversize versions. Lycoming offers .010" and .020" over.

However, the advent of nitrided steel cylinders has thrown a monkey wrench into the works. Nitriding hardens the surface of a steel barrel to a depth which varies between .005" and .015". If you grind a nitrided barrel to .010" oversize, the new surface is likely to have some places that are still hardened and other places that aren't. Such a cylinder will wear irregularly (not good). Go to .015" or .020" over and there probably won't be any of the nitride-hardened layer left at all.

Lycoming does not allow oversizing of nitrided cylinders except in a handful of low-compression engines. But Lycoming's service instruction doesn't have the force of law, so cylinder shops still oversize these jugs all the time. Continental prohibits oversizing only in their fire-breathing 375 hp GTSIO-520 engines. But that doesn't change the laws of physics, and doesn't make oversizing of nitrided jugs a good idea. It isn't.

Chrome Plating

Moving a notch up the cylinder rework food chain is chrome plating. Here, the worn barrel is ground oversize, and then a layer of chrome is deposited via electroplating to bring the cylinder back to new dimensions. (A good chrome plating job is about .015" thick. A bargain basement one might be a lot thinner.)

Standard pistons can then be used, but chrome cylinders require special cast iron rings (instead of the chrome-plated rings used with steel cylinders). An often-overlooked disadvantage of chrome cylinders is that the relatively soft cast iron rings wear out faster than ordinary chrome rings do.

Chrome is a very hard and durable wear surface--even more so than nitrided steel--and has the additional advantage of being almost immune from corrosion. However, a smooth shiny chrome surface is not oil-wettable, so something must be done to the chrome to allow an oil film to adhere to it.

The traditional solution to this dilemma, used successfully for decades, is channel chrome. In this process, when chrome has been electroplated to the desired thickness, the current flow in the plating tank is reversed for a short (and critical) period of time. This results in a chrome surface that isn't smooth but has numerous microscopic fissures (called channels) that provide a "foothold" for oil to adhere.

There are a couple of problems with channel chrome. The channelling process is apparently more black art than precise science, and it's difficult for even the best plating firms (such as ECI in San Antonio) to get consistent results. If the channels are too shallow, the cylinder won't

make TBO. If they are too deep, oil consumption will be high. Even the very best channel chrome cylinders tend to burn a lot more oil than steel. Lots of folks love chrome. They believe that its durability and corrosion resistance are worth the tradeoff in oil consumption. Chrome is a particularly good choice for operators with extreme vulnerability to corrosion, such as salt water floatplanes and highly seasonal operations.

Cermicrome and Nu-Chrome

In an effort to come up with a chrome cylinder with low oil consumption, ECI secured a license for a new cylinder reconditioning process that ECI dubbed Cermicrome(TM). Cylinders are bored oversize and electroplated with chrome, just as with channel chrome. But instead of channeling, Cermicrome uses tiny silicon carbide particles that are mechanically impregnated into the chrome surface. The particles have a strong affinity for oil, and provide the necessary foothold that allows an oil film to adhere to the surface.Unlike channel chrome, the Cermicrome process yields consistent, predictable results. The relatively smooth finish supports a much thinner oil film that provides far lower oil consumption than channel chrome--even lower than steel in many cases. And the carbide particles act like a polishing compound for cast iron rings, providing extremely quick break-in. Cermicrome was an instant smash hit, and Cermicrome cylinders started selling like hotcakes. For awhile, ECI had a lock on the market. Eventually, a similar competing process called Nu-Chrome(TM) was developed by Aircraft Cylinders of America. Nu- Chrome cylinders are distributed by Diversified Manufacturing Corp. (Divco) in Tulsa. Our comments about Cermicrome apply to Nu-Chrome, too.

It took a few years before there was enough field experience with these particle-infused chrome cylinders to discover that they have one significant shortcoming: they don't wear gracefully. The problem is that the mechanically-impregnated particles penetrate the surface layer of the chrome plating only to a depth of perhaps .001". Chrome is very hard and silicon carbide particles are even harder, so it takes a lot to induce wear. But if dry starts, cold starts, or inadequate lubrication manages to wear a Cermicrome cylinder as little as .001", the particle-infused layer is gone and what's left is shiny chrome that won't hold an oil film. Once this occurs, the cylinder is doomed. It's been known to happen in as little as 500 hours.

What's worse, there's no easy way to rejuvinate a worn Cermicrome cylinder in the field. You can't just hone it and put it back in service with new rings, the way you might do to clean up the ring-step of a steel cylinder. You certainly can't grind it oversize. There's basically no alternative but to have the clinder put through the entire Cermicrome process again, or to swap it for an exchange cylinder.

The bottom line is that Cermicrome and Nu-Crome work well for low-horsepower high-utilization aircraft where barrel wear isn't usually a problem. But high-horsepower low-utilization aircraft may not get good longevity from these cylinders. Most owner-flown aircraft fall into the low-utilization category, and many are also high-horsepower as well.

One might well argue that cylinder longevity is irrelevant in a truly low-utilization aircraft. If the aircraft flies only 100 hours per year, who cares if the cylinders make 2000 hours TBO? The cam and lifters will most likely rust out long before the cylinders wear out.

CermiNil

In mid-1994, ECI announced yet another cylinder plating process that they call CermiNil(TM). In this process, the cylinder is plated with a particle-infused nickel-based coating instead of chrome. Like Cermicrome, CermiNil uses silicon carbide particles to increase wear resistance, speed break-in, and improve oil adhesion. But unlike Cermicrome, the silicon carbide particles in CermiNil permeate the entire thickness of the nickel coating, not just the surface. So CermiNil should wear much more gracefully than Cermicrome, and it should be possible to re-hone CermiNil in the field.

Nickel is not nearly as hard as chrome. However, CermiNil contains three times the concentration of silicon carbide particles as the surface of Cermicrome does (7-10% by volume for CN, compared to 2-3% for CC), and silicon carbide is incredibly hard (think of it as man-made diamond dust). Consequently, ECI believes that the CermiNil composite should resist wear and corrosion just as well as Cermicrome. And when it does wear, CermiNil won't lose its oil wettability.

Chrome plating (including Cermicrome) is accomplished with the cylinder assembly intact, but the CermiNil process requires that the barrel be de-mated from the head before it is plated. ECI actually touts this as an advantage, since the head-to-barrel joint can be inspected with dye penetrant, the threads cleaned up, and an epoxy sealant applied during reassembly.
Another advantage is that nickel is much more eco-friendly than chrome. The EPA is making life more and more difficult for chrome plating firms, and that situation can only be expected to get worse.
All in all, CermiNil looks very promising to us...on paper, anyway, But frankly, Cermicrome looked awfully good five years ago, too. The fact is that there's simply no substitute for field experience, and CermiNil hasn't yet had enough to be meaningful. Will CermiNil make TBO in high-horsepower low-utilization aircraft? Nobody really knows. We're inclined to take a wait-and-see attitude about CermiNil until it has been in the field for a few years.
Rebarrelling
One more cylinder reconditioning technique is simply to de-mate the head from the barrel, discard the old barrel, and screw a new steel barrel into the old head. For many years, ECI has been the predominant cylinder rebarreller. ECI's replacement barrels are made of through-hardened steel and are not nitrided.
Lately, ECI has started offering replacement steel barrels with silicon carbide particles impregnated into the surface. As always, they have a catchy name for this: CermiSteel(TM).
Heat Treating
Regardless of how a cylinder is reconditioned--bored oversize, plated to new dimensions, or rebarrelled--an old cylinder head is being reused. As it accumulates thousands of hours in service, the aluminum head casting becomes more brittle and prone to cracks. Most of the time, cylinder reconditioning requires weld-repairing of minor cracks that commonly develop in the exhaust port area of the head. Even the most careful welding can heat-stress the head casting and make it more susceptible to future cracking.
A few years ago, ECI introduced a heat treating process for cylinder heads that they claim will restore the original crystalline structure and metallurgical properties of a cylinder head, and thus reduce the likelihood of head cracks. They call this process IFR(TM) (Improved Fatigue Resistance), and charge an extra $120 per cylinder for it. ECI has an impressive collection of engineering data and electron microscope pictures to support their claims for this process. Frankly, it hasn't been in the field long enough for anyone to know how effective it is in preventing head cracks. At this point, all we can say is that it probably couldn't hurt.
-
The 4th and concluding article will appear next month. Ed.

========On the Horizon========

Date	Day	Time	Event	Location
March 20	**Thu**	**2000hrs**	**EAA245 meeting**	**NationalAviationMuseum, Rockcliffe**
March 23	Sun	Sunday brunch		IFF St. LOV at Chimo Inn Ottawa
April 6-12	**Week**		**Sun 'N Fun**	**Lakeland Floride EAA Fly-in**
April 8	Tue	1930hrs	RAA meeting	Kars
April 17	**Thu**	**2000hrs**	**EAA245 meeting**	**National Aviation Museum, Rockcliffe**
April 15	Tue	1930hrs	RAA meeting	Smith`s Falls
April 27	Sun	Day	Safety & Recurrency relocated to Saugee Municipal at Hanover	
May 10-11	Sat Sun		Air Show	Ottawa Airport
May 15	**Thu**	**2000hrs**	**EAA245 meeting**	**National Aviation Museum, Rockcliffe**
May 25	**Sun**	**A.M.**	**Fly-in Breakfast**	**Embrun**
May 25	Sun	A.M.	Fly-in Breakfast	Stirling

June 1	**Sun**	**A.M**	**Fly-in Breakfast**	**Smiths Falls**
June 1	Sun	noon	IFF Brunch	Upper Canada Golf
June 5	Thu	1930hrs	Embrun Aero Club Mtg.	C. Martel
June 10	Tue	1930hrs	RAA meeting	Kars
June 15	Sun	Noon	IFF Fly-in	Bearbrook International
June 17	Tue	1930hrs	RAA meeting	Smiths Falls
June 19	**Thu**	**2000hrs**	**EAA 245 meeting**	**Carp Airport**

Classifieds

12March 1997

Place your ads by phone **591-7622** or e-mail to **adouma@ftn.net**
Deadline is first of the month.
Ads will run for three months with a renewall option of two more months.
Caveat Emptor.

New!!!

Cozy MK IV Project for sale, for details

contact Nigel Field Wk. (8 to 5) ph (819) 956-1416 Email fieldn@sos.pwgsc.gc.ca
Res. Embrun Ont ph (613) 443-5138 Email nfield@cyberus.ca

Owner Mr. Ian Percy Embrun Ont ph (613) 443-0581

Garrys Parts Bin

(613) 836-2829

Parachute,Seat-needs testing - $25.00
Dynafocal engine mount
Wheel pants $100.00
Oil, break-in, 12 litres, Shell, **Esso**
Shoulder harness, inertia reels, seat belts, metal to metal, like new
NACA air inlets
Elevator trim assembly
Primer
Fuel Pump, Pesco
Hydraulic pump
Valves, Fuel selector
Valve, Parking brake
Accelerometer (G-meter) 2.25 inch
Voltage regulator
Aluminum fuel tank, 5 gallons
Oil cooler - Continental 6cyl.
CHT guage and probe
Lycoming, Accesory case, dual take-off adapter for hydraulic and vacuum pumps.
Spinner, pointed, Cessna
Piston rings for Continental E-185 or O-470
Control wheel yoke assembly from Piper Tomahawk

Engine, VW 1600cc completely rebuilt

Propeller, Harzell HC82XL-2C constant speed plus Woodward governor for 320-360 series Lycomings.
01/97

For Sale - Pair canopy tracks 45"
4" venturi, Bendix SF4 magneto, New Zenaire wood propeller for 0200, Oil temperature guages 40" & 120", Oil pressure guage 0-80psi, Starter drive for C75/C85/C90.
Phone Lionel (613) 738-1066 01/97

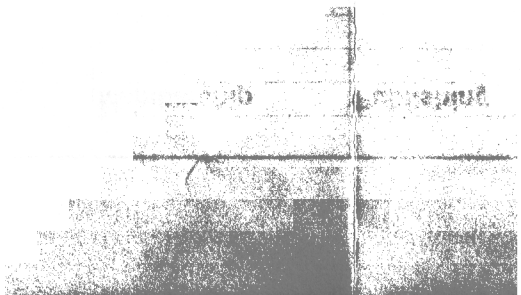
Aircraft Supplies

Steel, Aluminum, Plastic, Wood and hardware. Available from **Grass Roots Aviation**, 648 Adelaide Ave. West, Oshawa, Ontario. Dave Drain **(905) 434-4651**

PVC pipe, valves and fittings, **Fibreglass** - Resin, cloth etc., **Plastics** - tubing, bottles and

Published by EAA Chapter 245 (Ottawa) P.O. Box 24149 Hazeldean R.P.O., Kanata, Ontario, Canada, K2M 2C3

EAA Chapter 245 officers from 1970 to the present							
Date	Volume	Number	President	Vice president	Treasurer	Secretary	Recording Secretary
Sep-70	1	1	Ted Slack	Ken Cavers	Andre Gervais	John T. Smiley	
Jan-71	2	3	Ken Cavers	Irving Slone	Don Baker	John T. Smiley	
Feb-73	3	2	Jim Bradley	Red Morris	Don Kernohan	Frank Cianfaglione	
Nov 1973- 74	4	1 to 6	Red Morris	Ken Martin	Don Kernohan	Garry Fancy	
Jan-75	5		Paul Johnson	George Reid	Bill Argue	Garry Fancy	
Jan-76	6		Lionel Robidoux	Frank Cianfaglione	Marc Bastien	Alex Fulton	
Sep-76	6		Lionel Robidoux	Frank Cianfaglione	Marc Bastien	George Reid	
Jan-77	7		George Reid	Frank Cianfaglione	Marc Bastien	Eric Taada	
Jan-78	8		Eric Taada	Frank Cianfaglione	Marc Bastien	Jim Butler	
Dec-78	8		Eric Taada	Louis Saumweber	Biull Laundry	Jim Butler	
Nov-79	9		Frank Cianfaglione	Louis Saumweber	Dick Moore	Jim Butler	
Nov-81	11		J. Kieth Gillespie	Ray Perkins	Barney deSchneider	Laurent Ruel	
Nov 1982-83	13	1 to 10	J. Kieth Gillespie	Jim Butler	Barney deSchneider	Jack Macready	
Nov 1983-84	14	1 to 10	Eric Taada	Jim Butler	Gord Standing	Jack Macready	
Mar 1984-Nov 198	14	1 to 10	Eric Taada	Jim Butler	Gord Standing	Terry Peters	
Nov 1984-85	15	1 to 10	Eric Taada	Jim Butler	Gord Standing	Terry Peters	
Mar 1984-Nov 198	15	1 to 10	Eric Taada	Roger Fowler	Gord Standing	Terry Peters	
Mar 1985-Nov 86	15-16	1 to 10	Eric Taada	Roger Fowler	Gord Standing	Andy Douma	
Nov 1986-87	17	1 to 10	Doug Richardson	Roger Fowler	Deric Dods	Andy Douma	
Nov 1987-88	18	1 to 10	Doug Richardson	Roger Fowler	Deric Dods	Andy Douma	
Nov 1988-89	19	1 to 10	Doug Richardson	Lars Eif	Deric Dods	Andy Douma	
Feb 89-Nov 89	19	1 to 10	Doug Richardson	Lars Eif	Deric Dods	Andy Douma	Roger Fowler
Nov 1989-90	20	1 to 10	Lars Eif	Gary Palmer	Deric Dods	Andy Douma	Roger Fowler
Nov 1990-91	21	1 to 10	Lars Eif	Gary Palmer	Deric Dods	Luc Martin	Roger Fowler
Apr 1992-Nov 199	22	1 to 10	Lars Eif	Gary Palmer	George Elliot	Luc Martin	Roger Fowler
Nov 1992-93	23	1 to 10	Gary Palmer	Rod Emmerson	George Elliot	Luc Martin	Roger Fowler
Nov 1993-94	24	1 to 10	Gary Palmer	Rod Emmerson	George Elliot	Luc Martin	Roger Fowler
Nov 1994-95	25	1 to 10	Gary Palmer	Rod Emmerson	George Elliot	Luc Martin	
Nov 1995-96	26	1 to 10	Gary Palmer	Luc DeSadeleer	George Elliot	Luc Martin	
Nov 1996-97	27	1 to 10	Gary Palmer	Luc DeSadeleer	George Elliot	Luc Martin	



Editor	Membership	Publishing	Operations	Program	Captain	Young Eagles
				Special Events	Caffiene	Coordinator
Jack Dods						
Jim Wallace				Ted Slack		
Jim Wallace				Bill Peppler		
Fr. John MacGillivray				Jack Hicks		
Fr. John MacGillivray					Alex Fulton	
Bill Laundry					Alex Fulton	
Bill Laundry					Alex Fulton	
Garry Fancy	Bill Laundry			Glenn Brunton	Alex Fulton	
Roger Fowler	Lois Saumweber	Frank Tait		Don Cybulski	Alex Fulton	
Bill Laundry					Alex Fulton	
Bill Laundry					Alex Fulton	
Dick Moore					Alex Fulton	
Dick Moore					Alex Fulton	
Dick Moore	Andy Douma	Dick Moore			Alex Fulton	
Dick Moore	Andy Douma	Dick Moore			Alex Fulton	
Dick Moore	Andy Douma	Dick Moore	Garry Fancy		Alex Fulton	
Dick Moore	Rodney Stead	Dick Moore	Garry Fancy		Alex Fulton	
Ted Chambers	Rodney Stead	Dick Moore	Garry Fancy		Alex Fulton	
Ted Chambers	Rodney Stead	Dick Moore	John Van Tuyl		Alex Fulton	
Ted Chambers	Rodney Stead	Dick Moore	Dick Moore		Alex Fulton	
James Oliff	Rodney Stead	Dick Moore	Dick Moore	Gord Standing	Alex Fulton	
James Oliff	Rodney Stead	Dick Moore	Dick Moore	Gord Standing	Alex Fulton	
J. Oliff/A. Douma	Manfred Ficker	Dick Moore	Dick Moore	Gord Standing	Alex Fulton	
Andy Douma	Manfred Ficker	Dick Moore	Dick Moore	Gord Standing	various	
Andy Douma	Manfred Ficker	Dick Moore	Dick Moore	Barney deSchneider	various	Lars Eif
Andy Douma	Barney deSchneider	Dick Moore	Dick Moore	Barney deSchneider	various	Lars Eif
Andy Douma	Barney deSchneider	Dick Moore	Dick Moore	Barney deSchneider	various	Lars Eif
Andy Douma	Barney deSchneider	Dick Moore	Dick Moore	Barney deSchneider	Lars Eif	Lars Eif