

# Turn & Bank



OFFICIAL NEWSLETTER OF RAAC CHAPTER 85

March 2002

## **On The Wrong Channel: the Custer Channel Wing**



***Certificate of Airworthiness:  
Sorting Out Your  
Initial Application, Part II***



*On The Cover:  
The exciting new Sonex.  
Above: Peter Harrison's Rocket.*

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The TURN AND BANK is the monthly publication of RAAC Chapter 85 and is intended to keep members informed as to the club's activities, and to promote safety and technical excellence in the field of sport aviation. No responsibility or liability is assumed, expressed or implied as to the content of articles contained in the Turn and Bank: the intention is to provide a forum for discussion and exchange of ideas.

Newsletter contributions should be mailed to George Gregory, 19470-88th Avenue, Surrey, B.C. V4N 3G5 no later than the 12th of each month. Business Fax is (604)-469-3495. Please remember to indicate "attention George Gregory" on your fax. Contributions can be e-mailed to George at:

[gregdesign@telus.net](mailto:gregdesign@telus.net)

Enquiries to the Membership Chairman should be mailed to Rob Prior, 3032 Carina Place, Burnaby, BC, V3J 1B5

For inspections of Amateur Built Aircraft Projects contact the MDRA Inspection Services, ph. 1-877-419-2111 fax 1-519-457-0980 email: [mldrainsp@on.aibn.com](mailto:mldrainsp@on.aibn.com)  
Regular Meetings are held on the first Tues. of each month at 20:00 in the clubhouse:

Delta Airpark, 4103-104th Street Delta, B.C. Clubhouse  
phone: 596-3644

Mailing Address: Chapter 85, RAAC  
c/o Delta Heritage Airpark, 4103-104th St.,  
RR#3, Delta, B.C. V4K-3N3

Executive meetings are on the third Tues. of each month at 19:30 in the clubhouse.

Chapter aircraft pilots, mail cheques  
(Payable to RAAC Chapter 85) to: Tedd McHenry  
RAAC National Homepage:

<http://www.inforamp.net/~raac>

RAA Chapter 85 Homepage:

[http://www.b4.ca/raa\\_85](http://www.b4.ca/raa_85)

Delta Heritage Air Park Homepage:

<http://home.istar.ca~bb4>

Source for CARS and Chapter 549 Airworthiness Manual:

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# Technical Guy

Terry Elgood

Initial application for a special certificate of airworthiness for amateur-built aircraft , procedure for filling out form 24-0079

List of Revisions

Date/Revision

3 May 2001 Cover sheet added

8 July 2001 General revision , rotary wing added

## Part 2

19/ Maximum mass requested

Answer ; The design gross weight from the kit or plans, or for your own design, to a maximum of 3968 lb.for fixed wing, helicopters and gyroplanes maximum 1540 lb. This should be equal or less than box 18

20/ Maximum permissible load

Answer ; Formula from 549.103 and A549.5 also 549.203-rotary wing

a/ rotary wing 4.10 lb/sq ft

b/ without flaps 13.3 lb/sq ft

c/ with flaps do the calculation;

Load =  $13.3 + [0.96 \times (\text{flap} / \text{span ratio}) \times (\text{flap} / \text{chord ratio}) \times (\text{flap deflection})]$

Work this out as follows:

Flap/span ratio = ( span of one flap x 2 ) divided by wing span

Example  $4.8' \times 2 = 9.6$  then divide by  $23' = .41$  enter the correct amount in your calculation to a maximum of .75

Flap/chord ratio = flap chord divided by wing chord

Example  $.9'$  divided by  $4.8' = .18$  enter the correct amount in your calculation to a maximum of .25

Flap deflection from box 15 to a maximum of 45° for this calculation

So let's continue the example;

Load =  $13.3 + [0.96 \times .41 \times .18 \times 40]$

=  $13.3 + 2.83$

=  $16.1$  lb./sq ft enter the correct amount in box 20 to a maximum of 20.4

21/ Maximum requested load

Answer ; Box 19 divided by Box 13

Example  $1650$  divided by  $110 = 15$  lb./sq ft

Note; without flaps to a maximum of 13.3 lb/sq ft ,with flaps to a maximum of 20.4

This box should be less than the maximum permissible (box 20 ). If it is more than box 20, more than 13.3 or 20.4 then a placard for high performance endorsement is

required,(not applicable to rotary wing).

22/ Name of manufacturer (engine)

Answer ; Obvious

23/ Engine model

Answer ; Obvious

24/ Minimum rated power

Answer ; Formula from 549.109

For a monoplane

Minimum HP =  $( 0.016 \times W ) + [( 0.018 \times \text{square root of } W \times W \times W ) \text{ divided by Wingspan } ]$

W = Maximum weight from box 19 . For this example I'm using 1650 lb.

First look at square root of  $W \times W \times W$

What this means is square root of Weight x Weight x Weight

Example enter  $1650 \times 1650 \times 1650$  in your calculator = 4492125000.

Take 4492125000. And hit the square root symbol on your calculator and you get 67023.3

Or to make it easier, since most small calculators can not do this, for example enter 1650 then hit the square root symbol and you get 40.620192 . Use 40.62 then multiply  $40.62 \times 40.62 \times 40.62$ , the answer will be almost the same with 67022.3

What you have then to continue the example is;

Minimum HP =  $(0.016 \times 1650) + [(0.018 \times 67022.3) \text{ divided by } 23]$

=  $26.4 + (1206.4 \text{ divided by } 23)$

=  $26.4 + 52.4$

=  $78.8$  enter the correct amount in box 24

For a biplane use;

Minimum HP =  $( 0.016 \times W ) + [( 0.023 \times \text{square root of } W \times W \times W ) \text{ divided by Total span of both wings}]$

Notice the difference between the monoplane and biplane calculations and continue.

NOTE : do not change the 0.016 and 0.018 (monoplane ) or 0.016 and 0.023

(biplane ) For rotary wing use 0.016 and 0.018 then substitute the rotor diameter for wingspan.

25/ Actual estimated power

Answer ; From engine specification

26/ Name of manufacturer (propeller)

Answer ; Obvious

27/ Propeller Model

Answer ; From the manufacturer or use diameter/pitch for a custom made prop.

28/ Amateur built parts

Answer ; Aircraft constructed from a kit or list the major components that you built.

29/ Prefabricated parts obtained from other sources

Answer ; List the major components you used for example;

Engine, Propeller, Wheels, Instruments.

NOTE; THIS IS IMPORTANT PAY ATTENTION

The builder must sign and date this form ALSO the MD-RA inspector (who is doing the inspection) must sign and date this form OR IT WILL BE RETURNED.

In all the above calculations chapter 549 takes precedence and remains the only Transport Canada approved method of calculation.

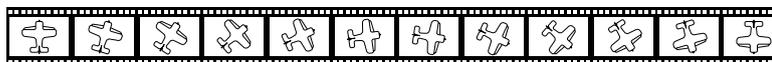
Well, how did you do? I hope I was able to help you .

Terry Elgood

MD-RA

Regional Chief Inspector ( B. C. )

## AIR Frame



Aircraft Portraits

Rob Prior  
www.b4.ca/airframe  
rv7@b4.ca

3032 Carina Place, Burnaby, BC, V3J 1B5

604/422.8446

# Bulletin Board

Last I heard, Norm Helmer is looking for someone to help with his Paradyne project. The Paradyne is a cutting edge new concept in STOL aircraft that shows promise. If you're interested give him a call at 943-7887.

Dan Lawler would like you to send your email addresses to him at:

dan.lawler@kvaerner.com

He will create a database so he can send announcements about meeting programs, etc. Currently he has a list of about 20 e-mail addresses, and would like to expand it and keep it up to date.

Want to learn more about aircraft construction? Get involved in the J-5 project! Also, we are looking for help from someone knowledgeable in fabric work. Talk to a member of the executive and they'll put you in contact with the right people.

**The Chapter's second aircraft carrier trailer is for sale. It's a gem! \$480 or best reasonable offer. It's at John Keon's place 16301 - 20 Ave., Surrey ph. 536-8589 or call Jim Hunter at 576-2678.**

Come in for a Landing at  
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## Minutes Jim Hunter

Minutes of the General Meeting, 5 February, 2002

Call to Order: 8:00 pm by President Tim Nicholas.

Hunter/Hoffman: that the Minutes of the General meeting of 8 January, 2002, be adopted as printed in "Turn and Bank".

Discussion Carried.

Correspondence: None received.

Committee Reports:

Treasury: Don Souter: Verbal report. We are

well solvent.

Membership: Rob Prior: 141 members as of tonight of whom 26 are complementary. These are, of course, the 2001 figures but membership is renewing handsomely.

Library: Tim Baker; Going well. Tim looking for books: "Diesel Aircraft Engines" and "Converting Automobile Engines for Aircraft Use". Would those having them please return; there is quite a demand.

Vice President: Emily Clemens; the Annual Bash set for Saturday, April 27 at the Sundance near Ladner. Tickets are \$25. See Emily for same.

Newsletter: George Gregory: George nearly out of material. Help him out, please.

Program: Dan Lawler: Tonight we have a very good video on the Smithsonian Aircraft Collection.

RAAC: Rob Prior: nothing heard from except that the reader's forum is back.

Aircraft: Tedd mcHenry: A whopping 1.6 hours on the Turbi in January which is not

surprising considering the abominableness of the month. Gerard van Dijk has taken over the mechanical part of the chairmanship and he thinks that the generator problems at last solved.

On the J-5: Gaetan: wings now being covered. More bods are welcome and even needed. Talk to Gaetan.

DHAPCOM: Terry Wilshire: Breakfast being served next Sunday but of course you are not too late for it. (Useful gen). Everything in good shape.

Old Business: None. New Business: None. Hoffman/Hubble: that we adjourn: And so...

Jim Hunter, Babjuji

# On The Wrong Channel

Text and  
Photos by  
Mark Munzel



**W**ITH MANY UNSUCCESSFUL aircraft designs, it's rare for an example to survive. One of the most famous failures, the Custer Channel Wing, has defied the odds. Two versions exist at museums in the United States - the early CCW-2 at the National Air & Space Museum's Garber storage facility near Washington, D.C., and the ultimate CCW-5 at the Mid-Atlantic Air Museum in Reading Pennsylvania. A Custer is sure to draw attention in any museum; the photos should make it clear why.

These aircraft were the creations of Willard Custer, a descendant of the general of the same name. Like his forebearer, abundant self-confidence led Custer the aircraft-maker to failure. He spent years developing radical airplanes without regard for the major flaws in his designs.

The popular story is that Custer was inspired by a barn roof. It's said you can make a barn door fly if sufficient thrust is

available; during a storm, Custer watched a roof travel several hundred yards through the air with no powerplant at all. He realized what raised the roof was airflow over the top of the barn - the fast-moving air generated low pressure that sucked the roof upwards.

You may be thinking, "The motion of air around an airfoil produces lift? Big deal. Hadn't this Custer guy ever heard of Bernoulli, or the Wright brothers?" He had, and he made a conceptual leap that distanced his aircraft designs from those of any other planemaker. Most aircraft generate lift by pushing or pulling themselves

through still air. Custer had the idea to move the air past the aircraft. In his own words, "The CCW does not plane the air to fly... rather it brings the air to the lift surfaces." Custer proposed a craft that could become airborne with little or no forward motion, at a time when the helicopter was also a proposition.

Planes need thrust as well as lift; Custer obtained both by locating the propellers of his twin-engine designs just above and behind the upper surface of the wing. Air on its way to the prop was sucked over the wing, producing lift even at zero air-speed. To maximize the amount of wing

**Above: Last of the line: The CCW-5, preserved in Pennsylvania, was quite stylish except for the funny-looking channel wings.**

**Right: Notice anything odd about the wings? The CCW-2 embodied Willard Custer's attempts to throw aircraft design for a curve.**



**Right: The Custer CCW-2 is stored by the National Air and Space Museum near Washington, DC**

**Below: Just because Custer failed doesn't mean he wasn't taken seriously. This NASA photo shows the CCW-1/2 being tested in a wind tunnel.**

area working for him, Custer curved the wings to match the prop arc. The result looked like a half-completed installation for a ducted fan.

It looked odd, but it flew, and at speeds as low as 11 knots. The first flight of the prototype CCW-1 in 1942 was unintentional - Willard Custer became airborne while taxiing the aircraft in front of potential investors. Not being a pilot, he made a hard landing that damaged the landing gear but his point had been proven. With funding assured, he continued to tinker, and by 1948 the CCW-1 had evolved into the CCW-2. This is the aircraft preserved by the National Air and Space Museum.

## It shared the CCW-2's astounding low-speed performance, being able to clear a 50-foot obstacle in 250 feet on takeoff or 350 feet on landing

The CCW-2 was built around the fuselage of a Taylorcraft L-2 (that's a BC-65, for the pacifists in the readership) and powered by two Lycoming O-145 engines. In the hands of test pilot Harold Custer, the designer's son, takeoff runs as short as 45



feet were demonstrated. Custer senior calculated that the CCW-2 could lift 11 lbs for every engine horsepower, versus eight for a Piper Cub.

these outer sections, which leads us to one of the flaws of the CCW concept. Along with thrust and lift, planes need control. After takeoff at 11 knots, the CCW's pilot didn't have much of that until his craft was up to speed and sufficient air was flowing over the tail and outer wings. Removing the outer sections actually cured the control problem, because with less lifting area the CCW's takeoff speed rose into the 35-knot range. But that wasn't a huge improvement over the performance of other light aircraft. Here was the irony of the CCW premise: with channel wings alone, Custer's aircraft weren't much better than normal designs. They were remarkable only when the channels were supplemented by wings that "planed the air."

The ultimate Custer design, the CCW-5 of 1953, had large, straight outer wing panels and normal control surfaces. It looked sleek and swift compared to its predecessor, because it used the fuselage of the unsuccessful Baumann Brigadier executive twin and sported Continental IO-470-T engines. It shared the CCW-2's astounding low-speed performance, being able to clear a 50-foot obstacle in 250 feet on takeoff or 350 feet on landing. But the CCW-5 showed up another flaw in Custer's ideas. The channel wing, such an asset at low speed, was a huge source of drag at the top end. Custer had predicted the CCW-5 to have a maximum level speed of 250 knots; in real-



*Continued on Page 8*

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*Classified Ads are free (within reason) to members. Display Ad rates are:*

*Business Card: \$25 per year*

*1/4 page: \$10/month \$100/yr*

*1/2 page \$15/month \$150/yr*

*1 page: \$25/month \$250/yr*

*Ads that have been in for more than 6 months are subject to removal if space is required for other stuff. Please contact George the editor if you want it kept in.*

#### For Sale: SIROCCO PROJECT

Fuselage, canopy, tail group complete. Air frame control components done except for cable. Main-wheel gear, wheels and brakes done. Tail-spring and wheel included. Panel made, no instruments. Lycoming 0-290 GPU Zero-timed. Will Neubert stainless cross-over exhaust with stainless muffler/shrouds. Bendix PSC5 carb. Bendix mags with non-shielded leads. No starter, starter ring or alternator. Weldtech engine mount. McCauley prop.

Wings: ribs and minor spars done. Spar diaphragms done. Two spar-grade spruce planks. No other wing parts.

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Jim Hunter 576-2678

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Roger Gauthier (Kelowna) (250)-763-1529  
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Wanted: PA 18 or PA 20/22 Wings. Some damage OK. 946-5881

For Sale: Electronic Tach 2.25" with generator (new) \$125, 6" castoring tailwheel, \$50, Electronic dimmer control, \$25, 2 New 600.6 Goodyear Tires, \$125 for pair, Combo EGT/CHT (needs probes), \$50, Tach Cont.C85-0200, \$35, Temp (OAT) gauge, new, \$35, Windscreen Ant., Van's, new, \$15, 525 battery (new) never had electrolyte, \$75, Fuel Pressure Gauge O/H, \$35, Lycoming Starter 0-290, 0235, 0320, 0360, for \$375.

Bob Cutting 275-1603

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E-mail: tmw@industriallaser.com  
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Pat O'Donnell 533-1839  
FOR SALE: Zenith 250 plans and parts, wing rib moulds \$360. Christavia Mk IV project, 4130 steel tube, wing ribs, flaps ailerons, gear legs, wheels and brakes, tail stab and rudder, \$3600.

Paul Trudel 532-8570  
Headsets -2 David Clark H10-30 \$125 / \$100 -2 Telex DBM-1001 \$75 for both  
Bendix starters for Lycoming - 2 @ \$ 250 each Terry Elgood 604-279-2062  
email: elgood@aebc.com

Don't Miss The

# Annual Bash

April 27, 2002

Sundance Inn

6574 Ladner Trunk Rd, Richmond

Cocktails 5:30

Dinner 6:30



George Gregory Photo

*CUSTER Continued from Page 6*

ity, it achieved just 200 mph.

Custer had problems with financing as well as with estimating performance. Due to a shortage of investors, the "first production" CCW-5 did not follow the 1953 prototype for over a decade. By then, the market for classy twins had been lost to Beechcraft and Piper, while helicopters had satisfied most demand for short takeoffs and landings. Custer's company staved off bankruptcy until 1994, but it didn't build anything in the interim.

And so, the Custer Channel Wing became another of history's "wasn'ts." But there is more to the CCW legacy than two airframes preserved in museums. American lawyers smile when they hear the plane's name, for the "last stand" of the Custer

Channel Wing Aircraft Company of Hagerstown, Maryland generated many precedent-setting legal decisions in the US. And the company's stock certificates, although worthless in a monetary sense, are popular with collectors of such things. They have a picture of the CCW-5 on the front - so in a way, the aircraft really was produced in large numbers.

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Fred Baron Photo