COZY AIRCRAFT FORUM

Soup to Nuts*?

Marc J. Zeitlin

August 2nd, 2013

1:00 PM – 2:15 PM

Forum Tent 06 – JP Instruments Pavilion

* With apologies to Bernard Kliban

What Will I Talk About?

- ***Standard Introduction for the Newbies – 15 min.***
  - ***Who Am I?***
  - ***What's a COZY MKIV?***
  - ***Why a COZY MKIV***
  - ***COZY MKIV Plans***
  - ***COZY MKIV Cost***
  - ***COZY MKIV Support***
  - ***COZY MKIV Parts Vendors***
  - ***How Many COZY's Under Construction / Flying?***
- ***Matt Bunch Presentation – <u>To Fly and Not Inspect</u> – 15 min.***
- ***Further / Suggested Topics – 30 min.:***
  - ***FAA AD/SAIB subscription***
  - ***Control Rigging***
- ***COZY Aircraft Structures***
  - ***Flight Testing Methods***
  - ***Common Modifications***
    - ***Major***
    - ***Minor***
  - ***Performance Modifications***
  - ***Recommended Modifications***
  - ***Discouraged Modification***
  - ***Safety Issues for builders / 2nd owners / buyers / non-builders***
- ***Futures / State of Design***
- ***Questions and Answer (ANY topic)***

Who The Heck Am I?

- Biography / Resume'
  - http://www.mdzeitlin.com/Marc/bio.html
- Built Quickie Q2
- Built COZY MKIV #386, N83MZ – ~965 flying hours
- Started / Administer Unofficial COZY Builders Web Page and COZY Mailing List (~695 members)
- As Burnside Aerospace, provide engineering consulting and canard A&P services (pre-buy, Condition Inspection, build assist, etc.) – also affiliated with Freeflight Composites in Co. Springs, CO.

- As of May 1st, 2011, I provide **OFFICIAL** technical support for **COZY** aircraft to all builders, flyers and prospective builders

What's a COZY MKIV?

- Aircraft Type
  - Canard pusher – big wing in rear, small wing in front, engine in rear
  - 4 place, or 2+2, or 2 + LOTS of baggage
  - Efficient, fast, long distance cruiser – have traveled over 1000 NM/leg and from Tehachapi, CA to Cleveland, OH in daylight

- History of the COZY MKIV
  - Designed by Nat Puffer as a derivative of Burt Rutan/RAF's Long-EZ
  - First as a side-by-side two seater in mid-80's
  - Next, added single rear seat (kept Long-EZ rear end, spar and wings)
  - Evolved from 3-place to current 4-place MKIV in early 1990's – rear end modified to be similar to Defiant landing gear/firewall structure; canard airfoil updated

- COZY/canard aerodynamics – Nat's 2005 Oshkosh Forum
  - http://www.cozybuilders.org/Oshkosh_Presentations/Nats_OSH2005_Presentation.pdf

Why a COZY MKIV?

- You want to **BUILD** an airplane
- Use-Model – your comparison indicates a COZY is the type of aircraft you want to fly – shouldn't be because "ooohhh, that's a cool looking plane"
- Economics – a COZY MKIV can be flown for less than renting a C-172 with fewer fuel stops in less time
- Carrying Capacity – you need more than 2 seats, or 2 seats and LOTS of baggage space
- Safety Features – you want a canard's stall/spin resistance
- Composites – you like the build materials

COZY Plans Availability

- Cozyaircraft Corp. owned by ACS since 2004
- Plans available through ACS

http://www.aircraftspruce.com

Vendor Display Building “A” at OSH

COZY MKIV Cost

- Low End - $35K to $50K
  - High time engine (maybe auto conversion)
  - Good scrounging
  - Minimum instruments - VFR only
- Mid-Range - $50K to $75K
  - Some prefab (not much)
  - Rebuilt engine
  - High end VFR - Low end IFR panel
- High End - $75K to $120K
  - Lots of prefab components / paid help
  - New Lycoming Engine
  - Complete latest IFR stack panel
- Plans – NOT A KIT!!! This means you can customize your spend rate, as well as what you spend money on. Cost control is completely up to you, your desires, needs, and ability to pay

COZY Support Methods

- **Official support from me (my contact info on last slide), afforded by ACS (thanks, Jim Irwin!)**

- Freeflight Composites (Burrall Sanders)
  - http://www.freeflightcomposites.com/services.htm
- COZY Newsletter archives
  - http://www.cozybuilders.org/newsletters/
- COZY Mailing List
  - http://www.cozybuilders.org/mail_list/
- **U**nofficial **C**OZY **B**uilders **W**eb **P**age (UCBWP)
  - http://www.cozybuilders.org/
- Canard Aviator's Mailing List
  - http://groups.yahoo.com/group/canard-aviators/
- CSA Newsletter (mandatory for all canardians)
  - http://www.cozybuilders.org/ref_info/other_news.html
- Other builder's web pages (links from **UCBWP**)

COZY Parts Availability

- ACS, Wicks, etc. for most composite & standard aircraft materials
- Two main vendors provide metal parts:
  - CG Products
    - http://www.cozygirrrl.com/aircraftparts.htm
  - EZ Noselift
    - http://www.eznoselift.com/
- Other part vendors for miscellaneous items – see:
    - http://www.cozybuilders.org/newsletters/suppliers.html
    - http://www.cozybuilders.org/newsletters/na_suppliers.html

How Many COZY's?

- > 2000 Rutan Derivative Canard Aircraft flying (VariViggen , V.E., L.E., Defiant, Berkut, E-Racer, SQ2000, Velocity, COZY III, COZY MKIV)
- ~ 250 - 350 flying COZY's all over the globe
- ~1700 COZY MKIV plans sold
- ~ 600-800 actually under construction
- 5-10 new COZY MKIV first flights per year

- These numbers are **ALL ESTIMATES –** real stats are hard to come by – but in any case, a **PROVEN** design

To Fly and Not Inspect

Putting Your Life in the Hands of the Previous Builder

Presented by:
Matthew B. Bunch
Lexington, KY

Trust But Verify – Inspections that May Save Your Life

- Why **INSPECT**?
- Why talk about **BALANCE**?
- Before you buy someone else's plane or fly your own, **KNOW WHAT TO LOOK FOR AND INSPECT BEFORE YOU BUY OR GO FLY**
- This presentation provides a list of some of the important inspections for the unwary that may save your life

Personal History

- 20 years of practicing bankruptcy law during the day
- Airplane builder at night
- Built COZY III from 1995 through 2005
- Flew COZY III for 300 hours until 2009 when my family outgrew the COZY

Pride and Joy:

COZY III Panel

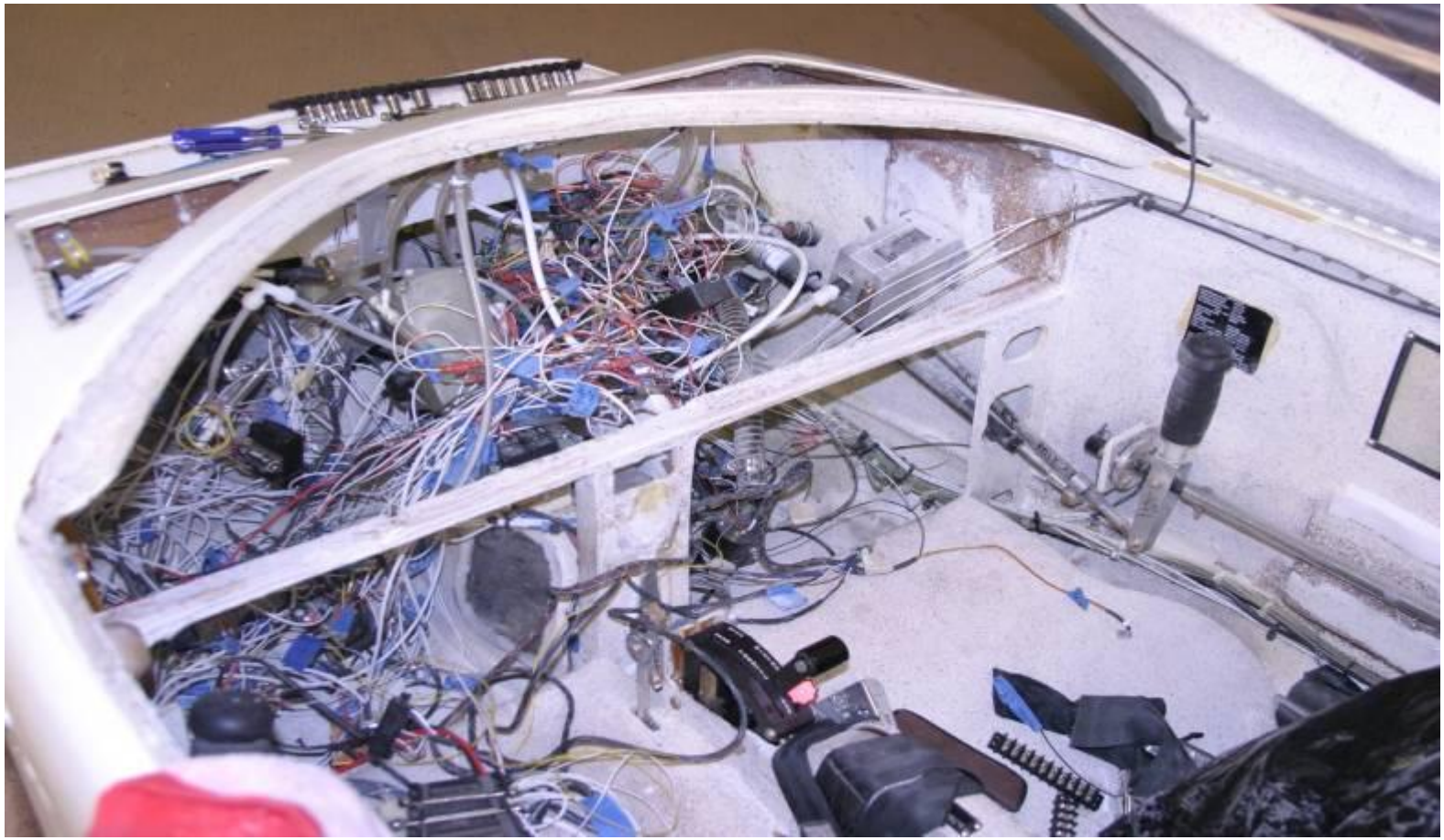
COZY MKIV

- In 2009 I purchased a Cozy MKIV with 300 hours of total flight time

Old Panel

Rewiring

- During engine rebuild and instrument panel upgrade, I discovered (or was informed about from others to look more closely at specific items) that the following potentially serious issues could increase the pucker factor exponentially:



New Panel

Elevators – Balance is the Question

- Balance (my elevator balance was way off – actually, in the opposite direction) – see Plans Chapter 11, Page 8, Step 6:
- TO PREVENT FLUTTER, the elevator must have the leading edge/nose pointing down - trailing edge must be level 0° or up) - when measured with the hinge pin through the elevator and resting on flat metal surfaces or dangling from a fine wire.
- If you need to add lead weight, add a maximum of 0.3 lbs (4.8 ounces) to the outboard balance weight. It will be easier to add it to the bottom of the weight. I found a Lowes Aircraft Supply Store a piece of lead flashing for the roof of a house is about 1/16" thick and can be contoured to fit under the outboard balance weight. Works great!!! Maximum total weight is 3.9 pounds for each elevator.
- After painting, re-test balance!!!!! Elevator NOSE must point down.

CAVEAT EMPTOR:

A discrepancy exists in the Owner's Manual (1st Edition 1993). The Appendix I under Control System, page 34, says that elevator should hang nose down by -12 to -25 degrees when suspended from the hinge pin by a fine wire. And, weight should be evenly distributed between inboard and outboard locations, rather than adding any extra ballast to the outboard ends only. Each elevator should weight MAXIMUM @ 3.9 lbs.

- Check elevators for proper mass balance. They should hang 12 to 25 degrees nose down when suspended from the hinge pin by a fine wire. Weight should be evenly distributed between inboard and outboard locations. Maximum elevator weight with mass balances installed is 3.9 lbs. each. Check this.

- Check ailerons for proper mass balance. When suspended from the hinge pivots, the ailerons must hang between the angle that makes the bottom surface level and the angle that makes the top surface level (after painting).

- Check for 1/16" minimum clearances around all mass balances. Binding can occur at elevated load factors if the clearance is too tight.

Elevators – Range of Motion

- Range of Motion (mine was at +26 deg. And -16 deg.) – See Plans Chapter 11, Page 7 Step 5:
- The elevator must have the trailing edge down to +30 degrees position (nose up command) and trailing edge up to -15 degrees with an absolute minimum of -12.5 degrees
- Mine measured -16 degrees up and +26 degrees down.
- Flox travel stops under elevator torque tube (inboard ballast) and make sure your outboard ballasts are NOT the travel stops!!!!
- Test range of motion, even if you have not added any weight!!!!!

CAVEAT EMPTOR:

A discrepancy exists in the Owner's Manual (1st Edition 1993). The Appendix I under General Section, page 33, reads that elevator travel should be +28 degrees (+/- 2˚) trailing edge down and -14 degrees (+/- 1.5˚) trailing edge up:

Elevator travel	=	28 ± 2 deg. trailing edge down. 14 ± 1.5 deg. trailing edge up.
Aileron travel 2.1" ± 0.3"	=	Measured at the inboard trailing edge, both up and down. When in the neutral position, both aileron trailing edges must be aligned with wing trailing edges.

Ailerons – Balance

- Mine was way off
- Aileron balance - the trailing edge must be level @ 0˚ with the bottom surface and not to exceed the top surface level while dangling from a fine wire around hinge pins.
- If you need to add lead weight, add a maximum of 0.3 lbs (4.8 ounces) to the top of the balance rod.
- After painting, re-test balance!!!!! Aileron TRAILING edge must be level or up!!!

Ailerons - Balance

Good

Not Good

Ailerons – Range of Motion

- RANGE OF MOTION (mine was way off too)
- The Plans state the range of motion should be between 2.1” (+/- .2”)
- The Pilot’s Operating Handbook says:
  Re-test range of motion!!!!! Aileron TRAILING edge must have ~2” of travel in both directions from neutral !!!!

CAVEAT EMPTOR:

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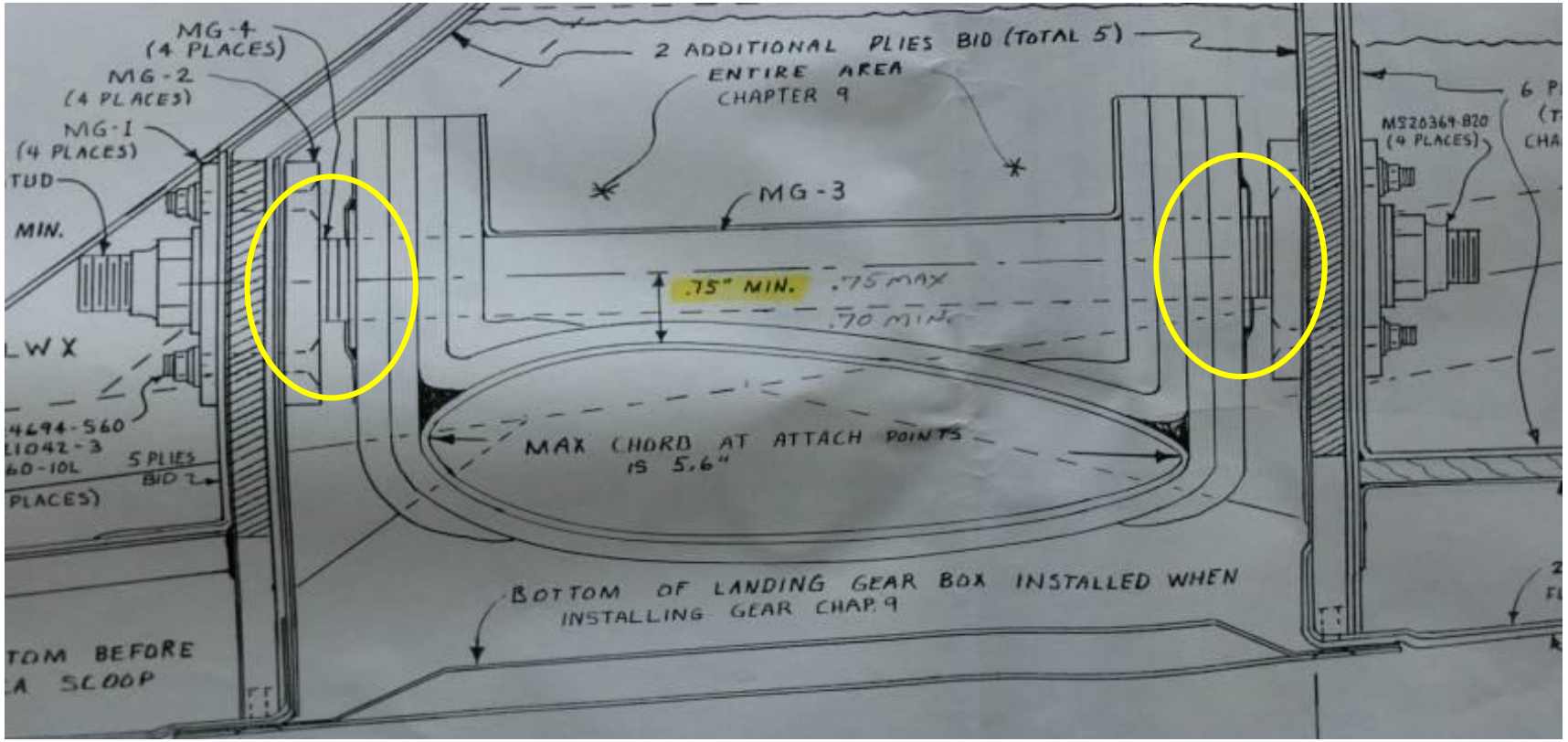
Aileron travel *2.1" ± 0.3"*	=	Measured at the inboard trailing edge, both up and down. When in the neutral position, both aileron trailing edges must be aligned with wing trailing edges.

Main Landing Gear

- Check that both attachment bolts (STEEL STUDS with threads on both sides) are installed tightly against MG-2. Mine had 1/4“ movement after 10 years of flying and it had always been that way. Took four (4) hours to add washers.

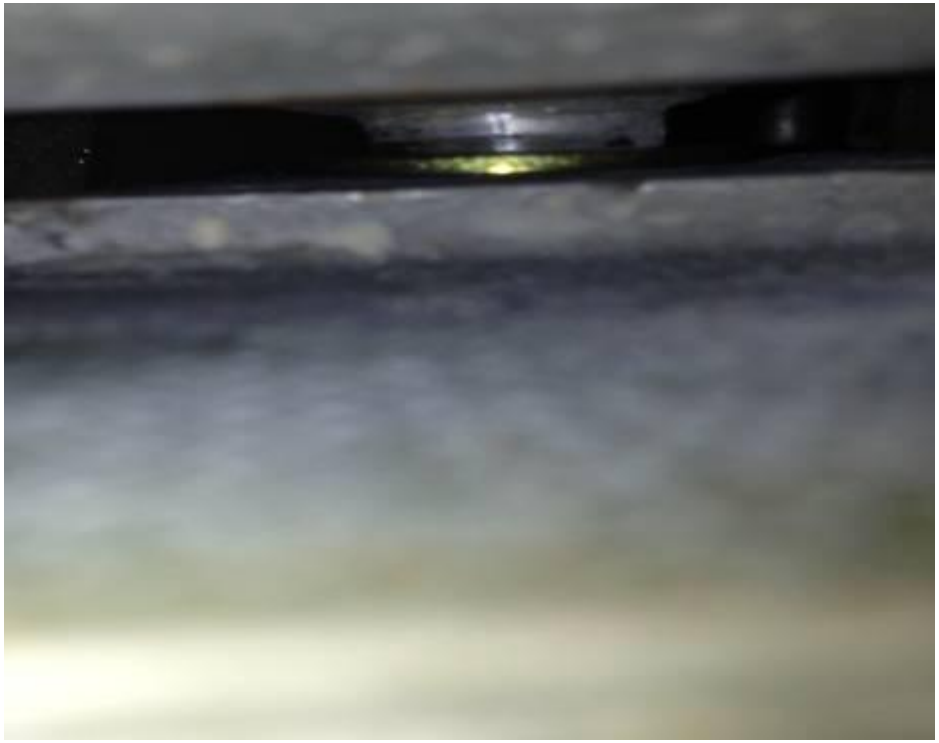


Main Landing Gear

- Not Good

Main Landing Gear

- Tightness Assured with Proper Size Washers



Canard Leading Edge

- To create painted lines on the leading edges, you normally use tape. Removing the tape can create ridges that cause turbulence over the canard and wings. Those ridges MUST be removed.
- The easiest way to remove ridges is to use a NIB FILE with short strokes.

Nib File


89790
FINE
NIB FILE
FIXES PAINT IMPERFECTIONS
WITHOUT RE-SPRAYING
EASILY REMOVES DIRT AND PAINT RUNS FROM FINISHED PAINT SURFACES
FINE PATTERN REMOVES TINY IMPERFECTIONS
SAVES PAINT JOB AND HOURS OF LABOR
PRECISION GROUND FILE ASSURES UNIFORM RESULTS
OVER FOR INSTRUCTIONS
TOOL AID
PROFESSIONAL AUTOMOTIVE TOOLS
NEWARK, NJ 07114

Questions / Comments?

Thanks, Matt!

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Obtaining AD's / SAIB's / SB's

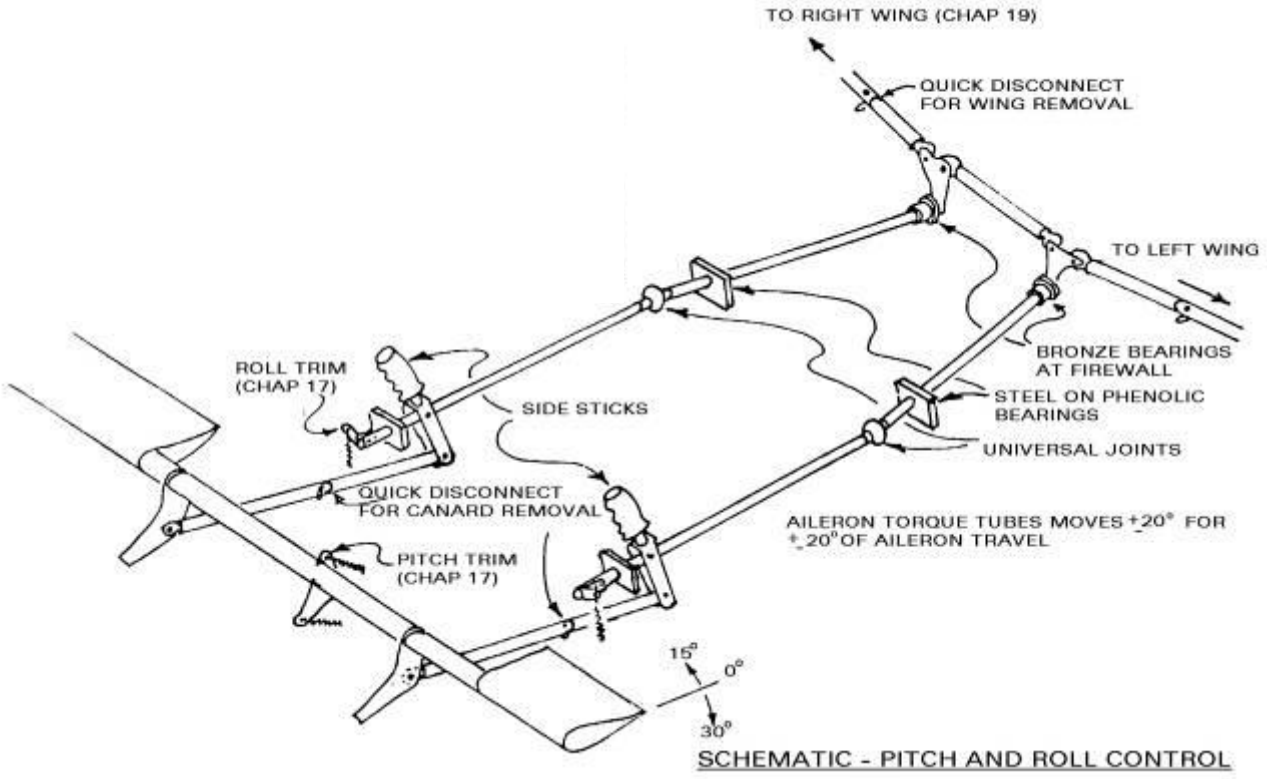
- Airworthiness Directive Applicability to Exp. Am-Built?
  - Common belief that AD's do NOT apply to EAB aircraft
  - For most part, true
  - HOWEVER, FAA recently stated explicitly that they CAN state applicability of AD to EAB aircraft, but it must be explicit in the AD applicability statement
  - If see an AD that MIGHT apply, must read the applicability section to determine if it does
  - Always a good idea to comply with AD's even if not regulatory requirement

- FAA AD's / Special Airworthiness Information Bulletins (SAIB's)
  - http://rgl.faa.gov/
  - Can subscribe to get emails when new AD or SAIB released if applicable to YOUR hardware
  - Can also search for AD's / SAIB's / Notice of Proposed Rule Making (NPRM's) / Advisory Circulars (AC's) – can search by applicable hardware, MFG, etc.

- Lycoming Information
  - http://www.lycoming.com/support/publications/
  - http://www.lycoming.com/support/publications/service-bulletins/
  - AD's/SAIB's may reference SB's

Control Rigging

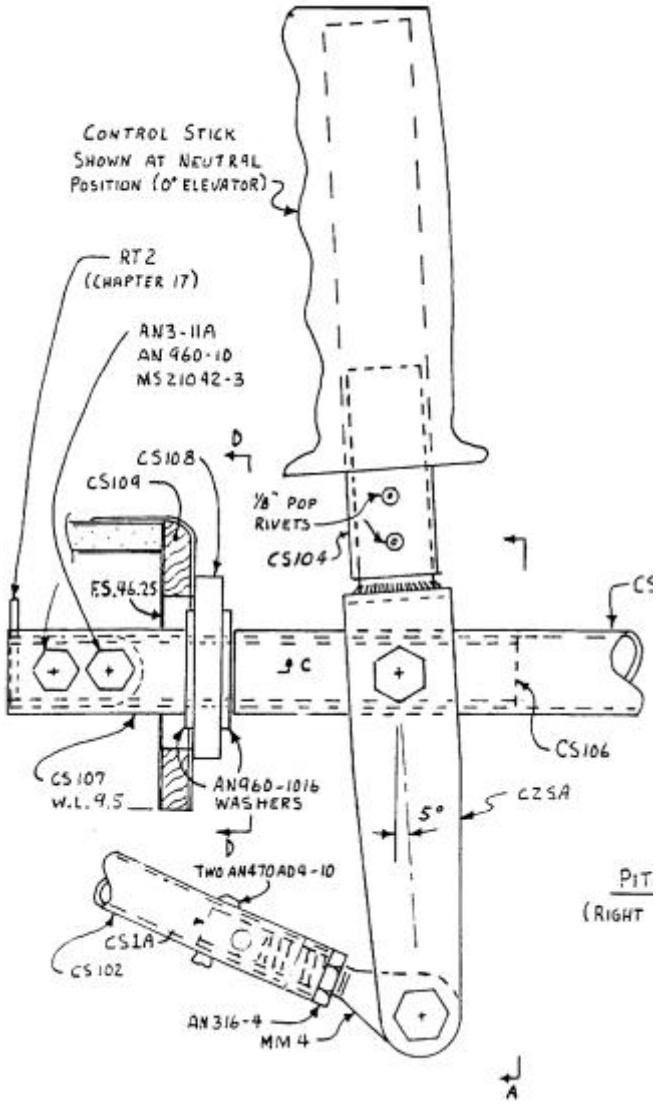
- **General:**
  - Plans do good job of describing rigging of control systems
  - Object
    - Put control surfaces in correct positional relation to each other (left/right) and to control stick/pedal
    - Ensure control surfaces have FULL travel in all required directions
    - Ensure control surfaces have correct motion in relation to each other and control stick/pedal
    - Eliminate play (flutter issue) and unwanted motion
    - Produce required/specified aerodynamic forces



SCHEMATIC - PITCH AND ROLL CONTROL

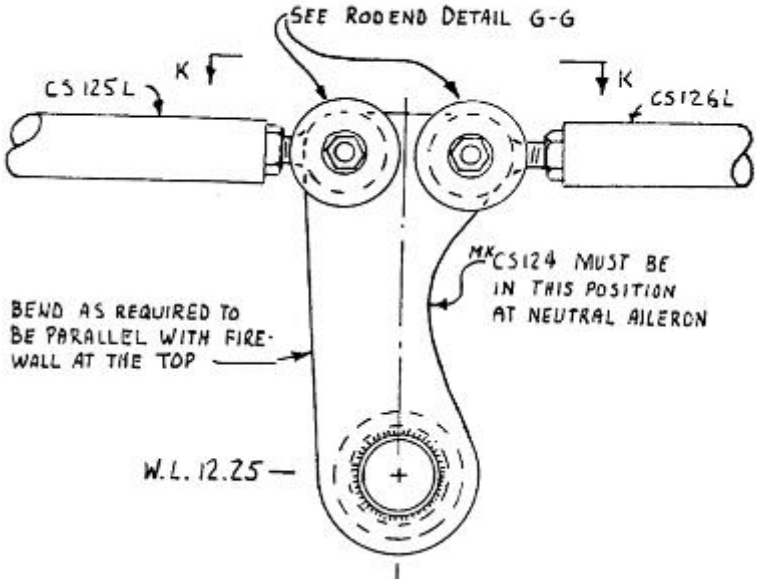
Control Rigging

- **Elevators:**
  - Pushrods from stick(s)
  - Eliminate play in hinges, rod-ends, connection bolts and pushrod Quick Disconnect (QD)
  - Ensure clearance of stick(s) to fuselage side, armrest, IP components and mounting bulkhead with FULL deflection of elevators AND ailerons at same time – NO stick interferences are allowed
  - Ensure clearance of pushrod(s) and belcrank(s) to all fuselage mounted components ahead of the IP
  - Adjust seating so stick(s) are centered fore-aft for comfortable positioning while providing the above



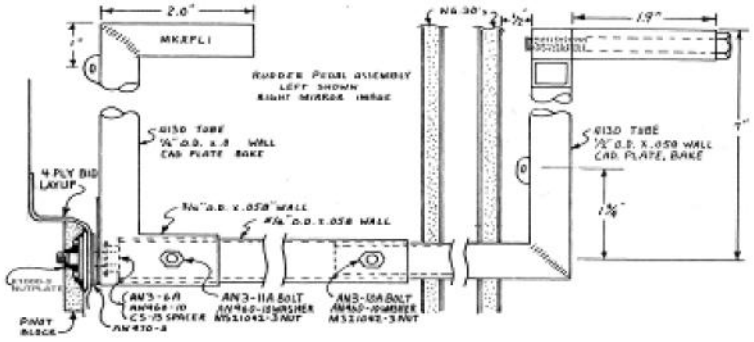
Control Rigging

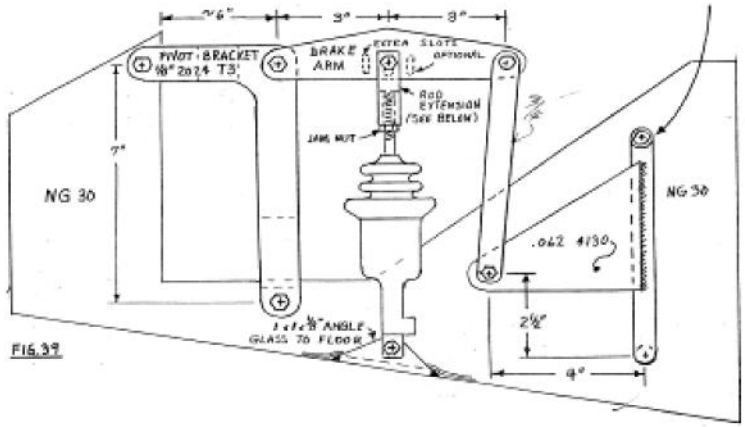
- **Ailerons:**
  - Torque tube from stick to firewall – pushrods to wing – torque tube in wing
  - Eliminate play in torque tube bearings, hinges, rod-ends, connecting bolts, all QD's
  - Ensure firewall belcranks are BOTH in correct centered position when sticks are centered
  - Ensure wing belcranks are both correctly centered when sticks are centered and that wing belcrank stops are the ONLY hard stops in the system
  - Ensure clearance of stick(s) to fuselage side, armrest, IP components and mounting bulkhead with FULL deflection of elevators AND ailerons at same time – NO stick interferences are allowed
  - Adjust so stick(s) are centered side-to-side for comfortable positioning while providing the above

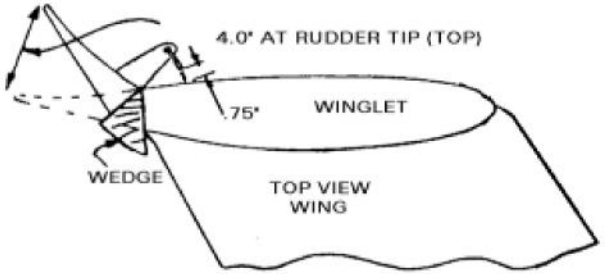


Control Rigging

- **Rudders/Brakes:**
  - Cables from pedals to rudders – 1/16” Dia.
  - Mechanical linkage from pedal to brake Master Cylinder with allowance for full rudder motion prior to brake engagement
  - Ensure rudder cables correct length for appropriate pedal positioning and motion
  - In-Line spring used ONLY for Hidden Belhorn Actuation system
  - Ensure correct rudder deflection at full pedal motion just as brakes begin engaging
  - Ensure clearance for pedal motion in case of sponginess in brake MC – still want to be able to engage brakes, even if not full torque capability
  - Ensure full rudder pedal and brake motion capability with full rudder deflection from BOTH pilot stations
  - Eliminate play in rudder cross-connect torque tubes







COZY Aircraft Structures

- Every component of an aircraft was designed with functionality in mind, at lightest weight – changing anything MAY have large or small ripple effect in unforseen ways
- Lack of structural failures in type is **NOT** a license to make structural mods, **HOPING** that the (**UNKNOWN**) safety factor will save your butt!
  - Only known testing **to failure** are on L.E./V.E. canard – one failed at 14G, another at 6 – 7G's – shows variability in MFG and structural capabilities
  - At least one L.E. wing test done – no details known
  - **NO COZY MKIV** structural testing has **ever** been done! Do you know the safety margins? I don't! Nat never published any structural design info or analysis – Neither did RAF for Long-EZ
  - Modifications to composite structures are far more complex and difficult to analyze than with metal structures

- **Wing/Canard:**
  - Spars: Carry bending loads in wings
  - Shear Webs: Carry shear loads in wings – transfer loads from top to bottom
  - Skins: Carry twisting loads in wings

- **Fuselage:**
  - Bulkheads: Stiffen fuselage in bending (sideways) and twisting
  - Sides: Stiffen fuselage in bending and twisting
  - Longerons: Help stiffen – mostly act as mounting "hardpoints"
  - Reinforcements: On LG Bulkheads/Firewall/Seatbelt Attach/Canard Attach - Thicken, hardpoints, transfer loads between major structures

COZY Aircraft Structures (continued)

- August, 2011 **Sport Aviation** article by **Dick VanGrunsven** (designer of all RV aircraft) addresses overweight/overpowered aircraft as well as other modifications – specifically in response to an award winning RV-10 written up in Sport Aviation!

- A couple of quotes from Dick:

  – …Any "penciled in" gross weight increase is just wishful thinking. **The laws of physics are not repealed by wishful thinking.**

  – **WHO OWNS THE MARGIN?**
  It seems common practice among homebuilders to second-guess the factory engineers, particularly regarding gross weight increases. Because of all of the added features, empty weight creep erodes the aircraft's useful load. The simple solution for the homebuilder is to "pencil in" a new gross weight limit. "It's only 100 pounds (3.7 percent) more; how much eff ect can that possibly have?" Imagine this example: You are on a mid-size airliner with a gross weight of 270,000 pounds. Just before leaving the gate, the captain comes on the PA system and says: "We've overbooked more than usual today, so we're going to assume that the factory engineers over-designed this airplane and allowed an abundant safety margin. We're going to take off at 280,000 pounds instead. So move over, there are 50 more passengers coming on board." Run the numbers; it's the same over-weight ratio as simply pencilling in an additional 100 pounds to the gross weight of an RV-10.

  Along with gross weight increases, some builders take the same liberties with horsepower increases and speed increases, betting their lives on the assumption that the airplane is designed with a huge margin of safety—it is really far stronger than it needs to be. This is not really true. **Certificated aircraft, and well-designed kit aircraft, are designed to withstand limit loads at specified maximum weights. During testing, they are subjected to ultimate loads, which are higher than design limit loads by a specified margin. Yes, there is a margin between the design and ultimate strengths. But that margin belongs to the engineer. He owns the margin. It is his insurance against the things he doesn't know or can't plan for, and the pilot's insurance against human error, material variations, and the ravages of time.** Wise pilots respect this design safety philosophy and leave this insurance policy in effect by operating strictly within established limits.

- Emphasis in **red** MINE…

Flight Test Review

- **NOTE:**
  - Flying around in circles for 40 hours at one CG is **NOT** flight testing, especially in a custom, plans built aircraft, no matter how many people **SEEM** to get away with it
  - Your airplane is **NOT** identical to any other airplane on the planet, and even if it has the same name as 200 or 2000 other aircraft, it needs to be flight tested as if it was the only one on earth

- **Purpose of Phase I Flight Testing period:**

  Determine **ALL** performance characteristics of airplane at **ALL** corners of the attainable performance envelope and known airmass characteristics
  - Calibrate Pitot Static System – CAS vs. IAS (**MUST** understand difference between IAS / CAS / TAS / GS)
    - Corollary – MUST understand difference between Indicated Altitude / DA / PA and how to calculate
  - Takeoff / Rotation performance / airspeeds
  - Climb/Cruise performance
  - Descent performance – gear/landing brake retracted, extended
  - Landing performance / airspeeds
  - Stalls / Accelerated stall (more than 1G – performed in 15, 30 45, 60 degree banked turns)
  - Deep stall susceptibility / resistance (at rear CG limit)
  - Static and Dynamic pitch stability (stick fixed / stick free)
  - Lateral stability (spiral, Dutch Roll, Roll/yaw coupling)
  - Flutter susceptibility (stick / pedal raps)

- **Performance Envelope Includes:**
  - Forward, Mid, Aft CG
  - Max Gross Weight (per placard), Middle Weights, Light Weights
  - Full, Mid, Low Fuel
  - Speeds from Vs (aft CG, min weight) to Vne+10%
  - Altitudes from SL to Service Ceiling (or max desired altitude)
  - **ANY AND ALL** maneuvers that may be attempted in Phase II
  - Phase II flight is restricted to flight envelope expanded in Phase I

Flight Test Review (cont.)

- **Flight Test Guidelines:**
  - **AC90-89A** – **EXCELLENT** FAA guide
  - **COZY POH** recommendations
  - **Aerocanard** Flight Test guidelines
  - Use a Test Pilot if not completely capable and current
  - Should take 35 hours **AT LEAST** to perform all required tests – if you're think you're done after 10-25 hours, you **haven't done enough testing!!**

- **CG Determination:**
  - CG is even more critical for canard aircraft, with relatively small CG ranges and deep stall susceptibility
  - Need **ACCURATE** empty CG – implies accurate weighing
  - Bathroom scales are **NOT** accurate enough – need/use calibrated aircraft scales
  - Can weight with ballast / passengers / pilot for more accurate station information
  - Use accurate spreadsheet / calculations to determine flight CG – see sample on **COZYBUILDERS** web page
  - Use weights (lead, steel, sandbag, water container) at appropriate station to set CG during testing
  - One stretched COZY had substantial stability issues early in flight test due to incorrect CG range determination

- **Flight Test Procedures:**
  - No friends, observers, family – only required test crew – don't need pressure to perform
  - Be ready to cancel **ANY** test and **ANY** flight for **ANY** reason if everything is not "just right" (weather, physical condition, aircraft readiness, airport issues, etc.)
  - Have a planned and practiced "test card" for each flight – plan **EVERY** flight completely – all actions and all coms – do not deviate except in an emergency
  - Sample test cards available from other builders
  - Start testing in **CENTER** of CG range
  - Start testing at light weights
  - Slowly add weight and move forward and aft within CG range
  - Start with mild maneuvers
  - Start with short flights – 20 - 30 minutes
  - Runway flights OK if have **LONG** runway
  - Gear stays down on first few flights – verify
  - Need to be able to hold airspeeds to within 1-2 kts.
  - Need to be able to hold altitude to within ~20 - 50 ft.
  - Need to document everything – take notes, record audio, run video camera – whatever works for you – you won't remember everything

Common Modifications - Major

Description	Pros	Cons	Notes
Remove Lower Winglets	Aesthetics to some	Decrease rear CG range limit – deep stall susceptibility	Nat Puffer - mandatory to have LW's on COZY MKIV
Raise Canopy 1" – 2"	More headroom	Slightly more drag	Nat Puffer Approved
Widened Canopy	More head/shoulder room	Slightly more drag	Aerocanard Style
Forward Hinged Canopy	Major safety improvement	More complex/heavier	Cosy Classic style
Long-EZ type strake shape ("Cozygirrrl")	Elbow room	Can't install fuselage side windows	Cozygirrl style - Per previous slide
Original Length Canard	Better performance at very forward CG's	Requires CG range modification	Nat Puffer Mandatory to cut 6" from original length
Retractable Main Gear	Slight speed increase	Extreme complexity and increased failure probability	Nat Puffer – not recommended
High Capacity Brakes	Useful braking capability	Slightly heavier	MATCO or Beringer?

Common Modifications - Minor

Description	Pros	Cons	Notes
Electric Nose Gear	Easier to raise nose – can raise with passengers – saves old folk's backs	Slight weight increase	Nat Puffer Approved
Electric Landing Brake	Saves weight, space, lower failure rate	None	Nat Puffer Approved
Move Landing Lights	Remove air entry to cockpit	Time to design / install	
Hanging Rudder Pedals	Gives free floor space for heels	Complex / heavier than plans	Velocity style – might be a few flying
Eliminate Fuselage Access Door	Fix air/water ingress	Have to have other method of opening from outside	
Main Gear Leg Fairings	Small speed increase	Time to install	
Nose Wheel Doors	Reduce air ingress to cabin / noise reduction	Slight complexity	
Electronic Ignition	Greatly increased efficiency	Unless using Pmag, need backup electrical system	
Electric Pitch Trim	Easier to use	Time to design / install	
Fuselage Side Windows	Greatly increased visibility	Time to design / install	
Canopy Seal Improvement	Better weather sealing / heating efficiency	Time to design / install	

Performance Modifications

• Wheel Pants (size / design)	- 8 to 12 kts
• Main Gear Leg Fairings	- 3 to 5 kts
• Retractable Landing Gear	- 0 to 20 kts
• Cowling/Cooling (airflow / boat-tail / exhaust)	- 0 to 15 kts **potential**
• Nose Wheel Door	- ?? (small)
• Winglet Intersection Fairings	- ~1 to ~4 kts
• Spinner	- 0 to 1 kts
• Electronic Ignition	- 5% - 10% fuel efficiency

- Appropriate VG's (per **Mark Beduhn's** installation):
  - Decrease landing speed - 7 to 10 kts
  - Decrease top end speed - 1 to 3 kts

My Recommended Modifications

- **Safety:**
  - Forward Hinged Canopy - Inadvertent canopy opening danger mitigation
  - High Capacity Brakes - Aborted Takeoff capability
  - Electronic Engine Monitor / Sensors - Automatic Warnings of issues
  - Prop Bolt Belleville Washers - Retain prop / reduce maintenance
  - "Bulb" Nose gear strut attach - Retain nose gear in case of NG-2 or flox failure
  - Appropriate VG's (per **Mark Beduhn's** installation):
    - Decrease landing speed - 7 to 10 kts
    - Decrease top end speed - 1 to 3 kts

- **Performance:**
  - Wheel Pants (size / design) - 8 to 12 kts
  - Main Gear Leg Fairings - 3 to 5 kts (see Curt Smith's 2008 OSH Presentation)
  - Electronic Ignition - 5% - 10% fuel efficiency gain
  - Fuel Injection - Allows better leaning for efficiency and temps.

- **Comfort:**
  - Nose Lift - Helps old backs
  - Fuselage Side Windows - Greatly assists downward vis.
  - Fuselage access door elimination - Stops air/water leakage
  - Electric Landing Brake - Simpler/lighter/more reliable
  - Electric Pitch Trim - Ease of use
  - Raised Canopy - Head room
  - Improved Canopy Seal - Heater works better

Modifications I discourage

- Retractable Landing Gear (cost, complexity, maintenance)
- Constant Speed Propeller (cost, complexity, maintenance – only if absolutely need TO performance increase)
- Eliminating Lower Winglet (CG range/deep stall margin)
- Keep original canard length (moves CG range forward - only OK in very specific situations)
- 6.00x6 wheels/brakes (unnecessary, heavy)
- Downdraft Cooling (no evidence of better cooling performance – difficult implementation)
- Fuselage Stretch (aerodynamic stability and deep stall implications – needs analysis to be safe)
- Fuselage Widening (same – a number are flying, but until test data is published, I will continue to discourage)

Safety Issues for Builders / Flyers / 2nd Owners / Buyers / Non-builders

- **Full Presentation:**
  - See 2013 Columbia presentation "**Holy Crap - you actually have been FLYING that thing?"**
  - Examples of poor build quality

- **Builders:**
  - Pay attention to the damn plans – read 3 times, build once
  - If Burt/Nat say something's important, mandatory, or critical, **DO IT RIGHT!**
  - If you did it wrong, do it **OVER**!
  - At all points in the build, ask yourself **truthfully**:

    "Do I know more about this plane than the designer?"

    The answer will almost always be:

    "NO – NO, I do not"

  - Document anything discrepant for future use/owners

- **Flyers:**
  - Keep track of any changes to the aircraft that may in any way affect safety – i.e., repaint (control surface balance), additions, modifications, etc.
  - Re-rig if there's **ANY** question
  - Test all changes

- **Purchasers/New Owners:**
  - Ask a lot of questions
  - Investigate ALL safety related issues
  - Hire qualified canard-knowledgeable inspector for pre-buy inspection
    - How to know who's "qualified"?
    - Just because someone is an A&P, or even a canard builder/repairman, does not assure knowledgeable inspections and careful work
  - Use published CI inspection criteria for pre-buy inspection
  - Use AC43.13-1B criteria for pre-buy inspection
  - Perform FULL Phase I flight test regime after acquisition to verify flight characteristics
  - **Caveat Emptor**

Futures / State of Design

- **Future of COZY:**
  - Very active community: plans sales still ~20-40/year (per Jim Irwin)
  - New completions all the time
  - Slow evolution of derivatives
    - Chris Esselstyn's stretched retract
    - FHC popularity
    - Other O-540 variants
    - Wider fuselages, etc.

- **State of Design Questions:**
  - Extremely well developed design/plans – however…
  - Official Builder Support – how well is this working?
  - Official Designer (qualifications)?
  - Who Approves Vendors/Parts?
  - Who Approves Modifications/Design Changes/Fixes?
  - How is Design Advancing?
    - Fits and starts
    - Randomly
    - Little good testing of mods, per Nat's example

- **MANY non-engineered mods occurring – <u>VERY</u> worrisome to me**

Questions? (& Answers)

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