COZY AIRCRAFT FORUM

Soup to Nuts*?

Marc J. Zeitlin

August 1st, 2014

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?***

- *Travelogue – What Can You Actually Do In This Plane? – 10 min.*
  - *Average Flight Performance*
  - *Easy Day Trip*
  - *Go Visiting #1*
  - *Go Visiting #2*
  - *Go Visiting #3*
  - *Long Cross Country*

- *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*
  - *COZY Accident Record*

- *Futures / State of Design*

- *Questions and Answer – until done*

  (ANY topic)

Who The Heck Am I?

- Biography / Resume'
  - http://www.mdzeitlin.com/Marc/bio.html
- Built Quickie Q2
- Built COZY MKIV #386, N83MZ – ~1060 flying hours
- Started / Administer Unofficial COZY Builders Web Page and COZY Mailing List (~713 members)
- As Burnside Aerospace, provide engineering consulting and canard A&P services (Pre-Buy, Pre-Sale, Condition Inspection, Builder Assist, Modifications, Upgrades, 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 – will show some representative flight maps

- 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
- Don't mind the performance restrictions – no grass / short fields

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 Builder/Flyer 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 (other composite sources available – check compatibility)

- Two main vendors provide metal parts:
  - CG Products
    - http://www.cozygirrrl.com/aircraftparts.htm
  - EZ Noselift
    - http://www.eznoselift.com/

- Other part vendors for pre-fab composite parts and other 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)
- ~ 300 - 400 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

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- ***Travelogue – What Can You Actually Do In This Plane? – 10 min.***
  - ***Average Climb Performance***
  - ***Average Cruise Performance***
  - ***Easy Day Trip***
  - ***Go Visiting #1***
  - ***Go Visiting #2***
  - ***Go Visiting #3***
  - ***Long Cross Country***

- *Further / Suggested Topics – 30 min.:*
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  - *Control Rigging*
  - *COZY Aircraft Structures*
  - *Flight Testing Methods*
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    - *Major*
    - *Minor*
  - *Performance Modifications*
  - *Recommended Modifications*
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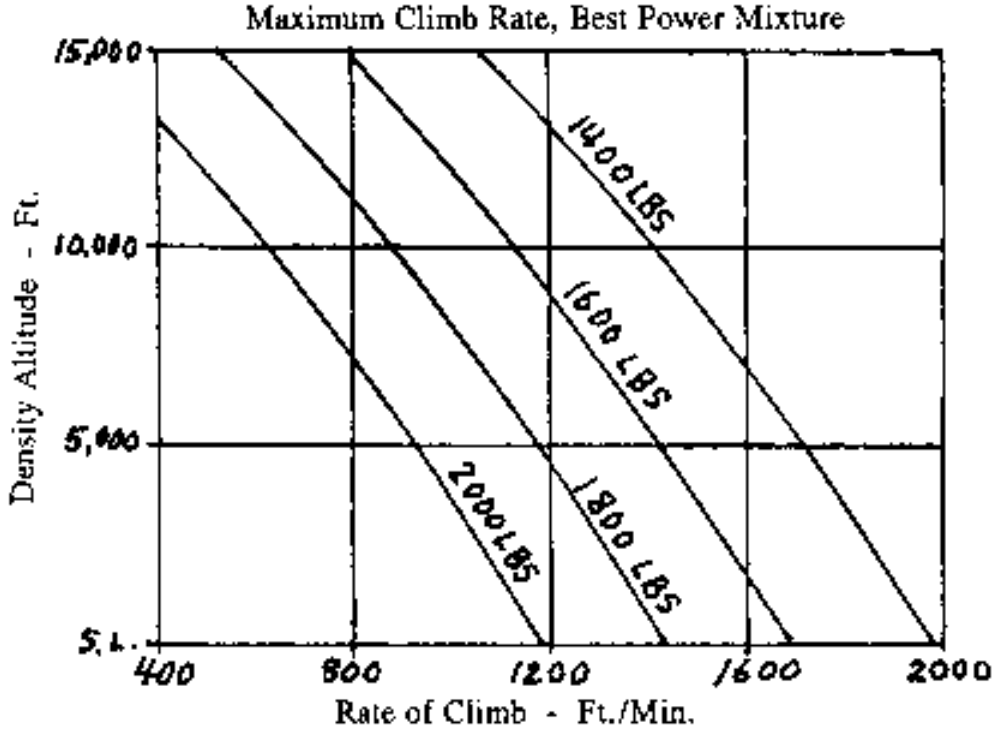
- *Questions and Answer – until done (ANY topic)*

Travelogue - Climb Perf.

- Sea Level
  - Depending upon Gross Weight, propeller, CG, IAS, can get 1000 to 2000 fpm climb rate
- 6K ft Density Altitude
  - 800 to 1500 fpm climb rate
- 12K ft Density Altitude
  - Depending upon Gross Weight, propeller, CG, IAS, can still get over 400 fpm climb rate at MGW



Note: Data for 180 hp Lyc 0-360 with 3-blade 64 x 76 Performance prop.

Can get over mountains – don't have to fly low or worry about terrain – can get high quickly – avoid heat, turbulence

Travelogue - Cruise Perf.

- My Configuration:
  - 180 HP
  - Hertzler or Catto Prop (very common)
  - Wheel Pants
  - 2600 RPM – 60% - 74% Power depending upon altitude

- Achieve consistent 165 – 169 KTAS (190 – 195 mph)
  (numerous other COZY MKIV's report the ~ same)

- 7,500 ft Density Altitude
  - Fuel Burn – 8.8 gph – 19 Nm/gal (22 mpg)
    (about the same as my Subaru Outback on the highway at 65 mph)

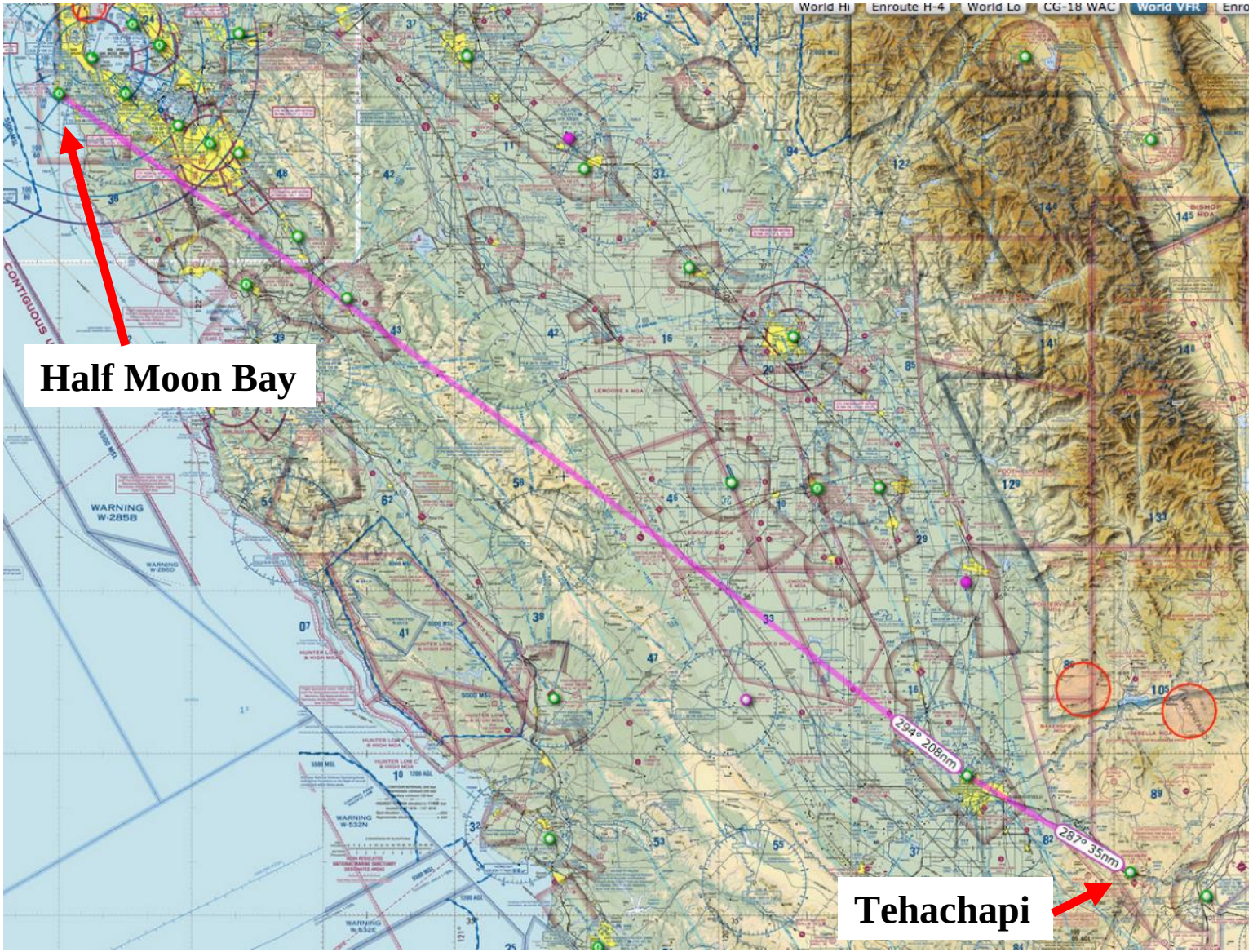
- 13,500 ft Density Altitude
  - Fuel Burn – 7.7 gph – 21 Nm/gal (25 mpg)

- Range
  - Well over 1000 NM (1150 miles)
  - Well over bladder range
  - Endurance over 6 – 7 hours

Travelogue – Easy Day Trip

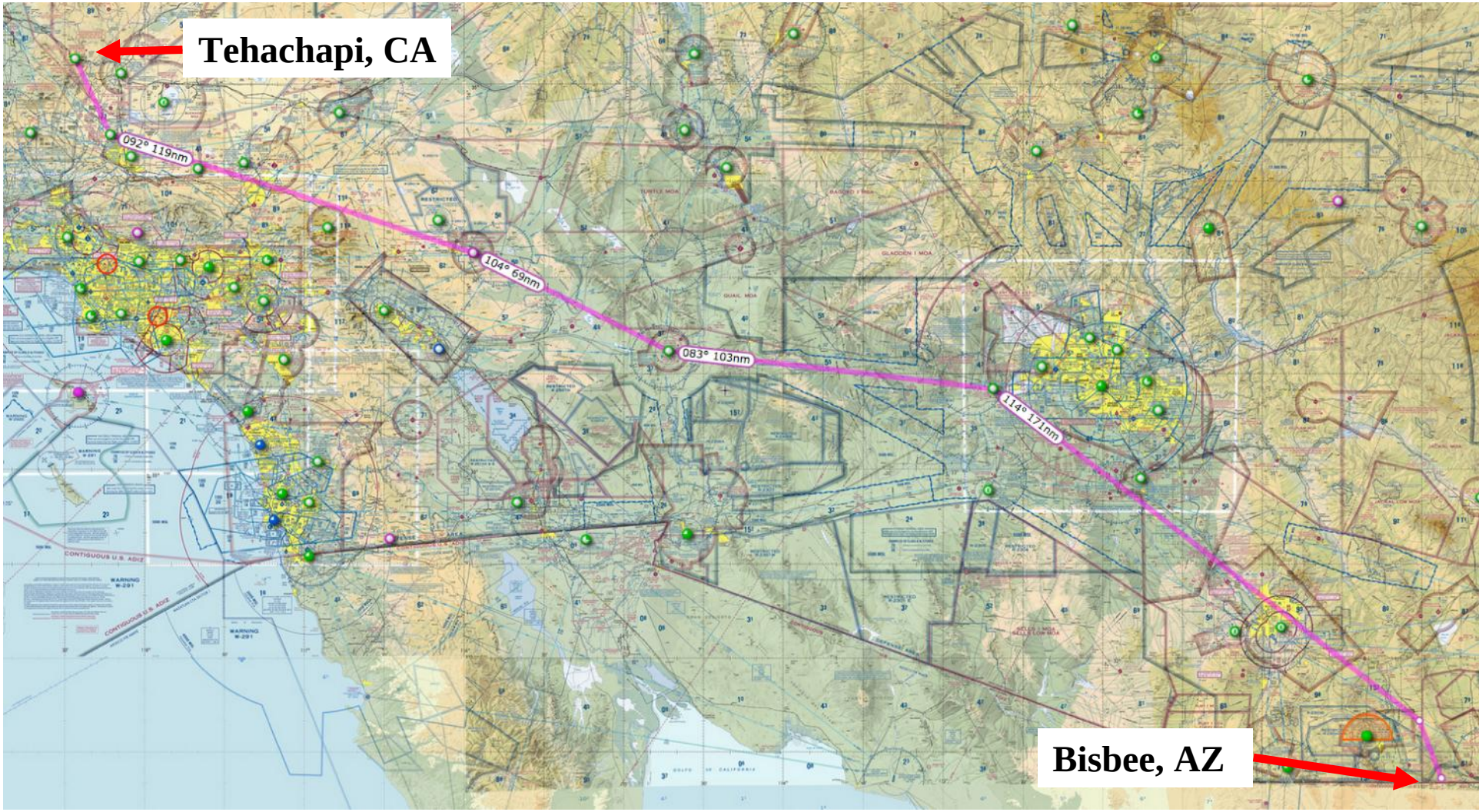
~6 hour Drive

1.3 hour flight



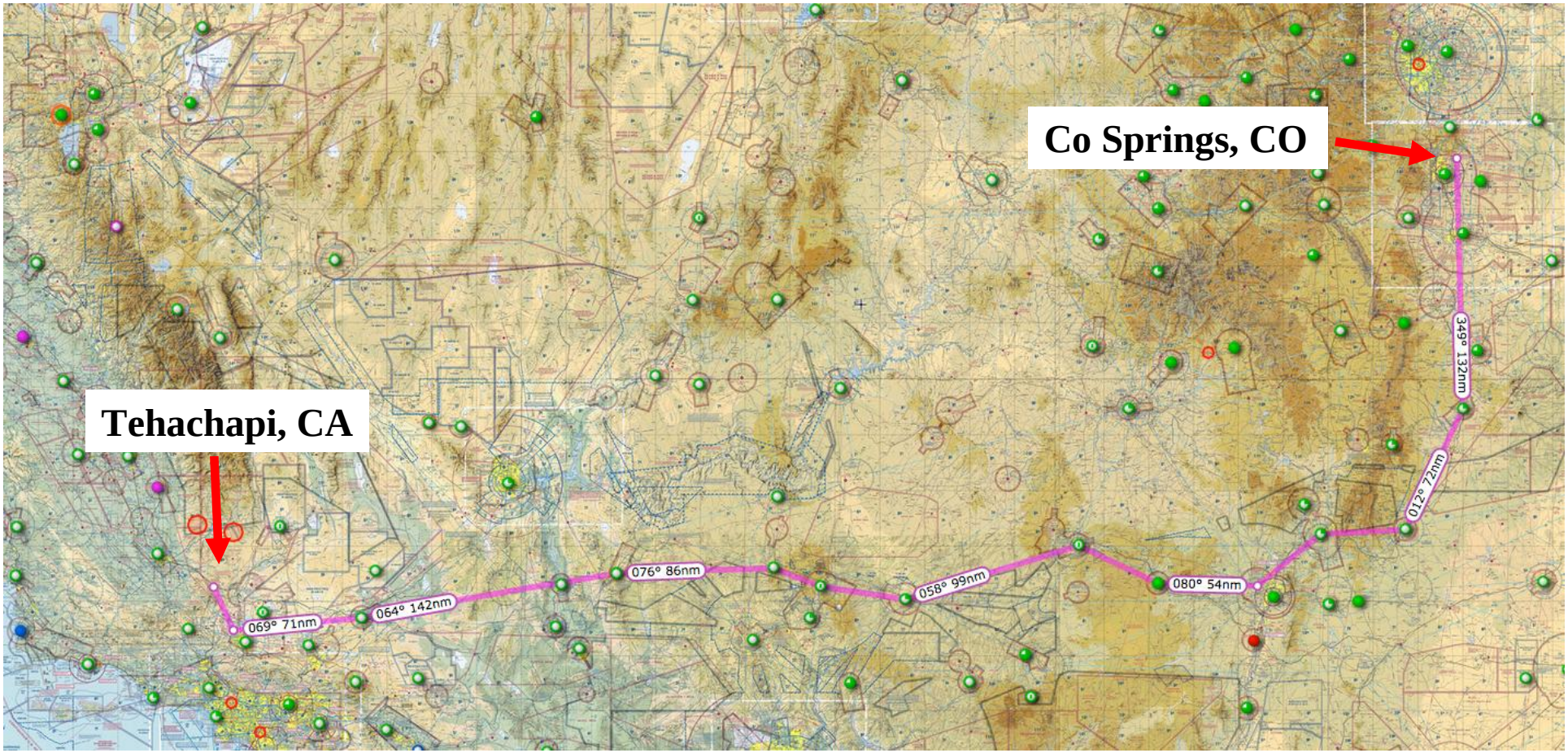
Travelogue – Go Visiting #1

~11 hour drive becomes 3.2 hour flight



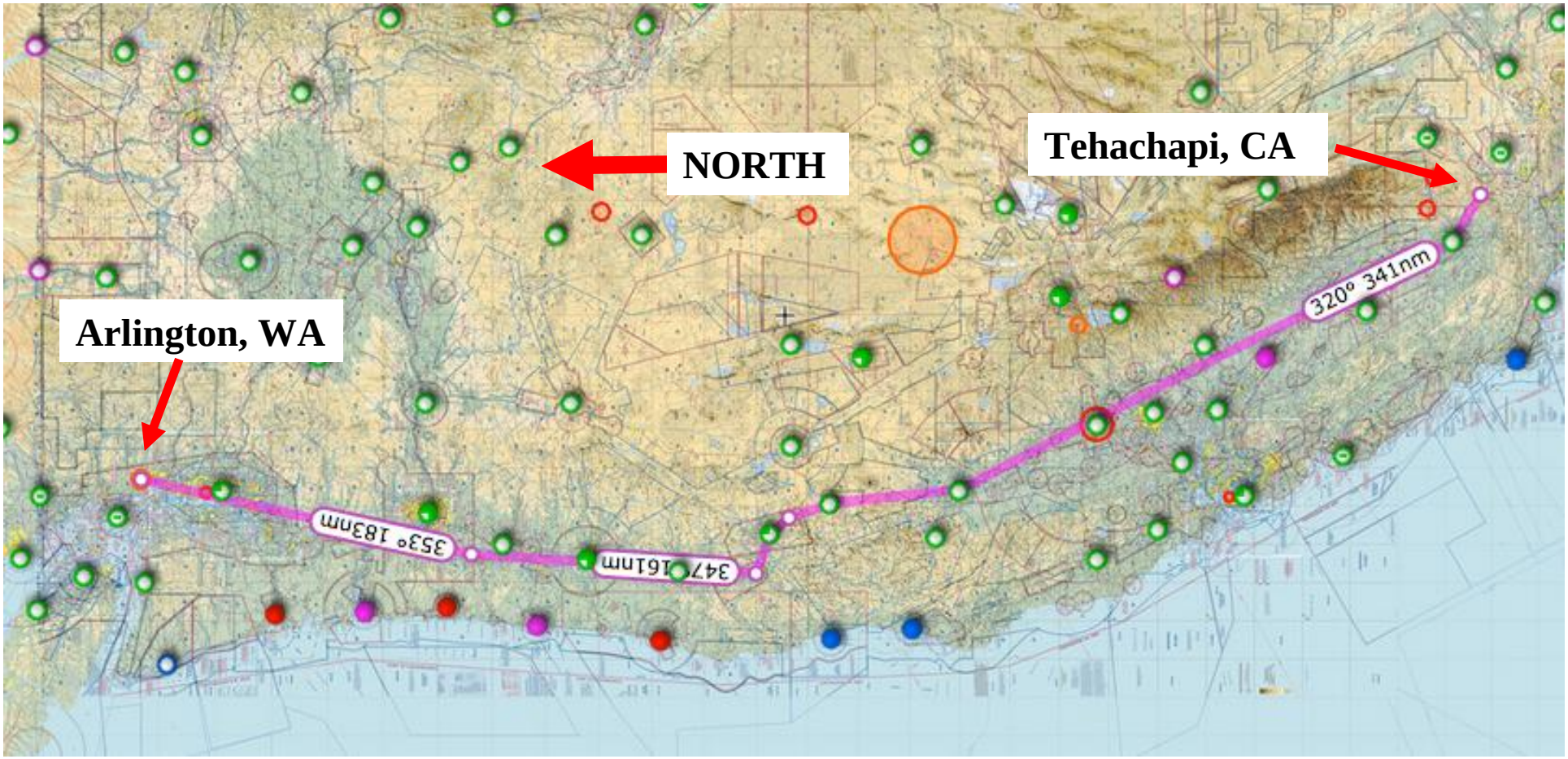
Travelogue – Go Visiting #2

~16 hour drive becomes 4.5 – 5.5 hour flight



Travelogue – Go Visiting #3

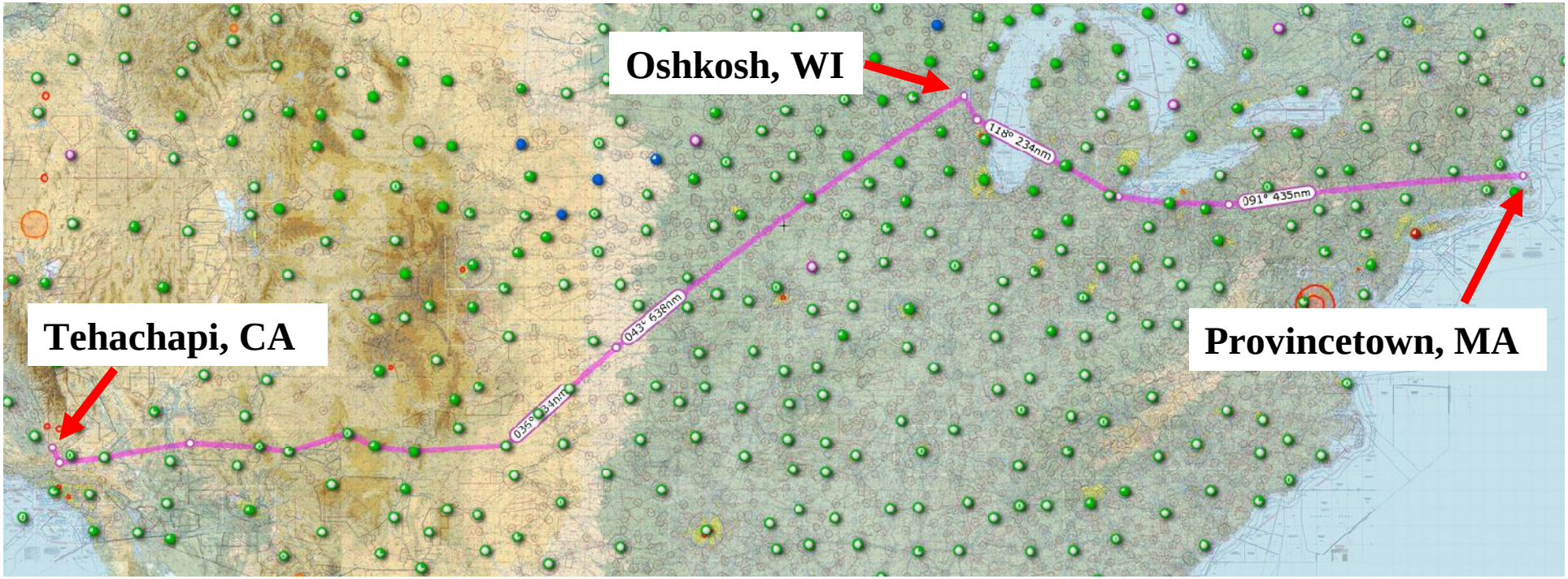
~17.5 hour drive becomes 5.5 hour flight



Travelogue – Long Cross Country

- ~46 hour drive becomes 16 hour flight over 2-5 days – can be done with only 2 stops, if desired

- Tehachapi to Oshkosh Door to Door (campsite) takes about the same time as driving to LAX, flying commercial from LAX to Appleton, WI and taking bus from Appleton to OSH – can get to OSH in 10 hours of flying with one 1 hour stop



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

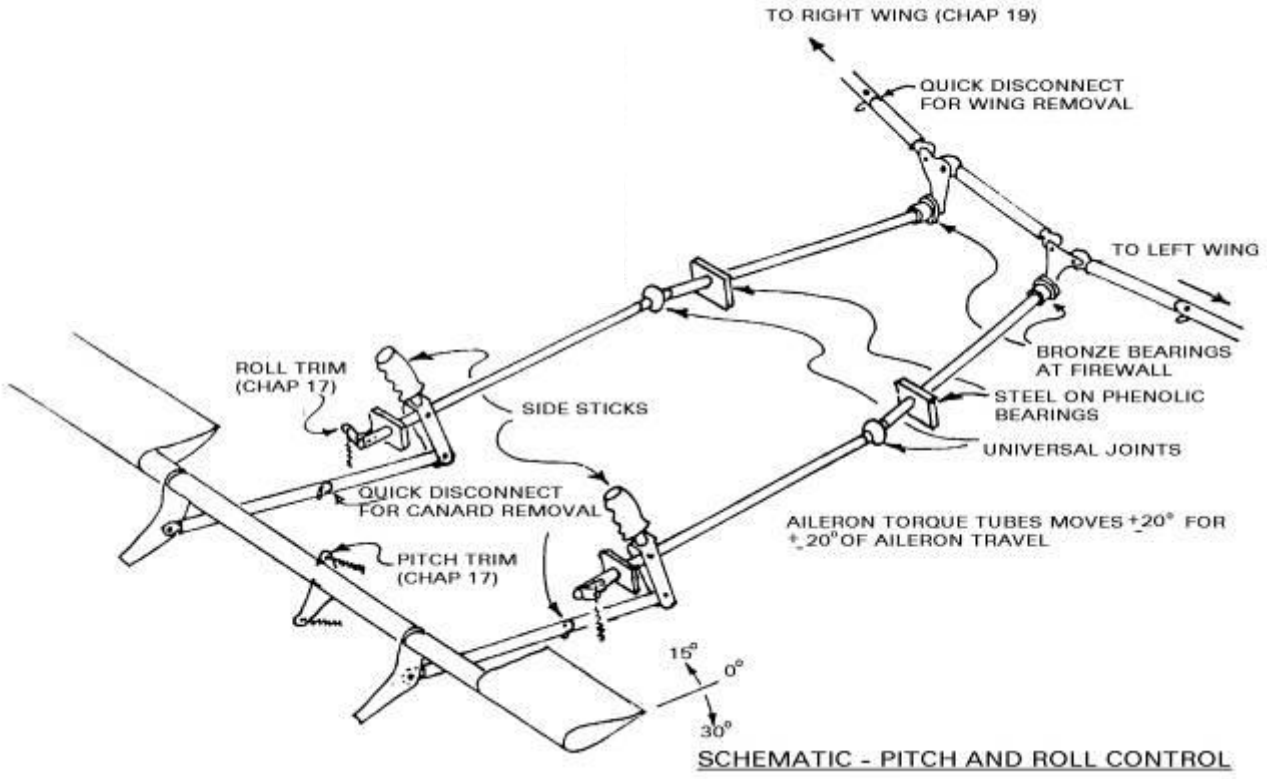
- Airworthiness Directive Applicability to Exp. Am-Built?
  - Common belief that AD's do NOT apply to EAB aircraft
  - For most part, true
  - HOWEVER, FAA recently stated explicitly that they CAN state applicability of AD to EAB aircraft, but it must be explicit in the AD applicability statement
  - 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

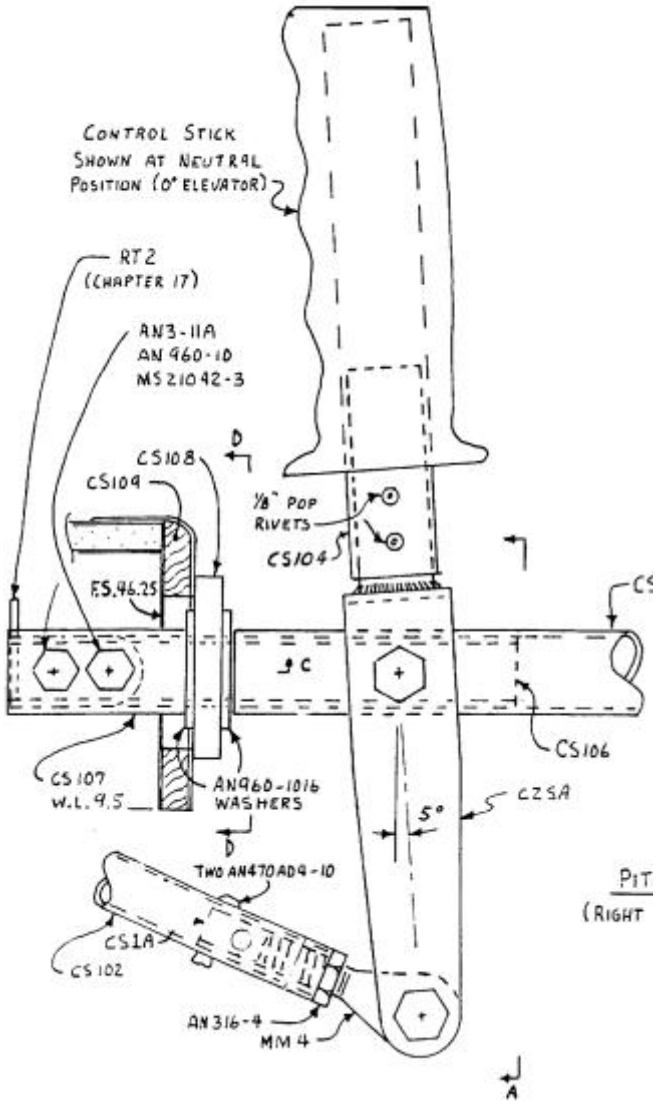
- **General:**
  - Plans do good job of describing rigging of control systems
  - Object
    - Put control surfaces in correct positional relation to each other (left/right) and to control stick/pedal
    - Ensure control surfaces have FULL travel in all required directions
    - Ensure control surfaces 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

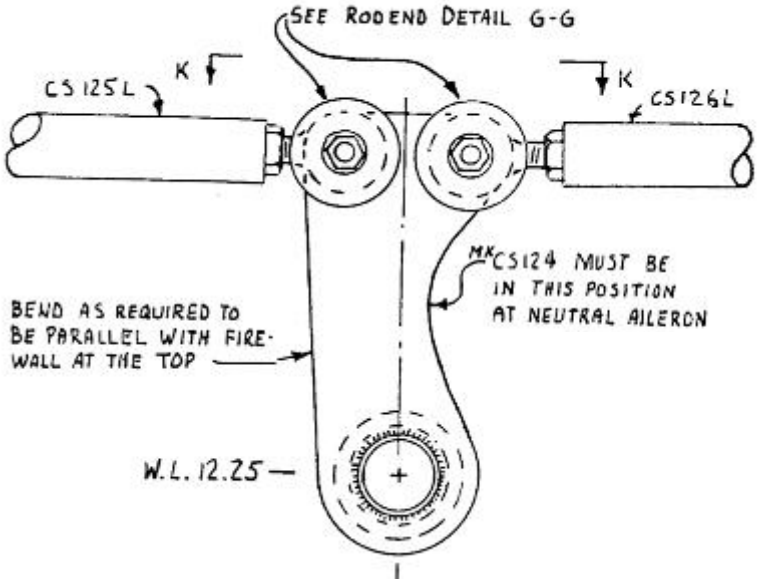
Control Rigging

- **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



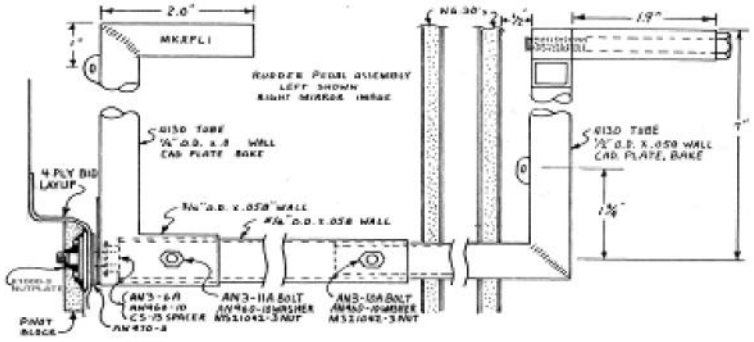
Control Rigging

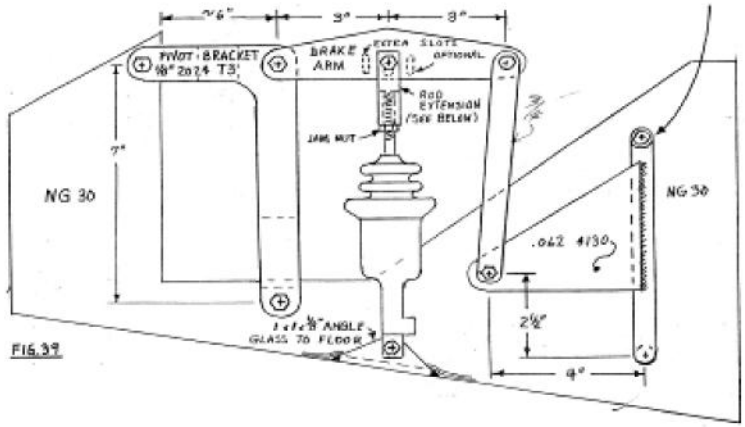
- **Ailerons:**
  - Torque tube from stick to firewall – pushrods to wing – torque tube in wing
  - Eliminate play in torque tube bearings, hinges, rod-ends, connecting bolts, all QD's
  - Ensure firewall belcranks are BOTH in correct centered position when sticks are centered
  - Ensure wing belcranks 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

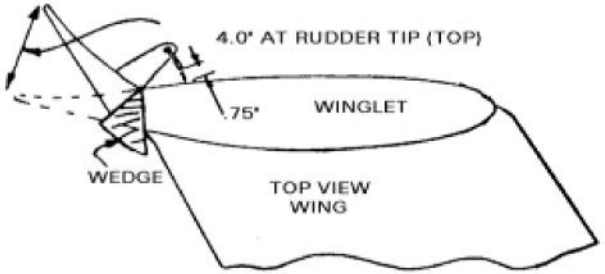


Control Rigging

- **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 – also **ONE** V.E. Wing/Spar set – failed at 3G's!!!
  - 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 – shown on next slide
  - 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

Flight Test Review (cont.)

Example First / Second Flight Test Card – Controls / Slow Flight:

GPS:	Set to FIT area - 12 mile range
Radio:	Fitchburg traffic, Experimental N83M(ike)Z(ulu) departing runway XX to the west – Fitchburg.
Throttle:	Full - Check for 2300 - 2400 RPM static
Accelerate:	To 75 - 80 mph and rotate
Climb:	100 mph straight out to 1000 ft.
Check:	CHT / Oil Pressure
Climb:	Climb checklist - 100 mph IAS gentle turn to west area to 3000 ft.
Level:	3000 ft.
Throttle:	2200 RPM or to 135 mph (do not exceed 140 mph IAS)
Radio:	Fitchburg traffic, Experimental N83M(ike)Z(ulu) maneuvering at 3000 ft. 3 miles west Fitchburg
Controls:	Check rudders - 5 degrees yaw - return to S&L (check control pressures, stability, engine gauges)
Controls:	Check elevator - 3 degrees up/down pitch – return to S&L (check control pressures, stability, engine gauges)
Controls:	Check roll - 5 degrees roll left/right increasing to 20 degrees - return to S&L (check control pressures, stability, engine gauges)
Radio:	Fitchburg traffic, Experimental N83M(ike)Z(ulu) maneuvering at 3000 to 5000 ft. Fitchburg
Climb:	100 mph, max throttle, to 5000 ft. (clouds allowing)
Approach:	Practice approach - use descent/landing checklist - to 4000 ft. (check control pressures, stability, engine gauges)
Approach:	same to 3000 ft. (check control pressures, stability, engine gauges)
Trim:	Check trim response - pitch and roll
Radio:	Fitchburg traffic, Experimental N83M(ike)Z(ulu) maneuvering at 3000 ft. Fitchburg
Climb:	100 mph, max throttle, to 5000 ft. (clouds allowing)
Level:	135 mph at 5K ft., two clearing turns, stabilize speed, altitude, heading
Throttle:	Reduce to 900 RPM - hold altitude with trim/stick - check control inputs (pitch, roll, yaw) throughout slowdown
Pitch:	Note nose bobbing at ~70 mph (If no nose bobbing at 65 mph, drop nose and increase speed)
Throttle:	Increase power to maintain altitude at nose bob speed
Roll:	Note roll/yaw response during nose bobbing (Check engine gauges)
Radio:	Fitchburg traffic, Experimental N83M(ike)Z(ulu) descending from 5000 ft. to pattern altitude Fitchburg

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
• Fuel Injection	- 5% - 20% 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 in-flight 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 visibility
  - Fuselage access door elimination - Stops air / water leakage
  - Electric Landing Brake - Simpler / lighter / more reliable than manual system
  - 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 takeoff 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 between Main Wing / Canard - Aerodynamic stability and deep stall implications – needs analysis to be safe
- Nose Stretch ahead of Canard - Same issue as Fuse. Stretch
- Fuselage Widening - Same issues – 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?"** (available on Cozybuilders web page)
  - 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, fix it or 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 Condition 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**

COZY Accident Record - Fatal

Date	Phase	Severity	Type	Registration	Plans #	Country	Pilot		Category	Keywords	Notes	Report Version
							First Name	Last Name				
21-Sep-94	1	Fatal	MKIV	N151JE	MKIV-389	USA	James	Edwards	Pilot Error	Landing, Rollover	Hard landing - rollover and burn	NTSB Final
1-Jan-95	2	Fatal	MKIV	N5037	MKIV-041	USA	Charles	Larson	Pilot Error	Approach	Low approach - snag wires	NTSB Final
16-Jun-01	2	Fatal	Classic	F-PRSC	Classic-593	France			Pilot Error	Canopy Opening	Canopy open on takeoff - pilot distraction	BEA Final
18-Jan-02	2	Fatal	III	N41CZ	III-081	Mexico	Anoir	Rizk	Weather	Landing	Severe wind shear on landing	NTSB Final
5-Mar-03	2	Fatal	Classic	F-POZY	Classic-???	France			Pilot Error	Maneuvering	Low altitude maneuvering over village	BEA Final
24-Jul-04	2	Fatal	Classic	F-PSCF	Classic-???	France	Saul	Halter	Pilot Error	Deep Stall	Sharp climb and stall on takeoff - suspected improper build and CG problems - Fire	
12-Dec-07	2	Fatal	Aerocanard	N199JW	AC-20	USA	Risto	Toukola	Pilot Error	Canopy Opening	Prop fouling from open canopy after takeoff	NTSB Final
4-May-08	1	Fatal	MKIV	N14GG	MKIV-573	USA	Gerald	Garrett	Unknown		Turbine engine; crash in ocean	NTSB Final
24-Jul-08	2	Fatal	MKIV	N500K	MKIV-163	USA	James	Marshall	Pilot Error	Maneuvering	Flew into side of quarry at 20 ft. AGL - pictures at http://desastresaereosnews.blogspot.com/2008/07/em-dois-dias-dois-acidentes-na-mesma.html	NTSB Final
27-Mar-10	2	Fatal	MKIV	F-PMGT		France	Guy	Terren	Pilot Error	Approach	Low approach - clip trees	
23-Oct-11	2	Fatal	MKIV	N795DB	MKIV-165	USA	Roland	Bremer	Pilot Error	Fuel System	Fuel mismanagement; crash in trees	NTSB Preliminary
11-Jul-12	2	Fatal	III	N718JT	III-???	USA	Joe	Tischler	Unknown	Takeoff	Engine Trouble on takeoff - cartwheel off airport	NTSB Preliminary - WPR12LA302
7-Jul-14	1	Fatal	MKIV - Mod	N79ZR	MKIV-???	USA	Zubair	Khan	Unknown	Maneuvering	Dave Coscio started project as twin; Zubair modified to single O-540	

13 Fatal COZY accidents worldwide since 1994 (20 years)

COZY Accident Record – non-Fatal

Date	Phase	Severity	Type	Registration	Plans #	Country	Pilot		Category	Keywords	Notes	Report Version
							First Name	Last Name				
25-Feb-89	2	Non-Fatal	III	N611CZ	III-061	USA	Dennis	Oelmann	Pilot Error	Fuel System	Fuel mismanagement - run tanks dry	NTSB Preliminary
13-Jun-91	2	Non-Fatal	III	N52CZ	III-01	Germany	Uli	Wolter	Aircraft	Engine	Nose seal leak - oil loss - forced landing	
6-Aug-94	1	Non-Fatal	Classic	OE-CYZ	Classic-???	Austria	Valentino	Fry	Aircraft	Engine	Throttle stuck closed	Personal
23-Jun-95	2	Non-Fatal	III	N84CZ	III-71	USA	Keith	Spreuer	Pilot Error	GU Canard, Brake Failure	Canard Contamination - no rotation	NTSB Final
7-May-96	2	Non-Fatal	Classic	N86LM	Classic-006	USA	Robert	Harris	Aircraft	Fuel System, Clogged Filter, Rollover	Clogged Fuel Strainer - rollover	NTSB Final
4-Oct-96	1	Non-Fatal	MKIV	N96PJ	MKIV-203	USA	Pat	Young	Pilot Error	Deep Stall	Vortilon and CG issues	NTSB Final
11-Feb-97	2	Non-Fatal	III	N34PC	III-566	USA	Salvatore	La Barbera	Builder Error	Fuel System	Fuel contamination – hydraulic lines inside tank - loss of power	NTSB Final
26-Mar-97	2	Non-Fatal	Classic	F-PSCF	Classic-???	France			Pilot Error	Takeoff, Rollover	Loss of control during takeoff	BEA Final
22-Jun-97	2	Non-Fatal	Classic	F-PRSC	Classic-???	France			Pilot Error	Landing	Pilot distraction - land short of runway	BEA Final
17-May-00	2	Non-Fatal	Classic	F-WJAK	Classic-???	France			Pilot Error	Takeoff	Canopy open on takeoff - pilot distraction	BEA Final
22-Jan-03	2	Non-Fatal	MKIV	N96PJ	MKIV-203	USA			Pilot Error	Landing	Hard Landing	NTSB Final
26-Jan-03	2	Non-Fatal	MKIV	N320FR	MKIV-???	USA	James	Willar	Pilot Error	Landing, Rollover	Hard Landing - rollover	NTSB Final
30-May-03	2	Non-Fatal	III	N794WD	III-022	USA	John	Totah	Aircraft	Fuel System, Clogged Filter	Clogged Fuel Filter	NTSB Final
16-Nov-03	2	Non-Fatal	III	N534S	III-177	USA	William	Swears	Aircraft	Fuel System	Engine seizure due to oil pressure loss	NTSB Final
2-Dec-03	2	Non-Fatal	III	N238CZ	III-505	USA	Richard	Hughes	Aircraft	Mechanical	Throttle Cable failure - engine power loss	NTSB Final
5-Feb-04	2	Non-Fatal	MKIV	F-PJJP	MKIV-819	France			Pilot Error	Approach, Rollover	Ran off runway - rollover	
17-Jun-04	2	Non-Fatal	III	C-GESK	III-299	Canada	Gaetan	Roy	Aircraft	Fuel System	Fuel Cap came off - break prop blade - force landing on highway	
1-Jul-04	unk.	Non-Fatal	Classic	F-????		France			Builder Error	Structure, Rollover	Canard flutter - rudder failure - land in field - rollover	
10-Jul-04	2	Non-Fatal	III	G-BXDO	III-???	Great Britain			Pilot Error	Rollover	Nose door goes through prop - forced landing	CAA Final
2-Mar-06	2	Non-Fatal	MKIV	ZU-DAR	MKIV-673	South Africa	Jannie	Versfeld	Builder Error	Mechanical	Axle installation failure due to loose bolts	
16-Jun-06	2	Non-Fatal	MKIV	ZU-BNH	MKIV-???	South Africa	Rego	Burger	Pilot Error	Takeoff	Grass runway - no rotation	
18-Jan-07	1	Non-Fatal	MKIV	C-GUZY	MKIV-387	Canada	Licio	Merlo	Pilot Error	Landing, Rollover	Lost control on go-round - low airspeed - rollover	CADORS 22007C0172
1-May-07	2	Non-Fatal	MKIV	ZU-DAR	MKIV-673	South Africa	Jannie	Versfeld	Aircraft	Engine	Exhaust Pipe failure - damage propeller	
5-Jul-07	2	Non-Fatal	Aerocanard	N337DS	AC-???	USA	William	Oertel	Pilot Error	Fuel System	Gas cap departed -fuel loss	NTSB Final
5-Nov-08	2	Non-Fatal	MKIV	N637PS	MKIV-287	USA	Leonard	Johnson	Pilot Error	Landing Brake	Landing Brake extended - engine overheat	NTSB Final
15-Nov-08	2	Non-Fatal	III	N149CZ	III-178	USA	Harland	Hauser	Pilot Error	Landing	Loss of control during landing	NTSB Final
17-Apr-10	2	Non-Fatal	MKIV	N68TF	MKIV-354	USA	Steve	James	Builder Error	Deep Stall	Deep Stall - probable canard span and empty CG calc. issues	NTSB Final
9-May-10	2	Non-Fatal	III	N144TJ	III-452	USA	Richard	Hughes	Pilot Error	Canopy Opening	Pilot opened canopy during flight - damage to propeller	NTSB Preliminary
11-Sep-10	2	Non-Fatal	MKIV	N9699	MKIV-1017	USA	Kevin	Carr	Aircraft	Engine, Rollover	Power Loss - rollover	NTSB Preliminary
30-May-11	2	Non-Fatal	MKIV	N204TJ	MKIV-204	USA	Tim	Jones	Aircraft	Engine	Power Loss	NTSB Preliminary
22-Jun-11	2	Non-Fatal	MKIV	ZU-BNH	MKIV-???	South Africa	Rego	Burger	Builder Error	Engine	Belt failure (V8 engine) in PSRU due to loose bolts in installation	
6-Jul-11	2	Non-Fatal	MKIV	N484BD	MKIV-???	USA	Bulent	Aliev	Other	Not at Fault	Other aircraft taxied into wing on ground - other aircraft at fault	NTSB Preliminary
28-Jul-11	2	Non-Fatal	Classic	F-PFMP	Classic-???	Germany	Klaus	Scheidl	Unknown		Wilksch Diesel power - crash in trees after takeoff	BFU Preliminary
23-Dec-11	1	Non-Fatal	III	ZK-COZ	III-749	New Zealand	Chris	Hoskins	Pilot Error	Takeoff	Canopy open on takeoff - pilot distraction	

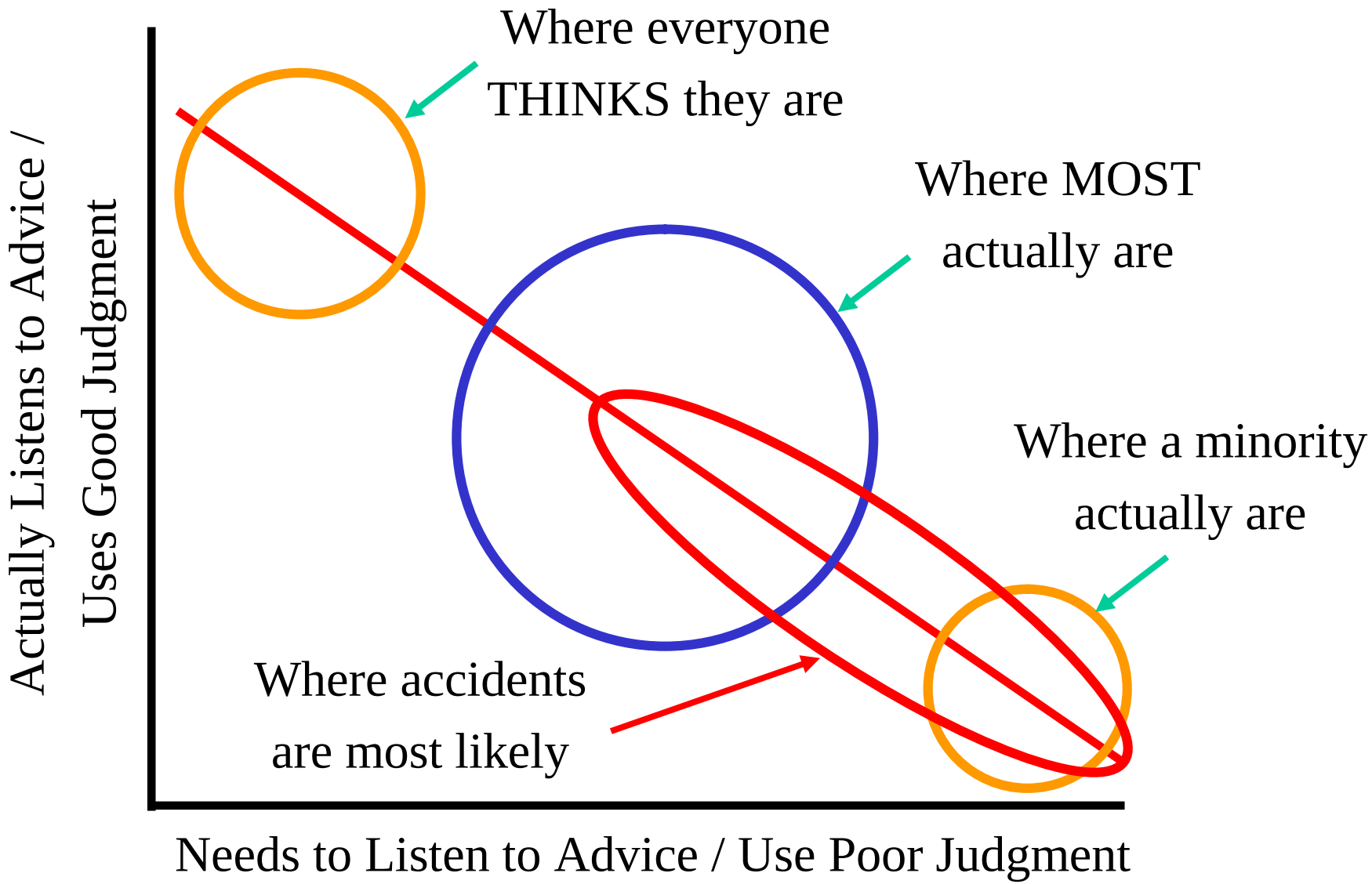
Analysis of Accident Record

- **Flying/Landing Techniques and Pilot (mis)judgment:**
  - Single largest factor – over **50%** of all COZY accidents
  - Almost all (9 out of 13) fatal accidents caused by pilot error
  - Under our control – must actively manage and learn
  - Gave presentation on "Judgment" at COZY dinner in 2009 – available on COZY builders web
  - Cause? Training, Low Flying Time, something about homebuilders?

- **Major Mechanical Issues:**
  - Almost all "Aircraft" related accidents are engine/fuel system related – maintaining a reliable engine installation is critical
  - Forward Hinge Canopy – have lost canard aircraft due to canopy opening upon takeoff and prop fouling – **FLY THE PLANE** (**FHC** does prevent bailing out, but who flies with a parachute?) FHC fixes a pilot error with design
  - Fuel contamination – follow Al Wick's tank cleaning methodology (and don't route hydraulic lines [or anything else] through gas tank)
  - Nose Oil Seal retainer – many instances of oil loss due to seal loss
  - Non-aircraft rated fittings/lines – "Walrus" custom canard aircraft burned June, 2010
  - Glenn Saunders' VE accident – plastic fittings in fuel system

- **Potential Issues:**
  - Roll bar – have been rollovers, hard to determine whether roll-bar would have helped
  - Control System play – torque tube mounts / bolted joints – flutter susceptibility and loss of control
  - Other?

Builder / Flyer Safety Diagram



Futures / State of Design

- **Future of COZY:**
  - Very active community: plans sales still ~20/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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- Websites: http://www.cozybuilders.org
  http://www.burnside-aerospace.com