THE LEADING EDGE

NEWSLETTER OF MUROC EAA CHAPTER 1000

Voted to Top Ten Newsletters, 1997, 1998 McKillop Award Competition

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http://www.eaa1000.av.org *December 2009*

Chapter 1000 meets monthly on the third Tuesday of the month in the USAF Test Pilot School Scobee Auditorium, Edwards AFB, CA at 1700 or 5:00 PM, whichever you prefer. Any changes of meeting venue will be announced in the newsletter. Offer void where prohibited. Your mileage may vary. Open to military and civilian alike.

This Month's Meeting:

Project Police Festivus

Celebration

Tuesday, 15 December 2009
1800 hrs (6:00 PM Civilian Time)
Kommandant's Kwarters
Quartz Hill, CA

Fellow 1Kers,

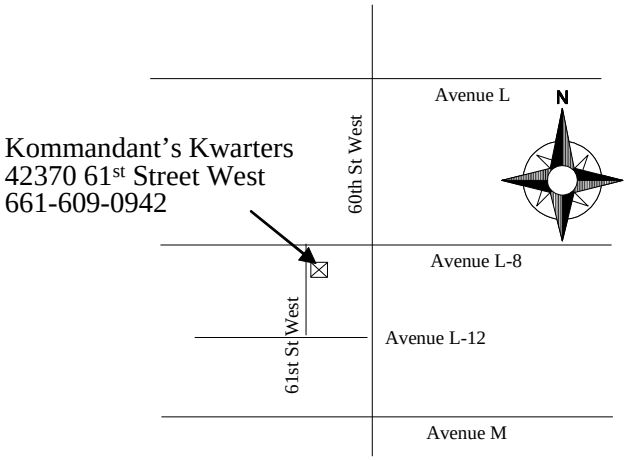
Congratulations! You made it through **Canada Day**, **United Nations Day**, **All Saints Day**, **Guy Fawkes Day**, and **Saturnalia**. Well, actually, you haven't made it through **Saturnalia** yet. But, take heart! The high point of the holiday season is upon us. Mark your calendars. The grandest celebration is imminent.

Once again, our beloved **Kommandant** and **Mrs. Kommandant** will host the annual commemoration of **Festivus** in their home at **42370 61st Street West** in Lancaster. The raising of the Festivus Pole will occur on **Tuesday, 15 Dec 09** at **1800** hours. We will enjoy an evening of fellowship, camaraderie, feasting, and tall tales. As always, each story must contain at least six percent truth, unless no one present can refute such a claim. Furthermore, all parameters (altitude, airspeed, gross weight, etc.) may be increased by as much as fifty percent. Most notably, we will have the **airing of grievances** and the traditional "**Kommandant's Krap**" gift exchange. So, bring a wrapped gift if you would like to participate. An aviation theme is intriguing but not required. As always, participation in the gift/re-gift is not required, but **ridicule of the non-participants** is. We are **NOT** planning to conduct "feats of strength" or "wrestling for authority," but who knows what can happen with this group. There will most certainly be the annual chasing of Pixel. Perhaps we could offer prizes for those who succeed in corralling Pixel this year.

So, please join us. Dress up in your holiday garb. Don't bother with the elf costumes - unless that is your normal apparel. It will be a grand celebration of Festivus!

- Scott "Stormy" Weathers
Vice Kommandant

P.S. If the Kommandant were Santa, I would be a subordinate Clause.



Last Month's Meeting

EAA Chapter 1000
High Cay Partyhaus
Rosamond CA
17 November 2009
Gary Aldrich, Presiding

The November meeting was held at **High Cay** at **Rosamond Skypark** with over 30 members and guests in attendance, **Kommandant Aldrich** presiding. **Doug "Houdo"** and **Gail Dodson** once again shared their home to host 16 visiting **Air Force Academy cadets** from the **Aeronautical Engineering 456** course. They journey to Edwards each semester for T-38 flights to conduct test programs and reports for the class. It is the pleasure of **Chapter 1000** to host the cadets and their leaders, **Lt Col Ryan "Rooster" Osteroos** and **Lt Col Angie Suplisson**. The cadets came in two waves, the second arriving directly from LAX direct L00 for their first taste of California and High Desert *haute cuisine*.

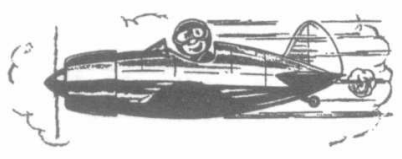
By 1830, a sufficient number of guests had arrived, prompting **Houdo** to make the somewhat premature announcement…."**Let's Eat**". The ceremonial lighting of the grill, much like the Olympic torch, promptly followed. It was a beautiful fall night, moonless and still as **Grillmeister "Knife" Gennuso** and I manned the chapter BBQ known as "**Grillmungus**". Human vultures soon appeared "**bunned-up**", gathering around the grill to begin their pagan dance around the firelight. The **Knife** enjoyed burger-flipping at arm's length via a large spatula, while I had to brave the billowing smoke in order to get a precise, hand-delivery of a cheese slice on each burger. Now I know how the fire bomber pilots feel. Note to self: get infrared goggles.

The vultures swooped in and we plopped cheeseburgers on their open, outstretched buns. **Doolittle** approaches and solemnly orders his *sans cheese*, announcing that "**the cheese stands alone**". Mysterious, yet clearly profound. Can't wait to hear what he'll come up with at next month's **Festivus** dinner.

The cadets performed their evening's task of eating everything edible with effortless efficiency (That's 6 words that start with "e" in the same sentence, for those who are counting). With nothing left to eat, the **Kommandant** declared that "**Victory!**" had been achieved. That's about it. After all, there's only so much you can say about the same thing you report on twice a year for as long as I can remember.

See you at **Festivus!**

- Kent "Cobra" Troxel
Minister of Propaganda



Kommandant's Korner

"Festivus for the rest of us"! Yup, it's that time of year again and **Mrs. Kommandant** and I are pleased and proud to invite the rag-tag band of ***PPTAF*** Troopers and their significant others to another silly chapter function. Continuing in our long (?) tradition, entertainment will be provided by good eats, komaraderie, and the good-natured stealing of treasures known as the "**Kommandant's Krap Exchange**". If you are planning on attending, the ROE for the Exchange will be explained by **Mrs. Kommandant** at the event…all you need to know for now is that the "cost" to play is a wrapped gift for each person who wishes to participate. There is no price limit on the gift items as most are judged "priceless" to the recipient. They should be tasteful (a relative term), or maybe tasty. Aviation-themed items are encouraged but not required. As **Festivus**-based wrapping paper is in short supply in the Antelope Valley, any holiday's theme is appropriate. **Mrs. Kommandant** continues to suggest that the only appropriate gifts come from high-end emporiums like Nordstrom and Nieman-Marcus…but we all know that boutique outlets like Aircraft Spruce or Sporty's…or the darkest recesses of the hangar/garage provide the best gift ideas.

I was perusing last year's K^2 for inspiration that was dominated by a scary aviation tale of heroic weather penetration and high-tech gadgetry. This year's Thanksgiving flight was, in contrast, as beautiful as it was boring. CAVU conditions prevailed and a high pressure area to the East even added a couple of knots to the ground speed readout. Our destination this year was Byron (C83) airport near the little town of the same name. This is a nice little field sporting an active glider club and a sky diving operation. It has two crossed strips providing ample runway options and even a GPS straight-in approach with nice low minimums should the need arise. While there is no on-field restaurant, the Byron Inn Café is not far away and is representative of all good roadside diners…great basic fare, reasonable price, and an ambiance of good ol'boy Americana. The **Pickup to Prius ratio** in the parking lot was near infinite. We considered returning from C83 on the Saturday after turkey day, but a quick consult with the weather guessers…augmented by a PIREP from **Trooper Erbman** convinced us that an afternoon of wine tasting in the Livermore Valley was preferable to fighting the nasty winds and clouds forecast for the route and the arrival time. Our departure on Sunday morning, after a hearty breakfast at the aforementioned eatery was into clear blue skies and calm winds. Despite the near constant light chop from turbulent winds aloft, Anne didn't even wear her magic bracelet for the trip and suffered no ill effects (to which she will admit). Arrival at WJF's runway 06 was into 20 knots of wind that was only 20 or so degrees off the nose…pretty much calm for this part of the world.

So, the **Fightin' Skywagon** is nestled snug in her hangar with visions of avionics upgrades dancing in her

head. The **Kommandant's Kwarters** are being spruced up with holiday decoration and **First-Dog Pixel** (who's alcoholic tastes have matured from beer to very expensive Scotch) is perusing her extensive wardrobe to pick out an appropriate ensemble for the big event. Hope to see you here!

Check Six, fly…and drive safe

- Gary Aldrich
Kommanding

Shields Up!

Finally! I am happy to announce that the most vexing and difficult problem with Three Sigma has finally been solved!

Alibis

By degree I am an aeronautical engineer. Sometimes I play an electrical engineer, but mostly with regards power distribution. Signals are more elusive, but I can usually handle them. Electromagnetic radiation is PFM (pure f'in' magic) and very frequently eludes me.

The Problem

When flying on autopilot with altitude hold engaged, transmitting on COM 1 would cause a hard pitch up. After pitching up, releasing the transmit button would cause a hard pitch down (even more disconcerting!). The autopilot is a TruTrak ADI Pilot II.

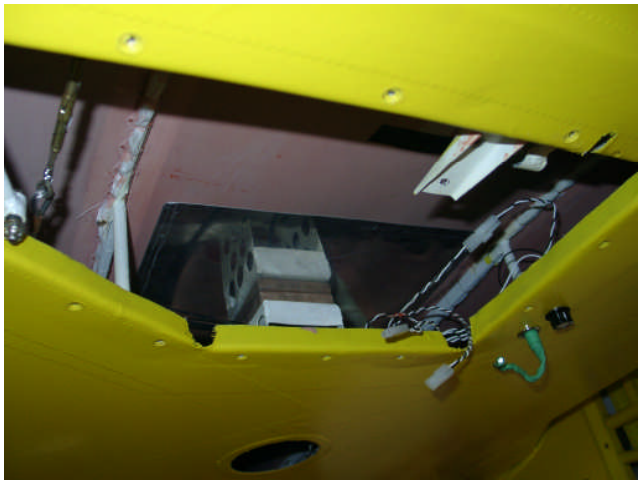
Troubleshooting

My avionics guy pointed me to a thread on the TruTrak site that suggested that the solution was to install a filter between the DSub connector and the control head. I think this filter connected each pin to ground through a capacitor. I tried this and it made no difference whatsoever. Since it didn't make the problem any worse, I left the filter in place.

At Oshkosh I described by problem to the TruTrak tech rep. He said that the "pitch gyro" (which I'm guessing is some sort of solid state "gyro", not a spinning mass gyro) is being hammered by excessive RF (radio frequency radiation) and the EMI (electromagnetic interference) is causing the pitch up. That much I didn't question. He then said it was because I had a problem with my antenna. Because the antenna wasn't matched to the antenna lead correctly, some RF was going up the antenna lead, reflecting off the antenna, coming back down to the radio and spewing out all over the cockpit. This turned out not to be the problem, but it did drive the next several attempts to solve the problem.

On the advice of my avionics guy, I cut the antenna leads and spliced them back together with BNC connectors. I tried swapping which antenna was connected to each radio. I also learned that I could engage altitude hold on the ground, and then transmit on antenna 1. This would have the same effect on the autopilot, causing it to drive the pitch servo. The autopilot would respond to whichever radio was connected to antenna 1.

I had not originally installed a ground plane, since **Bob Archer** had told me that the fuselage and wing structure would suffice as a ground plane. Back home again, my avionics guy suggested that I put in an aluminum ground plane at least 12 inches square. Because of the way I had installed access to my trim system, this was actually possible without too much difficulty. I did this, but it had no effect on the problem. Even so, I left the ground plane in place.



The concept of RF energy reflecting back from the antenna sounded like an excessively high SWR. Because of the BNC splice in the antenna lead, I was able to insert an SWR meter in the antenna lead. I checked the SWR of both antennas and they were very high (assuming I did the test correctly--yes, I read the directions). Anything I could find on SWR said that the only way to adjust it was to change the length of the antenna.

I found that antenna 1 was 24 inches long while antenna 2 was 22 inches long. I don't know why, since they had the same part number. This led me to believe that the problem was antenna 1 was too long. Since my antenna was a simple stainless steel rod, with the SWR meter in place and cutting wheel on the Moto-tool, I set about shortening the antenna in 1/4 inch bits. I tested the SWR after each cut, but never really saw a significant change. This went on for a while until the antenna was about 17 inches long, clearly too short for VHF frequencies.

Moving on to the next theory: The antenna lead was connected to the antenna with a crimped ring connector held in place by a nut. The shield was connected to the fuselage structure. The new theory was that the portion of the antenna rod below the ground plane was acting as a low gain antenna, spewing RF down into the cockpit. I thought I could solve this problem by replacing the antenna with a COMANT CI-121 antenna. I had to replace the antenna with something, since it was now too short. Since the COMANT antenna used a BNC connector, I thought this would keep the RF inside the antenna lead shield until it was time to come out the antenna. The new antenna was installed after modifying the antenna mount. This required the construction of what **Stormy** and I called "The Bridge to Nowhere", which was supported on the wing roots and allowed me to work above the fabric covered fuselage.

After completing the installation, a test of the radio and autopilot showed...no change.

As I said, I'm not a EE, and at this point I wasn't doing a good job of playing one. It seemed that the problem was that antenna 1 was just too close to the autopilot control head. Because of the R-squared rule, the power of the RF reaching the autopilot control head from antenna 2 was one-tenth that from antenna 1, which could explain why one antenna was a problem and the other wasn't. Reviewing the autopilot documentation, TruTrak claimed that the autopilot control head was shielded from any RF interference. There was also a note that the control wheel steering wire might need to be shielded because it was the most vulnerable. I used a handheld radio transmitting right next to this wire and it had no effect. However, the response of the autopilot was very well correlated to the distance between the handheld radio and the autopilot control head. Transmitting the radio right in front of the instrument face had no effect, but anywhere behind the instrument panel (toward the firewall) there was a response to the radio, decreasing with increasing distance from the autopilot control head. More discussions led to the theory that maybe the autopilot control head wasn't shielded as well as TruTrak claimed. It was in a plastic box after all.

It also occurred to me that most TruTrak installations are probably in RVs, where the nearest transmitting antenna is somewhere on the aft fuselage (turtledeck), at least 6 feet from the control head. My antenna 1 is right over the cockpit at the intersection of the fuselage and wing (over the center of the "X" in the tubes above the cockpit). That means it is all of about 3 feet from the autopilot control unit, the equivalent of being right in the middle of an RV canopy. Half the distance means four times the radiated power reaching the victim unit (the autopilot).

So having finally determined the real problem, it was now time to find a solution. The solution seemed to be that the autopilot box needed shielding. **Gary Aldrich** suggested I try wrapping the control box in aluminum foil, not as a final solution, but as a way of testing if shielding the box would make a difference. I tried making the foil sarcophagus around the control box and did the ground test again. The foil shielding showed a significant improvement, with almost no response from the autopilot while transmitting on antenna 1.

The Fix

Buoyed by this success, I pulled out the autopilot control box and set about trying to figure out how best to design an electrical shield to go around it. Part of the problem was that there wasn't a lot of clearance between the box and the stuff around it.

Not knowing much about shielding, I did some research on how to do it. I knew it had to be a conductive material, but which one? I certainly had experience in building with aluminum sheet, but I was concerned about getting an aluminum box tight enough around the autopilot box. If rivets were used, they would stick through underneath. Aluminum couldn't be soldered, but might be brazeable. **Miles Bowen** suggested that steel might possibly do a better job of blocking the magnetic part of the electromagnetic wave. Steel could be welded, but would be heavy. Lightening holes would defeat the purpose. A box of copper or brass would be conductive and could be soldered, but would be rather expensive. I thought about trying to use galvanized window screen. **Gary Aldrich** suggested mu-metal, a special alloy that is used for shielding magnetic field producing items so that they don't mess with the magnetic compass. While effective for static or slowly varying magnetic fields, its effectiveness drops off above about 100 kHz, way below VHF frequencies.

Do RF shields work like radiation shielding, where the shield is more effective the thicker it is? Is there a multiplicative effect from putting one shield inside of another with a gap in between? Does that make a funky capacitor?

Eventually I found some sources that stated in a shield, the RF induces a current that flows on the surface of the shield. Since it flows on the surface, thickness is not important. Think of it as the shield makes the energy travel around the protected item while not allowing the RF into the interior of the shield. To make this work, the shield must be conductive all of the way around the protected object. Any non-conductive gaps would just act as antennas (radiators), defeating the purpose of the shield. Thus, it was key that the shield be conductive completely around the protected object and any point on the shield must be electrically connected to any other point on the shield.

Finally, **Stormy** suggested that I should just wrap the box in "Speed Tape". I wasn't sure what he meant, since I had heard this name applied to various types of tape, including a thin, yellow plastic tape that reminded me of electrical tape. He brought me a roll of the stuff he was talking about, reportedly procured from the aviation section at the local Home Despot. This tape was a thin strip of aluminum, 2.5 inches wide, with tape stickum on it. Apparently it is intended for sealing duct work since "duct tape" actually deteriorates pretty fast.

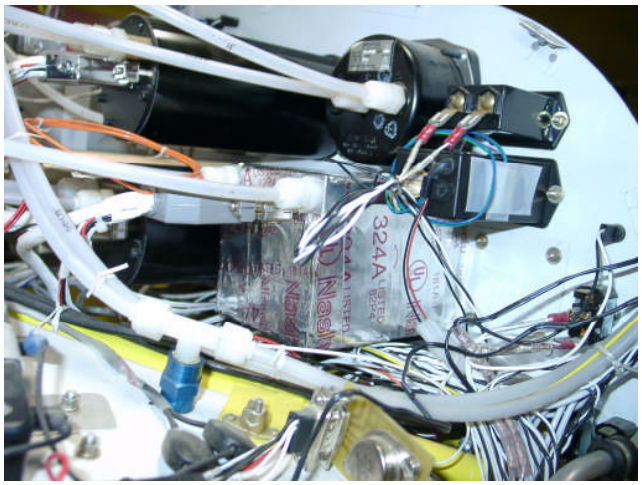
As I was trying to make a decision on which of the plethora of options to pursue, **Stormy** gave me some unusually wise advice. Start with the option that is the easiest and cheapest to do. If that doesn't work, then try the next easiest/cheapest.

That led me to think about how to make the Speed Tape work. My question was "Is the stickum electrically conductive?" I took two pieces of tape and stuck one to the aluminum side of the other. An ohm meter showed continuity across one piece of tape, but not through the stickum to another piece of tape. This greatly complicated the process, since I couldn't just stick a bunch of pieces of tape on the box and expect them to be electrically connected.

After much thought, I decided to cover the box by wrapping the tape in a spiral fashion around the box. If I could completely cover the box with one piece of speed tape, then the entire shield would be electrically connected to itself. When the spiral got to the end of the box, there was just enough extending beyond the box to fold over and cover the back completely. Thus I completed a shield that covered 5 sides (not the display face) completely and was fully connected electrically.

There were a couple of stickers on the autopilot control box--the serial number and the inspection sticker. I placed a small piece of plastic wrap (saran wrap) over these stickers so that the tape wouldn't stick to them. That way, if I had to remove the tape those stickers would be undamaged. I also took pictures of the stickers so that I would have a record of what they said shouldst the need come up.

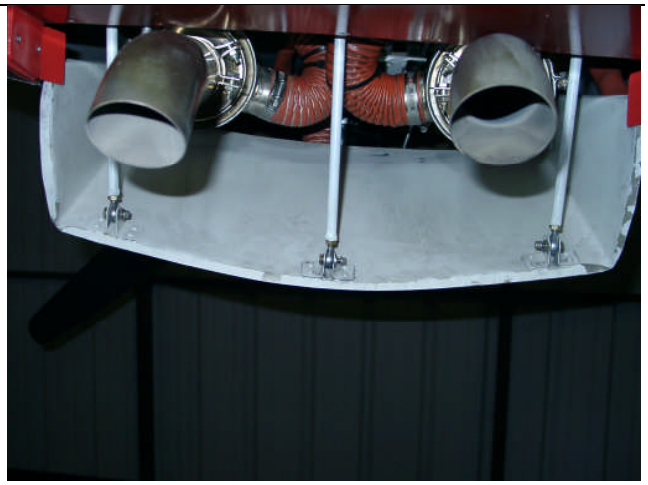
I installed the autopilot control box back in Three Sigma and ran the ground test again. This time transmitting on either radio (both antennas) produced no response from the autopilot. Success!



The Rest of the Post-Oshkosh Fixes

The flight test prior to Oshkosh and the trip to and from Oshkosh uncovered a whole litany of "issues" to address.

The number one issue of all was the persistent lack of suitable engine cooling. I had determined before going to Oshkosh that I could keep the CHTs more or less under control, though somewhat hotter than desired (generally about 390F to 435F), if I kept the cruise power to less than 65%. Climbing was a bit of a problem, requiring low RPMs and high climb speeds. I also had to reduce RPM upon reaching pattern altitude on the initial climbout.



I designed my cowl flap to have an exit area equal to 150% of the intake area, which is a recommended ratio. So why didn't it work? If you look up my cowl flap, what you'll see is a whole mess of exhaust pipes, mufflers, and SCAT tubes that seem to create a lot of blockage, effectively reducing the exit area. My solution was to add louvers to the sides of the cowling, where the cooling air could go straight from the cylinders unencumbered out the side of the cowling. The louvers are Avery part number 4685. Do they make a difference? Who knows? That answer will have to wait until after flight testing. I'll paint the louvers someday after I sort all of this out.

The oil temperature has also been high, but I have seen evidence that the oil temperature comes down when the CHTs are down, so I decided not to do anything with the oil cooler until I have the CHTs down to an acceptable level.

You may have noticed in the photo above that the cowl flap isn't painted anymore. After getting back from Oshkosh I noticed some weird wear marks on the inside of the cowl flap.

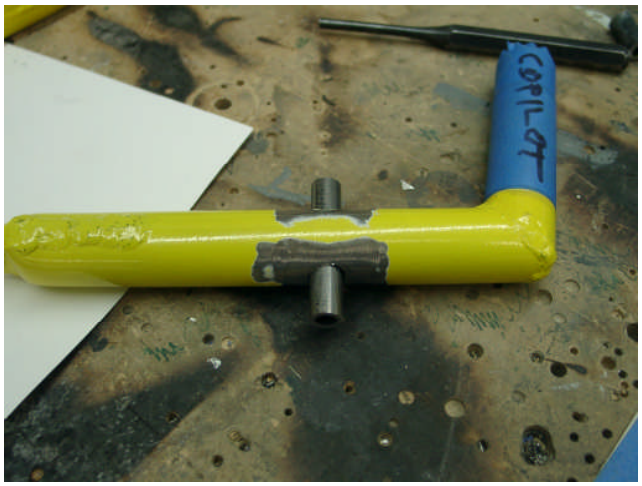
If I pushed up on the cowl flap, these marks lined up perfectly with the muffler and SCAT tube clamp. That told me that air pressure was deforming the cowl flap, and the front edge needed stiffening. I was going to rivet an angle to the cowl flap to make a flange. Then I noticed a 3 inch crack next to the right pivot point.

This was too close to the pivot doubler to repair it with a doubler, so I made a completely new cowl flap. This version of the cowl flap has the leading edge stiffening flange built into it.

You probably remember that I had failures in the mounting hardware of my alternator on the way to Oshkosh. While at Oshkosh, I swapped out the original POS alternator for a very nice (and pricey) Plane Power alternator. This alternator alternated very well all of the way back from Oshkosh. This alternator came with a 1 inch tube on the back which I assumed was for attaching a SCAT tube for cooling air. Not absolutely required, but certainly couldn't hurt. I found a location to mount an inlet flange to feed cooling air to the alternator with a very neat SCAT tube routing. I also removed the alternator wiring I did in the field at OSH and replaced it with wiring done to the same quality as the rest of the airplane.

Another unnecessarily stressful moment at some point during the Oshkosh trip was during one of the takeoffs. Immediately after takeoff I found myself in a couple of cycles of a pitch PIO (pilot induced oscillation). This was accentuated by the aft cg of all of our Oshkosh stuff which reduced the longitudinal stability. The biggest cause was the excessive free play in the pitch stick. The top of the stick could be moved about 1/2 inch without moving the lower part of the control stick assembly. In case you're not sure, that is WAAAAAAY too much! This came about because there was way too much clearance between the lateral pivot bolt and the pivot tube in the control stick. How did this happen? The answer to that lies in a dirty little secret of the 4130 tubing world. While the outside dimension of a tube is usually very close to the proper dimension, the inside diameter (wall thickness) is not nearly as precise. The plans call for a 3/8x.058 tube for the pivot tube. I ordered such a tube and used it for the pivot tube. If the tube had been dimensionally correct, there would have been a total of 0.009 clearance with an AN4 (1/4 inch) bolt. I would later estimate that the total clearance between my bolt and pivot tube was something like 0.028. Because I used material from the same tube for both control sticks, both of them had the same excessive freeplay.

To fix the pitch freeplay, I removed the control sticks from the airplane and ground down the welds holding the pivot tubes in. I then punched the old pivot tubes out. Now using a 3/8x.063 tube I welded in new pivot tubes.



The key point was that I started with a tube with an inside diameter too small to fit an AN4 bolt into. After the welding was done, I used a 1/4 inch reamer to enlarge the hole to the proper size. Now the AN4 bolt slides in with a tight but smooth fit, even tighter than specified in the plans. Now the total freeplay (entire control system) at the top of the stick is no more than 1/8 inch, which is much more acceptable.

Another freeplay issue was in the lateral stick. The source of this freeplay was the way that I implemented removable control sticks, using a bolt to hold together a tube in a tube. Because of slight clearances around the bolt, the outer tube would rotate around the inner tube slightly. To fix this, I used a B&S taper pin reamer #1 (Aircraft Spruce 12-01622) to open the holes just enough to get full contact of the taper pin (Aircraft Spruce AN386-2-12).

If the hole is reamed too much you won't be able to pull the taper pin in to seat. As you can see in the photo, I could have used a shorter taper pin, but I couldn't tell that before ordering them. With the taper pins in, the two parts of the control stick are locked together as though they were one. Lateral freeplay gone.

Because of the way I designed my seats, some of the seat structure wore through the fabric of my seat back cushions. I took the cushions back to the lady who sewed them and she repaired them. Based on an idea she had, I used some leftover covering fabric (medium weight Dacron) to wrap around the top of the seat backs. I held it in place with duct tape. The duct tape will probably deteriorate with time, but that's okay because it will be held in place with the cushions and this is a test configuration--I don't know for sure if it will work long term.

While at Oshkosh I was talking to the JP Instruments folks about a display problem I was having with my EDM-900 engine monitor. They told me I would have to return the display unit to the factory to get it fixed. The next day I went to another JP Instruments booth to ask them a question which to this day I can't remember what it was. While waiting I saw an offer to upgrade an EDM-700 to an EDM-730. This made me think to ask if I could upgrade an EDM-900 to an EDM-930. They said I could for $800, but I would have to send the display unit in. I already needed to do that anyway, so I decided to do the upgrade. The bad news was that I would have to enlarge the hole in the panel for the EDM-930 to fit. The good news was that electrically both units use the same circuit board, so the existing wiring harness would plug in with no modifications.

I can now download the data from the EDM-930 with just a USB drive. I don't have to take the whole computer to the airplane. Apparently JPI transferred the programming that I had in the EDM-900 because the EDM-930 knows my tail number and I haven't done any programming on it yet.

While my first radio, the Garmin GNS480, worked fine with the exception of that autopilot pitchup thing, the second radio, the Garmin SL40, started acting funny at some point. The second radio was important, because the first radio was for talking to ATC and the second radio was for talking to the wingman. On the Oshkosh trip the SL40 developed an intermittent problem (our favorite kind) of sometime it would work and sometimes it wouldn't. Sometimes it was the transmit, sometimes it was the receive. Coming out of Oshkosh I was talking to Minneapolis Center on the SL40 just fine. They handed me off to the next sector and suddenly the SL40 wouldn't receive anything at all. We never did figure out how to replicate the problem. After getting back I pulled the SL40 and sent it off to my avionics guy. Apparently he couldn't find anything wrong with it either, so he forwarded it to Garmin, who had a service bulletin against it, but I don't think it addressed my problem. Best as I can tell, Garmin didn't bother looking hard for the problem. I'm guessing they just replaced some circuit board and sent it back with the report "Unit passed all functional tests - Meets MFG Spec.", "Installed mod AE in accordance with SB 0921". At least I was able to pay $400 for this non-informative response.

Prior to departure for OSH I had noticed the vernier cable control I was using to control the cowl flap was slipping. Apparently the cowl flap was putting more load on it than it was designed for. Because of the engine cooling problems, I was always leaving the cowl flap wide open, so for the trip I just blocked the control full open. **John "Bushman" Bush** suggested I should try a T-handle control (Aircraft Spruce 05-15100) of which he has several in his Cessna 310. The catalog stated it could take a load of 200 lbs, so this sounded like the ticket. It's a friction lock device, locking and unlocking with a quarter turn. We'll see how it works.

When we got back from Oshkosh the oil only had 35 hours on it, but I drained it out anyway. Considering how long the engine has sat since August, it's just as well I changed the oil. The primary motivation to drain the oil was that I didn't like the drain valve that I had in my oil sump. It didn't seal properly while in the open position and oil would come down the inside and outside of the drain tube. While the oil was drained I replaced the valve with a P5000 valve (Aircraft Spruce 07-00879). It's currently sealed in the closed position. We'll see how well it works in the open position when it's time to drain the oil again.

Three of the maintenance actions required on the Oshkosh trip involved changing out the fuel sump drain valves. After 40 hours or so many of the drill cuttings and other detritus from fuel tank construction had finally made their way down to the tank sump. The problem came when one or more of the shards wedged itself in between the O-ring and its seat, causing the drain valve to start leaking. In hopes of cleaning out the remaining shards, I pulled out the drain valve and let the fuel run freely into a 5 gallon gas can for about 2 to 3 gallons. After replacing the drain valve, I poured the fuel back into the tank, filtering it through a Mr. Funnel. I will only know if it made a difference if I don't have any more leaks for a while.

I wasn't too happy with my tailwheel steering as it had a large deadband and wasn't very effective. I had been using the Maule compression springs, where one is a bigger spring than the other. Budd Davisson said that he always used two of the larger springs. I ordered the Aircraft Spruce spring kit (06-15600) which turned out to be two springs of the same size which were larger than either of the springs I had before. I put them on and they seem to be tighter with less deadband. We'll see if it made a difference when I actually taxi.

Finally, at Oshkosh Scott Weinberg strongly encouraged me to reinforce my tailwheel fork. Based on Eric Newton's experiences to and from Oshkosh (breaking the tailwheel fork twice, once on each side) I figured this was probably a good idea. Also shown above you can see the doublers on the sides of the tailwheel yoke. Like the other new parts, I'll paint them after some testing to make sure they don't need more modifications.

Yet To Do

With any airplane there's always a list of things to do. If it's not repairs it's upgrades. I still need to repair a tear in the fabric on the inside of the cargo door that was probably torn when we went through that severe turbulence. I also need to weatherstrip around the doors to slow down the drafts. Then I need to mount to the floor the brackets for the oxygen bottle I bought at Oshkosh. Then there's applying the tape outlines around the color separations.

So that's the current status of Three Sigma. Now I need to put together a plan for the functional check flight.

- Russ Erb

Plane Fly Good

Three Sigma flew again Friday (27 Nov 09) for the first time since arriving home from Oshkosh on 3 Aug 09. It's like a whole new airplane--all of the fixes/upgrades worked as intended. WOO-HOO!

Just to review, for the trip to Oshkosh I had limited myself to about 60% power in cruise to keep the CHTs under control. Even then, the CHTs would run between 360 and 435 F, and that was with the cowl flap full open. You can argue where those temperatures are vis-à-vis the limits, but everyone will agree that they're higher than we would like them. Oil temperatures are supposed to be between 180 and 200 F. Mine were generally between about 200 to 220 F.

Taxi Handling Qualities

One of the modifications was to change out the steering springs on the tailwheel. The new springs are heavier than the old springs and are installed tighter (less free play). Before, I got very little steering out of the tailwheel and used a lot of braking. With the new springs I get a lot more effectiveness from the tail wheel steering without the large dead band in the middle. I was able to taxi around most of the airport using just the steering, only using brakes to stop. A significantly lowered workload.

Takeoff and Initial Climb

I did the initial takeoff using the same procedure I had used before. With the cowl flap full open, I climbed at 2700 RPM (which was really about 2650--need to dial in the governor) at 100 KIAS until reaching pattern altitude, then reduced the RPM to 2400 for the remainder of the climb to 5500 feet (about 3000 AGL), still at 100 KIAS. The RPM reduction was used in the past to reduce power so that the CHTs would not get too excessive.

The throttle was still wide open so that the economizer would give an appropriate fuel flow.

This time the maximum CHTs ranged from 366 to 423 F, which was roughly equivalent to those seen at cruise power before. The oil temperature got all of the way up to 175 F. This was at an OAT of about 51 F. **Stormy** suggested that I fixed my cooling problem by adjusting the calendar.

Cruise

For comparison, I set up a cruise at 5500 feet MSL at 60% power with the cowl flap full open. After several minutes the CHTs had cooled down to 313 to 343 F, WAY below what they used to run. Oil temp was still around 173 F.

Since the temperatures were so low, I tried closing the cowl flap to see it the CHTs would come back up. After a few minutes the CHTs were up to 360 to 388 F. These were very acceptable. I could be happy with that. Oil temperature came up to 183 F, which is at least above the accepted minimum of 180 F.

Climb Power

Since the engine cooling seemed to be working better, the next step was to see if I could use full RPM for climbing. I climbed from 5500 ft to 8500 ft at 100 KIAS using full throttle and 2700 RPM (actually about 2650 RPM). Per the checklist, the cowl flap was full open. The CHTs climbed to 354 to 417 F, which are actually a little less than the initial climb. I attribute that to lower power at higher altitude and also colder air temperatures.

Oil temperature got up to 199 F.

Descent

Having finished the engine cooling tests, I descended from 8500 ft to 3150 ft with the cowl flap closed. CHTs decreased to 248 to 299 F, and oil temp came down to 175 F.

Autopilot EMI

During one of the cruise legs I engaged the autopilot altitude hold. I then cautiously pressed to transmit on COM1, and then...NOTHING HAPPENED! Well, the radio transmitted, but there was no pitchup from the autopilot. Just to be sure, I tried the same test on COM2 with similar non-results.

Stick Freeplay

I made a few small inputs fore and aft to the pitch stick and found appropriate motion from the airplane. The next day I took the family (wife and two kids) flying for the first time. Heavy weight and with a cg near the aft limit, I noticed a tendency for a minor pitch PIO on climbout if I trimmed to zero force. Turbulence in the air helped to aggravate the PIO tendency. However, it was nowhere near as exciting as the one we had on the Oshkosh trip. I also found that if I kept it slightly out of trim (requiring a slight pull force to stay on speed) the PIO tendency was greatly reduced, since it kept me out of the freeplay band.

Antenna Tests

I made two landings and takeoffs at Fox. One set was done on one radio/antenna, and the other was done on the other radio/antenna. Both seemed to transmit and receive just fine.

In Summary

The three major problems tested in this flight test were all found to be fixed. The addition of louvers on the cowling really did the trick, confirming the problem was getting the air out of the cowling. The engine CHTs can now be controlled as they should be and can be kept within limits. As a side benefit, the oil temperature is under control as well. Once concern I had was that the louvers were more or less in front of the boot cowl fresh air inlets and would thus cause heated air to come through the vents that are supposed to provide cold air. A quick test of this vent seems to show that it will not be a significant problem.

The autopilot pitchup problem is gone, so the autopilot is finally fully useable.

The pitch PIO tendency because of pitch stick freeplay has been greatly reduced.

All of the other fixes/changes seem to have had the desired effect.

I think this means that after about 63 hours I have a usable airplane. It's about time. Come to think of it, that's about how long it took me to get my original pilot certificate. Hmmm...

- Russ Erb

Project Police Aircraft Spotters Quiz

Once again, **Evil Editor Zurg** has uncovered another obscure airplane that he's guessing you've never seen before. Now he wants to annoy you by showing it to you so that you'll realize that you have no clue what it is while he sits smugly knowing exactly what it is.

Prove **EEZ** wrong by submitting a correct identification to erbman@pobox.com . If you don't know for sure, make something up! The funnier the better! You can also mail to the editor's address seen on the last page of this newsletter. Include any other information you know. Links to web sites with more info are a plus. Next month we'll tell you who (if anyone) was correct.

Web Site Update

As of 5 December 2009, the hit counter showed **129824**, for a hit rate of 16 hits/day for the last month.

Just a reminder that the EAA Chapter 1000 Web Site is hosted courtesy of Quantum Networking Solutions, Inc. You can find out more about Qnet at http://www.qnet.com or at 661-538-2028.

Chapter 1000 Calendar

Dec 15: EAA Chapter 1000 Festivus Etc Celebration, 6:00 p.m., Kommandant's Kwarters. Quartz Hill CA. (661) 609-0942

Jan 5: EAA Chapter 49 Monthly Meeting, 7:00 p.m., General William J. Fox Field, Lancaster, CA. (661) 948-0646

Jan 12: EAA Chapter 1000 Board of Directors Meeting, 5:00 p.m., High Cay, 4431 Knox Ave, Rosamond CA. (661) 609-0942

Jan 19: EAA Chapter 1000 Monthly Meeting, 5:00 p.m., Edwards AFB. USAF Test Pilot School, Scobee Auditorium. (661) 609-0942

Feb 2: EAA Chapter 49 Monthly Meeting (?), 7:00 p.m., General William J. Fox Field, Lancaster, CA. (661) 948-0646

Feb 9: EAA Chapter 1000 Board of Directors Meeting, 5:00 p.m., High Cay, 4431 Knox Ave, Rosamond CA. (661) 609-0942

Feb 16: EAA Chapter 1000 Monthly Meeting, 5:00 p.m., Edwards AFB. USAF Test Pilot School, Scobee Auditorium. (661) 609-0942

Mar 2: EAA Chapter 49 Monthly Meeting, 7:00 p.m., General William J. Fox Field, Lancaster, CA. (661) 948-0646

Mar 9: EAA Chapter 1000 Board of Directors Meeting, 5:00 p.m., High Cay, 4431 Knox Ave, Rosamond CA. (661) 609-0942

Mar 16: EAA Chapter 1000 Monthly Meeting, 5:00 p.m., Edwards AFB. USAF Test Pilot School, Scobee Auditorium. (661) 609-0942

Apr 6: EAA Chapter 49 Monthly Meeting, 7:00 p.m., General William J. Fox Field, Lancaster, CA. (661) 948-0646

Apr 13: EAA Chapter 1000 Board of Directors Meeting, 5:00 p.m., High Cay, 4431 Knox Ave, Rosamond CA. (661) 609-0942

Apr 20: EAA Chapter 1000 Monthly Meeting, 5:00 p.m., Edwards AFB. USAF Test Pilot School, Scobee Auditorium. (661) 609-0942

May 11: EAA Chapter 1000 Board of Directors Meeting, 5:00 p.m., High Cay, 4431 Knox Ave, Rosamond CA. (661) 609-0942

May 15: Nineteenth Annual *Project Police* Airport Barbecue, Rosamond Skypark (L00), Rosamond CA. (661) 256-3806

To join Chapter 1000, send your name, address, EAA number, and $20 dues to: EAA Chapter 1000, Doug Dodson, 4431 Knox Ave, Rosamond CA 93560-6428. Membership in National EAA ($40, 1-800-843-3612) is required.

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Inputs for the newsletter or any comments can be sent to Russ Erb, 661-256-3806, by e-mail to erbman@pobox.com

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ADDRESS SERVICE REQUESTED

THIS MONTH'S HIGHLIGHTS:
FESTIVUS 15 DEC @ KOMMANDANT'S
CADET FEED BIG SUCCESS
THREE SIGMA FLYING AGAIN
EEZ SPOTTER QUIZ

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