Tips from Comanche *Flyer* magazines Feb 1973 – Sep 2012

CHAPTER TEN

INSTRUMENTS / NAVAIDS

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Compass / DME Interference

We discovered that the cabin compass was influenced to an incredible degree by the DME head which someone had mounted near the top of the panel. Mounting the DME lower down by swapping it with the VSI cured this problem entirely.

The remote compass had three faults: the needle in the indicating head was sticking slightly in some sectors, corrosion on some terminals of the connecting wiring was affecting the indication in other sectors, and an incorrect converter which had been supplied with the unit was putting out a wave pattern which was incompatible with the rest of the unit. It took an oscilloscope to find this one, and changing the converter removed the last trace of deviation.

The reassurance of seeing one compass check the other has put back the joy of flying the 400, a thing to be savored, 'cos they don't build 'em like that anymore.

Antenna Position

Broad Band Com. by all means, even for 90 channel transceivers. Minimum spacing should be 36 inches − no closer. Early Comanche Com. antennas were mounted 6 inches apart and side by side (see picture on cover of January 77 issue of FLYER). Close mounting causes one antenna to absorb transmitter power from the other, thereby reducing effective range.

The "towel rack" or "fin" type Balanced Loop are the best VOR antennas you can use to eliminate needle wiggle and to pick up VOR stations off your wingtips at greater range. I also recommend replacing the VOR antenna coaxial lead−in from antenna through the fuselage to the receiver or coupler every 10 yrs. Coax develops VHF "shorting" or attenuating properties at VHF frequencies due to rotting, water damage, hot / cold etc.

Vacuum Regulator Maintenance

My vacuum gauge gradually increased over a period of time. After a lot of time spent and phone calls I found the problem. I removed the regulator and on the bottom was a fine screen which I cleaned. My headache was over.

Vacuum Filter

If your DG begins to wander excessively and your friend in the right seat, knits and purls a lot, before you spend a couple of hundred bucks for an overhaul on the Gyro, try changing the filter. That fuzz from the yarn sure clogs them up. However, don't say anything to the friend, we sure don't want to discourage the Little Darlings from flying with us.

Of course, smoking is even worse. It goes right by the filter and gums up the bearings in the Gyro, not to mention the chance of fire from the leaking fuel meter. But that's another story.

Fuel and Oil Pressure Gauge Interference

Approximately one year ago, I noticed that the right fuel gauge on my PA-30 was heading South, every time I started the right engine. I initially attributed this phenomenon to a malfunctioning gauge, and/or sensing system, I therefore, went through the agony of tracing all the wiring back to the fuel cells and to the grounds.

All of this effort was to no avail. The symptoms were that while the engine was not running, the gauge would indicate properly, however, once the right engine was started, the right gauge headed South. In desperation, I switched gauges. However, the gauge reacted the same way upon starting the left engine.

I was just about to make inquiry as to where a new fuel gauge could be found, when one day, I decided to take off the plates in front of the fuel quantity gauge, and investigate yet another problem I had noticed, and that was that all of a sudden, the oil pressure on the left engine was lower by about twenty pounds than what it used to be.

Pursuant to this problem, I had switched the gauges and discovered that the problem seemed to stay with the location of the gauge. Thereupon, I rolled the airplane out on the apron and ran the left engine lo and behold, with the false panels off, I could see that the coil in the oil pressure gauge was expanding and making contact with the fuel quantity gauge and immediately upon contact, the gauge headed South. I noticed that there was a small copper strap that went across the bottom of the fuel gauge, however, one end of it had come loose, and was protruding down approximately one-eighth of an inch further than it normally would have, had it maintained its prior position. I then took a screwdriver and pair of pliers making a slight bend in this copper strap, allowing it to stay clear of the coil on the oil pressure gauge, whereupon, I started the left engine once again, and lo and behold, the fuel quantity gauge did not head South. I also noticed that the oil pressure went back to its correct reading.

What had been happening undoubtedly was, that when the coil came in contact with the fuel quantity gauge, the fuel quantity gauge failed but the strap also prohibited the oil pressure gauge from unwinding to its fullest extent and thereby giving the low oil pressure reading.

I would suggest that a number of you out there who have fuel problems might look into this as a possible problem. When the gauge was set up for the right engine, the oil pressure did not decrease. I suspect the reason for that was that when it was fully extended, it had just at that time come in contact with the strap and that in changing the location, clearances were slightly different which caused the low oil pressure reading, which I noticed. Therefore, it very well could be that in other installations, your fuel gauges are heading South, due to contact with the oil pressure gauge, and you would still not see any decrease in oil pressure. It is also my feeling, that the strap that came loose did so with the passage of time, and should be soldered to the instrument but the soldered joint had failed allowing the strap to drop down slightly. In any event, I hope this solves a few fuel gauge problems.

Single Probe EGT

Another "Tip" is with a problem I had with my EGT.

It is an Alcor Ekonomiser with a L - R switch. At cruise, it would not work at all in the R position and in the L position. At best, it would move. I found the nuts that hold the printed circuit on the back of the meter had worked loose over the years. A 1/2 turn on one and 3/4 turn on the other took care of the problem.

Fuel and Oil Pressure Gauge Interference

It is always interesting for me to talk with ICS members and find out just what the problems are which they may be having. So many of our members are most knowledgeable about their aircraft and can resolve many of the problems which arise.

A case in point is a recent conversation I had with Bob McNutt, ICS #04327 of Ada, OK. In his airplane, a PA-24, when the master switch was turned on, the fuel gauge would read normal (correct amount of fuel). But as soon as the engine was started, the fuel gauge would go to empty. Armed with the fact that grounding the fuel level circuit makes the gauge read empty, Bob came up with the answer to the problem he faced. Just below the fuel gauge is the oil pressure gauge. As the oil pressure came up the Borden tube in the oil pressure gauge straightens out with the pressure increase and that was enough to contact the fuel gauge. This grounded the post or wire going to the fuel gauge.

Compass Calibration

Compass calibration is accomplished by the relative position of two small calibrating magnets to the main sensing magnets. This is necessary to compensate, at least partially, for the many and varied magnetic influences within the aircraft (or other vessel). Such influences can be from any rotating machinery (motors, generators, etc), avionics (transformers, meters, etc.), magnetic materials, engine, electrical currents, etc, etc. They can also vary widely from aircraft to aircraft, even between aircraft of the exact model, configuration and installed equipment. And, potentially, from time to time within the same aircraft even though no equipment changes have been made!

To adjust the compensating magnets, use a brass or plastic screwdriver of proper size. (A screwdriver made of magnetic material, such as steel, will also work but can make the job tedious and potentially inaccurate due to the reaction of the compass to the tool even before it is in contact with the adjusting screws). Start with both compensating magnet screws set the mid point of their range. There is one screw for N-S and another for E-W adjustments, and should be appropriately marked. Also, all adjustments should be made with the engine operating as in flight (at least above 1,200 RPM so that the generator system is in the charging mode) with all avionics systems on. Lights and other electrical systems can be checked on the ground to determine if they offer any adverse influences. All adjustments should be done on the ground, preferably on a compass rose, but they can also be done in flight.

The adjustment sequence is always the same. First position the aircraft on a known MAGNETIC north heading. Adjust the N-S compensating screw to eliminate any error. Then reposition the aircraft on a south heading. Re-adjust the N-S screw to remove 1/2 the apparent error. Reposition the aircraft on a north heading again and check the compass. There may now be a slight error, hopefully no more than that just observed on a south heading. If there is, then re-adjust the N-S screw while on the north heading to eliminate 1/2 the remaining error. Then re-check the compass, and re-adjust for 1/2 error as necessary, on a south heading. This may take a couple of tries. Then when satisfied that the error is split evenly, position the aircraft on an east heading and adjust the E-W compensating screw for zero error. Reposition the aircraft on a west heading and re-adjust the E-W screw to reduce any error to 1/2. Then recheck and read just on east and west headings as necessary to split the error. Then when satisfied, recheck the compass readings on N-S headings. Re-adjust the N-S screw, but only if necessary to reduce the N-S errors by 1/2. If necessary to do this, then also recheck and adjust the E-W screw appropriately in a similar fashion. The objective is to reduce, not necessarily eliminate, the errors. Once this is done and any errors are split fairly evenly, then position the aircraft on each of the other cardinal headings in turn (in any sequence) and record the errors for each heading. Do not re-adjust either screw on any intermediate heading! Then enter the error readings on the compass correction card for reference in flight. This may be noted as a corrected heading (in degrees) or a correction (in degrees), typically: "For 130 steer 132" or "for 130 steer +2" (I prefer the latter as it avoids confusion with the numbers associated with headings). In this example, the pilot would assume a flight heading of about 2 degrees greater than the compass would be indicating when flying in that general direction.

The above adjustment description assumes a compass rose is available on the airport. If not, it can still be done nearly as. accurately if the traffic or tower will allow you to position the aircraft at the end of a runway (one preferably not in use at the time) and oriented in alignment with the extended center line. To do this expeditiously though, determine in advance the exact runway heading from instrument approach charts or other published airport information, if available. Then make up a table that will give you four cardinal points based on the center-line heading. (This may be necessary should you have to position the aircraft in a run-up area or taxiway that is oriented 90 to the runway center-line). When ready, position the aircraft exactly on the center-line, and with the engine and systems operating sufficiently, set the directional gyro to the exact specified runway (or other) heading. Then position the aircraft to magnetic north as indicated on the gyro and adjust the compass compensating screws as previously described. Use the gyro as the heading reference, in place of a compass rose. Recheck the gyro on the runway heading periodically to ensure that precession is avoided. But whether using a compass rose or the other ground method, be sure to roll the aircraft sufficiently to get the aircraft fuselage center-line aligned completely, not just the nose wheel.

The compass can also be adjusted in flight provided the air is calm, there is no wind (so as to avoid crab angle errors) and there is at least one road on the ground that is aligned for several miles in a true N-S or E-W direction. Section lines or similarly oriented roads or fence lines are the best and most available. Then, in advance, determine what the magnetic variation (to the nearest degree) is for the area and use this figure to compensate for the true N-S road orientation. Establish a smooth, steady slow cruise flight path heading exactly over the reference road, at a safe and legal height. When established, set the directional gyro to the equivalent magnetic heading. Then proceed with the compass adjusting process in a fashion similar to that used if the aircraft were on the ground. Recheck the magnetic reference headings and reset the gyro as needed, periodically.

Backup Vacuum

We asked for input on member experiences with alternate vacuum sources. We learned that a number of our members have installed various types of units over the years to assure working gyros in the event of engine driven vacuum pump failure while IFR.

Here are pertinent excerpts from our responses so far: I have not been attracted to backup vacuum sources which utilize manifold vacuum to provide the power. The reason is that to provide the vacuum, the throttle should be less than full open. When you take off at 3,900 feet or higher, as we do in many parts of the west, you find yourself realistically using full throttle nearly all the time.

My answer to a back-up is my S-TEC Auto Pilot. It is totally independent of a vacuum source being totally electric and even uses a pressure transducer to maintain altitude hold. Maybe other autopilots have similar features, I don't know. But I feel that I have the most reliable backup for vacuum failure available. (Bill Creech, ICS #03423)

The best manifold vacuum system on the market in my opinion is "Auto-Vac-2." This system draws its low pressure from the central induction point for all cylinders, either the carburetor or injection air intake. This eliminates single cylinder melt down that could occur with the "Precise Flight" system which draws its low pressure from only one cylinder. This leans out one cylinder to an extreme when the system is employed. "Auto-Vac-2" is a very complete kit with all parts included and I can't convey the relief of mental pressure when flying hard IFR knowing that, if your vacuum pump breaks, the instruments will continue to work and only a little yellow light comes on to tell you it broke. (Bill Roberts, ICS #01681)

I decided on the electrical "Guardian 1" by "Aero Safe" out of Ft. Worth, TX. I had it installed with a red "Idiot Light" to call my attention to the failure of the engine driven pump and total cost was about $1,500. I can test the system before an IFR flight by turning on the switch before I start the engine. I can use my attitude indicator, DG and autopilot even after a failure of engine driven pump.

I was reluctant to use the "Precise Flight" system because I once had an engine that ran rough on occasions for months until we found a bad gasket on one of the induction tubes. This is quite bad with fuel injection as the injector servo misread less engine "Breathing" through the servo as an indication that less fuel should be sent to the engine.

I'm not knocking the Precise Flight or A&I Product approaches to the vacuum backup problem, but merely explaining why I chose the more expensive system to avoid putting holes in my induction air pipes since I am fuel injected. (Jack Weiss, ICS #00138)

The advantages of the "AUTO-VAC" systems are: they are completely AUTOMATIC, lightweight, "-1", 2 1/4 lbs., and the "- 2" just slightly over 1 lb.; easy to install, self-contained low vacuum light switch; and MOST IMPORTANT OF ALL, NONDEPENDENT of any aircraft system. All of the electrically driven pumps rely on a battery, which normally is loaded to the "hilt", weigh in excess of fifteen pounds and costing from over $1,200 to $2,500 plus installation that runs from $300 and up.

This kit was made for the "little guy" costing from $350 to $395 fob.

When the "AUTO-VAC-2" intake manifold system is in use, adjust the mixture for normal CHT or EGT as a small amount of extra air is being introduced that is not being compensated for by the fuel control or carburetor.

"AUTO-VAC-1 " and "AUTO-VAC-2" both use the same AUTOMATIC transfer valve and low vacuum warning light. The low vacuum warning light switch is part of the transfer valve and senses vacuum pump inlet vacuum pressure.

When the installation is made in accordance with our instructions, it becomes an automatic system and operates thusly: when the master switch is turned on, the low vacuum light will illuminate, indicating no vacuum, upon engine start and vacuum in excess of 3 1/2" Hg. the light will go out, indicating that the engine driven vacuum pump is operating. At idle and up to 1,800 or 2,000 RPM, the intake manifold vacuum will be the primary source of vacuum. The explanation is this, with an idle manifold pressure of 12" Hg. and barometric pressure of 30" Hg., there will be an 18" Hg. differential, whereas the vacuum pump (depending upon it's condition) may be delivering 4 to 7" Hg. As engine RPM rises manifold VACUUM decreases and vacuum pump increases and when vacuum pump delivers more than intake manifold the valve will translate over to vacuum pump inlet pressure.

In flight vacuum pump failure will be indicated by the illumination of the low vacuum warning light and the throttle has to be adjusted to maintain the required vacuum pressure for the particular aircraft, generally 4.8" Hg.

As with any intake manifold system, climb to higher altitude may be accomplished by increasing the power as needed. If full power is applied, vacuum to the instruments will drop to one inch (1" Hg.) or less and climb may continue for a period of three to nine minutes, again dependent upon the instruments and the vacuum driving them, the artificial horizon should be the first instrument to show signs of decay then the throttle must be reduced to increase vacuum to "spool up" the instruments may take from one to two minutes and then full power may again be applied. This may be done as often as necessary.

During approaches using from 1,800 to 2,200 RPM and manifold pressure of 16 to 18 Hg., ample vacuum pressure will be maintained, during a "missed approach", full low pitch, (high RPM) and a manifold pressure of 24" Hg. should give at least five (5" Hg.) at sea level, giving a descent climb power. Of course, these figures are a variable.

Backup Vacuum

John Van Bladeren, ICS #01282

John Van Bladeren at "Ron & John's Comanche Service" in Portland, OR, has received STC authority to install a second engine driven vacuum pump on all Comanche 260 models. This is another possibility for members interested in an alternate vacuum backup source for gyro instruments. The installation utilizes the hydraulic pad below the right magneto on the 540 series engines.

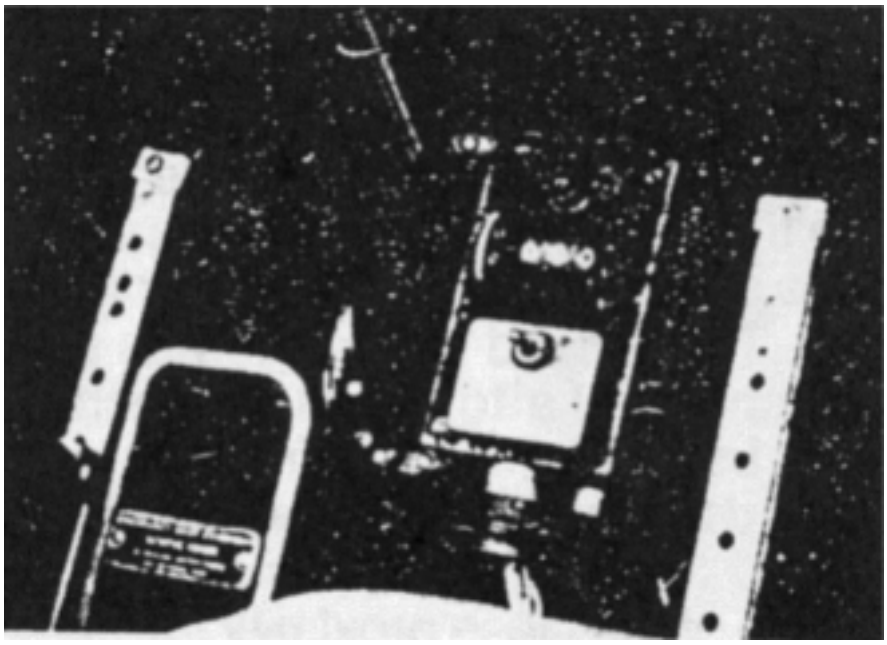
The system is made completely automatic with an Airborne shuttle valve transferring to the alternate system if and when needed.

The STC does not cover the '250 models because of the proximity to the muffler and exhaust system. However, slight modification to that system is feasible.

The STC is available for sale at $50 per aircraft. All parts and material for the modification may be purchased "off-the-shelf" from your usual aircraft parts suppliers for a total of approximately $900 - $1,000. John estimates installation time of eight hours or less, except that the C model would require some additional time for re-routing extra plumbing.

HF Radio Installation

I used my HF communications radio for many years when flying in West Africa. It is a Sunair T-5-RA with a trailing retractable antenna. The antenna motor relay is on the floorboard in the cockpit between the gear handle and co-pilot seat rail. The antenna is drawn out by a light-weight cone (top portion of a plastic bottle).



Relay box has indicator light and counter to measure extended antenna.

Top portion of bottle makes excellent stretcher for trailing antenna.

Rewinding of the antenna must be done at minimum airspeed, less than 100 knots to avoid overload of the rewind motor.

The motor relay box contains a counter to show the length of antenna released, similar to the counter on a tape recorder, so to assist in tuning for maximum signal emission at each frequency. I got excellent reception in West Africa, often having good communication at 600 nm or more.

Oil Temperature Gauge High Reading

About a year ago, I purchased one of the best taken care of and most loved Twin Comanches in existence. Considering the admiration and care the proud owners devoted towards this aircraft, the high oil temperature reading on the right engine did not concern me as a serious problem, and I was right. Part of the excitement (or in my case - therapy) of owning an aircraft is working it. With a box of tools, a volt-meter and a lot of weekends, resolving this problem became a hobby in itself. First, the oil coolers were cleaned and interchanged with little results. Next the oil temperature probes were switched, with no change, the right gauge still read much hotter than the left. Next, I switched the leads on the oil temperature gauges themselves, so that the left engine reported on the right gauge and vice versa.

After flying the aircraft in the South Florida summer, there was no change, the right gauge still read much hotter than the left. This proved the gauge was bad. I called Keystone Instruments in Pennsylvania and spoke to Glenn Barnhart. He informed me that this problem is found on Aztecs, but unusual with Twin Comanches. Considering the price of aircraft parts, I was thrilled to discover the gauges only cost $20 each, plus freight. As soon as they arrived (five days later), I installed them with much improved results. Apparently, because of the close proximity they are in the instrument panel, Glenn said that they tend to magnetize themselves and have to be re-calibrated and replaced.

While investigating the oil temperature problem, I used a voltmeter to measure the resistance values at various stages of flight. I discovered unusually different readings on the right engine. It turned out that the ground cable had been connected to the "AUX" port of the alternator. According to Rick Clay of Prestolite, this port is used on a "Low-Voltage" warning light system, if equipped. On my aircraft, since there is no such system, it should not have anything connected to it.

Autopilot

Another item in the aircraft that I think is not getting enough attention from both the pilot and maintenance personnel is the original autopilots made by Mitchell.

Each axis has a clutch which will let you override the autopilot. If the clutch is not slipped for a second or two quite frequently, the disk and plates will corrode and seize together. To preflight the autopilot, turn on the roll section. Check to see that the servo can be overridden by hand at the control wheel. It should require 16 +/- 3 pounds.

Caution:
If you haven't slipped the clutch in a long time, don't hold it too hard. Have a qualified person remove, clean and adjust it. Turn on the pitch section and check to see that the servo can be overridden 20 +/- 3 pounds. Same caution as above. The pitch also has a break away. This requires 40 +5 -3 pounds to pull a ball out of a socket to disconnect the pitch section from the autopilot. If the autopilot seems a bit behind the aircraft, check the cable tension.

These autopilots have done a very good job and when properly serviced, will continue to do so for many more years.

	PA24	PA30
Ailerons	20 lbs +/- 20%	26 lbs +/- 20%
* Rudder	18 lbs +/- 20%	* 25 to 40 lbs
Stabilizer	18 lbs +/- 20%	18 lbs +/- 20%
Trim Cable	12 lbs +/- 20%	12 lbs +/-20%
Bridle Cable	17 lbs +/- 2 lbs	17 lbs +/- 2 lbs
Rudder Trim	10lbs +/- 20%	

*To be taken at flexible position near the fire wall on the single and near the forward cabin bulkhead on the twins.

New Panel on a Budget

Richard Wolf, ICS #12517

I'm one of those who believe most of us watch a budget, for sure. The thing is, some of us watch a great big budget and some of us watch one somewhat smaller. So, several months ago after gazing at our instrument panel and contemplating the little gaggle of radios over here and the little gaggle of radios over there and the splattered array of instruments in front of me, I zoned out.

Ever done that? It's what happens when your Hip National Bank can't cover your covets. It's the dollar depression, the buck-out blues. You want it so bad you can taste it, but man, you know fixing this thing is going to cost a fortune. So you sit down and come to the realization there are only two ways to make a quick solution, more debt, or stubborn tenacity mixed with some very good help. I chose the latter; here's my story.

When we bought our airplane two years ago, the equipment list included on the left, a Narco MK12 w/ GS, a Narco, AT50 transponder w/encoder, and a King KX125. On the right, inoperative DME and a Bendix ADF. The large artificial horizon had been replaced with a 3 1/8" horizon and a hole patch. After the MK12 died, I began to explore ways to convert to a center radio stack and pilot friendly arrangement of instruments. I read all the conversion advice I could find in the 'Tips Special', then called Ron & John's Comanche Service.

John Van Bladeren was kind enough to send a few photos, and one look was all it took. That's what I wanted in my airplane. It looked the best, and was the cleanest install I had seen. What's more, it was STC'd. Therefore, I could skip a field approval and the paperwork was already provided.

Next, I went to my mechanic and told my story. I cried and turned my pants pockets wrong side out and he agreed to supervise my work very closely and sign me off. Then, I visited my local radio shop and we worked up a plan. He would de-install that antique MK12 and replace it with a yellow-tagged NavCom w/GS. I located a King KA24 for a couple hundred bucks, added Apollo 612B Loran for a couple more. I would do at least part of the work and he would do the rest and re-certify the airplane for IFR operation.

Meanwhile, Ron & John's agreed to sell me the STC portion of the conversion without me buying their panels. (These folks are great.)

In another life I was a toolmaker and could handle that portion of the task. OK. All the pieces were coming together nicely. The price was right. Time to get started.

Let me state one thing at the outset. If you are not completely confident in your mechanical ability, you have no business starting this. On the other hand, if you have ever rebuilt a 327 or restored a classic car or boat, or put a family room on your house, or sheet-rocked your basement and hung a ceiling, or re-did your kitchen cabinets, you get the idea? You have to be the one to sort all of that out and choose whether or not to go for it. One thing's for sure, this project will stretch you.

You begin by removing every radio and instrument in your panel, all of them, everything, including lights and switches and gauges, everything, even the yokes. You de-install all the old electronic stuff you don't want anymore and marvel at the horrible job the miscellaneous radio guys have done over the years and vow your work will be absolutely perfect. Then you step back and look at that twisted pile of spaghetti and your face flushes red-hot and then it hits you. You have really messed up this time. You're about a mile down in a deep, dark cave and dang if you didn't forget to drop breadcrumbs. You are now trying to figure a way out of this before any of your flying buddies see you. You are completely convinced you will never get your airplane back in the air and will be making payments on this piece of junk for the rest of your life. Now is a good time for an iced tea break or a cup of coffee or something stronger while you wait for this to pass. It does.

Next you build the panels themselves. I tried an expensive hydraulic punch and die set on the instrument holes and did not have very good luck. The material required by the STC is 2024 T3, one eighth inch thickness. This stuff simply does not punch well, especially the ATI cutouts. I also would not recommend a fly cutter or hole saw on a drill press. It is unlikely you will maintain good location without the ability to clamp the panels firmly and dial off in X and Y to the correct position for the next hole.

If you want a truly great looking result in your Comanche, either build your panels on a mill using a boring head or equivalent or buy them from Ron & John's (I am assuming you don't have access to a CADCAM system and a Laser or Waterjet or Wire EDM. As far as the mounting holes and all the hardware, the STC instructions are impeccable and very complete.

Once the sub-panel is located to the bulkhead, just follow the directions for the removal of the excess original metal and de-burr your work. One note of caution here: please be sure you cover the spaghetti with several old bath towels. You want to control the chips as much as you can. And make sure you keep your die grinder away from those towels! That would really get your attention! Clean up all the chips and dust very thoroughly and take the opportunity to inspect the cables and pulleys and lubricate as necessary.

Once the overlay panels are completed and installed, you will be sick of fling holes but completely happy with your decision to do this. Even though you know you're not finished, it feels great when it starts to come together. After a trial fit of all the instruments and radios, you're ready to de-install the panels and send them off to be powder-coated or painted. If you choose wrinkle-paint, you might want to either mask off all the holes or drum-sand them out a bit as the paint is quite thick. Powder coating is the best, of course, but I'm not sure what you would do in the event you made a future change in your panel layout. Just a thought.

OK. Everything is back from the vendors and ready to go back together. Shoot a little flat black around the yoke holes and the extreme right and left edges of the original panel (mask off all the Plexiglas, please) and install the sub-panel. Next, put the yokes back in. I know, with the yokes in place you don't have as much room to install instruments and wiring and radios. But if you wait until later, you'll have a bugger of a time reaching the safety wiring for the mounting screws on those yokes. I would rather work around them.

Before installing the overlay panels for the final time, I took the airplane to my radio shop for the new harness and my 'new' radios. Here is where it really starts to get exciting. I was completely happy with the work performed by Tomlinson Avionics, KDTO, (940-382-2460). They are professional and willing to work with a guy who didn't buy a whole panel full of new gear. All the spaghetti goes away at this point and you're now looking around the hangar hoping someone is eyeing your great-looking Comanche with its new panel-in-the- making. Man, were you smart to start this mod! You're a genius! Not to mention the increased value of your plane!

All that's left is installing the right and left overlay panels and all your instruments in their new locations. I found this to be a good time to buy new pitot-static line and new vacuum hoses. Change the filter while you're at it too, and inspect everything for clearance with the cables. In my airplane, the tach cable made it to the new position, no problem. I did have to lengthen the manifold pressure line and lengthen the wiring to move the engine gauges to the new overlay. A few miscellaneous challenges along the way to keep it interesting and you are finished.

You can't imagine how good it is to review your work. My materials list and approximate costs follow.

	$

Aluminum (sheet stock 3' x 4' x 0.125" thk 2024 T3)	130
Hardware per STC list	50
Used KA24	200
Used Collins NavCom. w/GS (installed)	1700
Used Apollo 612B Loran	300
Additional install labor	300
STC cost	200
Pitot/Static and Vacuum lines and filter	30
Total Project Costs	2,910

You've got to admit this isn't terribly expensive and the result is a great basic IFR panel for a budget most of us can handle.

Since the mod, my son has finished his commercial/instrument rating in the airplane and we file and fly as often as we can. The panel is perfect for our kind of flying. Of course, I have a wish list as long as your arm, a new autopilot and IFR GPS to name two. But the need for a new prop caused a slight delay. I'm sure most of you can relate to that. But, in the mean time, I can go everywhere I need to go, behind a panel very safe to use and pleasure to look at.

I cannot close without giving much credit to my son, very good friend and flying partner, Adam.

I wish you well with your project should you choose to do this and hope your experience with your Comanche is as exciting and enjoyable as mine has been. Fly safe.

Personal GPS Mounting Secrets

J. A. (Joe) Wilhem, ICS #02038

Method of mounting a hand held GPS/Transceiver to the yoke of the COMANCHE. This is a more or less permanent manner of placing the GPS unit in front of you and easily read and programmed.

1. Pop out the COMANCHE medallion from the center of the yoke.
2. You will find two (2) holes in the hub of the yoke. Enlarge these two holes as required to tap them for either a #8 or #10 screw.
3. Fabricate an aluminum plate (I used a sheet of 1/8 in. to add stability to the size of the unit being mounted) Spacers may be added to the back to place the unit on the desired angle for easy reading. I used Velcro adhered to the mounting plate and the back of the unit for easy attaching and removal.
4. Route the power source wires and antenna leads to the column with wire ties allowing for a full travel of the fore and aft movement of the column and route wires to the back of the panel using an existing hole (or make one out of the way of instruments).
5. Wire power into nearest source past the master and place the antenna of the GPS on top of the panel cover toward the center of the windscreen so that it does not interfere with anything already in that position.

I have used this system with two different GPS units successfully for the past 4 years and highly recommend it over any of the other factory supplied methods of yoke mounting that I have seen.

Garmin GDL-49 weather data link (Feb 2003)

Ron Steiner ICS #14420

In an effort to make more trips less stressful, I've wanted a weather data link system since I first heard of it several years ago. We've had the new Garmin GDL-49 weather data link system working in N9491P since early October, 2002, and now have had a chance to see how the system works on several long cross-country trips. Hopefully, by sharing my experiences with those of you who may be looking at adding this upgrade, your expectations will be realistic. Being close to the first to install any new technology requires more than a little patience to work out the bugs, both from the factory and at the avionics shop, but I'm getting ahead of myself.

With my first plane, I painstakingly added and/or upgraded the avionics, item by item. That proved to be extremely costly, and the panel wasn't very well laid out by the time I had filled up all the holes. When I bought our Comanche, I intended to gut the panel and start from scratch to get it right the first time. That also proved to be even more expensive, but my wife hasn't been able to find out how much it cost thus far, so no foul! ! We took the plane to the avionics shop in January, 2000, and did most of the work then; but, in September of 2002, there was another minor upgrade including the GDL-49 installation. Naturally, I wanted the data link system as soon as it was available and was at my avionics shop, having what I understood was the third active box in the country installed in September, 2002. The first box was dead on arrival. We weren't really sure why it wasn't working and thought at first that the problem might be with the satellite data provider, but it wasn't. The second box was partially functional and would download the graphical METARs, but would not download the NEXRAD images. The Garmin technical reps were helpful, but skeptical, about the installation. After we checked a bunch of stuff, including the audio panel for the proper modifications, and flew with it almost 15 hours, Garmin finally agreed to send another unit.

Ever the optimist, I soldiered on, and gratefully the third GDL-49 worked properly. I've made two cross-country trips now, and, while the weather wasn't perfect, there wasn't a lot of variation in it either. It was either VFR or fairly widespread, light precipitation. The displayed images were very consistent with the weather we observed.

The unit is totally software driven from the GNS 430 and GNS 530. There is nothing to add to the panel, although the radio/computer module is mounted either under the panel or in the empennage and a third VHF antenna is required. There is an additional map page on both the 430 and 530, and the GDL-49 cross feeds the same information to both displays. The graphical METAR is only available on the weather map page. The weather map page can be configured in a 360 degree view like a storm scope, or in a 120 degree forward view like a radar display. Both configurations will zoom in and out. When a NEXRAD image is downloaded, it automatically overlays the moving map display; and there is a little digital display in the upper right hand corner of the map that tells how old the image is in minutes.

The good news is that this technology is something that was previously unavailable at ANY price and, in my opinion, is reasonably priced for what you really get. How much, you ask? Assuming you already have a Garmin GNS-400 / 500 series navigator, probably about $4,000 to $5,000 installed, depending on the individual aircraft and the way the existing Garmin GNS installation was completed.

The images show three levels of intensity displayed as green, yellow, and red, depicting precipitation intensities from light to heavy, respectively. The software is easy to use and extremely intuitive. You can learn to operate it in few minutes, and it can be set up easily to download a single image or update the image as often as every ten minutes automatically. Data for up to a 250 nautical mile radius around a waypoint, around your present position, or data along your course can be downloaded and displayed.

Nothing is perfect, and there is some bad news. Perhaps it's my engineering mentality, but I believe some significant improvements can be made to the software to make a great system even better. Oh, and I've already relayed these concerns to the people at Garmin, but feel free to send your own experiences and "wish list" to them also.

I'm not happy with the density of the colors. The green and yellow are very difficult to discriminate between in some backlight conditions. These colors need more contrast in my opinion. For example, the green needs to be a little darker

and the yellow lighter. The contrast of the red probably needs to be just a shade lighter also because it can be difficult to discern from the black background at a glance, especially if there is only a very small area of red, which is often the case.

The different colors are impossible to tell apart in the graphical METARS. This system uses little colored, vertical and horizontal bars to show ceiling and visibility. It is almost impossible to determine the difference between the best and worst conditions. I recommended to Garmin that coloring a portion of the bar would be much easier to interpret, instead of using the green and yellow colors - for example, all green for VMC and half GREEN for MVMC and no color for IMC. Because the little bars are small, it's easy to misinterpret the colors at a glance (yeah, I know you can zoom in, but that's more unnecessary button pushing, often in an environment where you don't have time for it). The textual METARs are not working at this time, although that is intended to be part of the system. Garmin says it's still in the works, and there is a separate page for that information which is currently inoperative.

Lastly, the downloads are slow by the standards we are all used to on the internet because the signal from the satellites is VERY weak and the transfer rate is extremely slow. Expect to get graphical METAR information in three to five minutes. Expect to get NEXRAD images in five to ten minutes, depending on the density of the information and the radius selected. By selecting a smaller area, you get a faster download time. Naturally, faster is better, but having a composite radar image in the cockpit within ten minutes is a huge improvement over what I had before, which was nothing!

When I bought our Comanche two years ago, I intended to make a major avionics upgrade, including a complete Garmin stack and a bunch of other stuff that my wife assured me I didn't need either. The work on the instrument panel was done by Superior Aviation at Iron Mountain, Michigan. John Sersich runs the avionics shop at Superior and did a fantastic job for me. The stuff even worked when I flew away the first time. I joked with John that I'd never left an avionics shop before when at least something didn't work. He winked and said, "We've never had a failure yet" John struggled with the data link system a little since no one had any experience with this system and we weren't really sure how it was supposed to work. We were all talking to ourselves after the second box didn't work, but his installation proved to be correct. When we finally got a box from Garmin that functioned properly, all of the problems disappeared. John and his staff at Superior Aviation did all of the avionics work on N9491P. I've been very impressed with the quality of their work and their attention to detail. I recommend them highly.

To review quickly, new steel panels were cut for both sides of the instrument panel, so everything fits precisely as we planned. The radio stack included the Garmin 340 audio panel, the GTX 327 digital transponder, and both the 430 and 530 navigators. All flight instruments were replaced with new backlit instruments on the pilot side. There are two attitude gyros: powered and slaved. Both a JPI system for digital fuel flow and a separate JPI engine monitor for EGT and CHT for all cylinders, oil temperature, shock cooling, and voltage buss monitor were installed. In addition to factory engine gauges, warning lights were installed at the top of the panel directly in the pilot's line of sight for low vacuum, low oil pressure, pitot heat on, fuel pump one is vacuum powered, and one is electric. The HSI is a Century NSD360, which is vacuum on, and gear down, as well as for right and left landing lights on indications. For weather avoidance, the plane has a WX-900 Series II storm scope and the Garmin GDL-49 weather data link.

The autopilot installed is an S-Tec System 50 with altitude hold. The autopilot is coupled to both navigation radios and both GPS navigation systems. The GPS boxes feed roll command information directly to the autopilot through an S-Tec GPSS system, which makes the S-Tec autopilot follow a DME arc approach as if it's locked on rails.

Other minor things that were added included a Shadin Altitude Alerter, separate Digital OAT, a four- function Davtron digital timer, and a three-function Davtron digital electrical system monitor, as well as David Clark panel-powered ANR headsets on both sides in front.

The instrument panel is pretty much as good as it gets in a single engine piston plane, and I've been happy with the end result as long as I don't think about how much it cost. Having the ability to call up a NEXRAD composite radar image from anywhere in the country, in flight or on the ground, is a powerful tool for strategic planning and weather avoidance. With this kind of information available in the cockpit, it's a lot easier to make rational decisions about what is ahead and which way to go to most efficiently circumnavigate menacing weather. In my opinion this is the first major breakthrough in weather avoidance for a long time and is the first time that a display in the cockpit can show weather a significant distance ahead, or for that matter anywhere within the North American NEXRAD network. Try it - you'll like it, especially if you fly around, under, and sometimes into weather.

Replacing the Tachometer (RPM Gauge) (Mar 2004)

Q I assume the fluctuating needles of the rmp indicator refer to a worn out tachometer cable. Is it advisable to replace the assembly or will it help replace the inner cable only?

A Replacing the complete tachometer cable in a twin is a major job, it is much easier in the single. If you remove the inner core and you find some chafing marks, you better replace the complete assembly. Be careful to re-install the part with no sharp bends. In case you find no chafing, a replacement of the inner cable will do also for some years.

Gem 1200 Engine Analyzer (Apr 2004)

Q I had a Gem 1200 in my 250 Comanche, and after a couple years of satisfactory service, it began to give me erroneous, erratic readings. This would occur as soon as power was applied. At idle the readings, it seemed normal. I first replaced the display thinking that was the problem. But the same crazy readings occurred. The mechanics searched all over for the problem. They checked for adequate grounding from the engine to airframe. They replaced probes. They disconnected the alternator to make sure the interference wasn't coming from it. They pulled out the magnetos and overhauled them.

In desperation, I replaced the unit with a JPI unit that plugs into the same connections.

I still have the same problem! What is going on?

A (Note: before answering, I called the owner for more information.) The problem is the "piggyback" coupler on the No. 3 cylinder. Since it is necessary to keep the factory CHT sending unit installed, there is the option, when installing an aftermarket engine temp display,to either install a spark plug "gasket" type sending unit or install a piggyback plug in at the No. 3 cylinder base. With the piggyback plug, both the factory sending unit and the aftermarket probe are mounted at the same place. If the connection at the piggyback is corroded, it will cause the erratic readings.

Autopilot Porpoise (Oct 2004)

Q My autopilot is *porpoising* in altitude hold. What can the causes be?

A It is generally related to a couple of factors. The first place to look is the pitch servo. The servo has DC motor with brushes. The motor reacts to a voltage which Another place to look would be the static pressure reference point. Most autopilots use a static pressure source as the altitude reference point. If the static system is leaking or unstable, that could cause the autopilot to be unstable.

Finally, the other potential area could be the attitude indicator. The Century autopilots such as the Altimatics, Century 2000 and Century III use the horizon. A faulty horizon could also be the source of problems. S-Tec autopilots do not take feedback from the horizon and as such, will not have a "horizon" problem. By some accounts though, the Century Autopilots are better able to handle turbulence because of an instantaneous response from the horizon.

Gear Light Quandary (Nov 2004)

Q I have a problem with my PA30 model "C." When the master switch is turned on, the gear-down green light is dim, as would be when the panel lights are on. The light does not change from dim to bright regardless of panel light switch position. My mechanic has been trouble-shooting with no success, so I thought perhaps you might be able to shed some light on the matter. Is there a diagnostic procedure we can use to find what the problem may be? I will appreciate any advice, including finding another mechanic.

A Before you get another mechanic, give the one you've got these suggestions and have him try the procedure outlined below. It may be simpler than you think.

The landing gear indicator lights are wired through the switch for the instrument lights. It is a double pole double throw (DPDT) toggle switch with separate terminals for the gear indicator lights and the instrument panel lights. This switch controls both circuits.

In the "off" position, the gear light circuit goes through the switch to ground, to make the gear light(s) bright. In the "on" position, this circuit is routed through a resistor to make them dim. Also, when this switch is "on," 12-volt power is routed to the panel lights through a rheostat which controls the amount of brightness. The switch has a little cup-shaped receptacle which has to engage with the arm when the rheostat is turned to the off position. If it gets out of alignment, then when the arm comes around it won't let the switch go to the off position.

We suggest checking to make sure the toggle switch is engaged properly. If the switch is out of kilter, the dimmer rheostat terminal may not be switching the dimming resistor off when the dimmer rheostat is shut off. Or, it could be as simple as having the wrong bulb. Our "Down Under" expert recommends the following procedure for checking the system:

1. Confirm it is a 14-volt bulb, not a 28-volt one. If uncertain, replace with a known good bulb.
2. Put a short across the dimming resistor using a jumper wire (this resistor is mounted behind the switch on back of the dimmer rheostat) and turn on the master switch. If you now have full brightness, this confirms the reason the bulb is dim is that the dimming resistor is always in the circuit – which means either the toggle switch is not being operated by the rheostat or it has failed internally. A visual inspection will confirm the first, and an electrical check (after unsoldering a bit, or removing the bulb) the second.
3. If the bulb is still dim, then the problem is elsewhere in the circuit and you will have to find the fault wire by wire, contact by contact, and connector by connector using a voltmeter or test lamp. You will need a circuit schematic from the maintenance manual. This should not be too hard; just approach it methodically.
4. There is an outside chance that someone has done some wiring in the past and made an error.

Airspeed Indicator Not Working (Mar 2005)

Q I have a 1960 180 Comanche and on takeoff today, the airspeed did not indicate. It stayed at zero. What could be wrong?

A The Comanche (and most general aviation aircraft) airspeed indication system has three major components:

- Airspeed indicator;
- Pitot probe or head mounted on the underside of the left wing;
- Tubing connecting the indicator to the pitot probe.

The airspeed indicator is also connected to the static system along with the altimeter and the rate-of-climb indicator. A problem in the static system will cause an error of the airspeed indication (accuracy), but not a non-indication condition.

Here are some reasons for a zero airspeed indication, in order of most common to least common:

- Blockage of the pitot probe and/or tubing;
- Indicator failure;
- Tubing system connecting indicator to probe leaking or failing.

Blockage can be as simple as, "Oops I left the pitot cover on," or as problematic as a bug jammed up in the tubing or pitot head. A quick way to check the pitot system is to have a companion watch the indicator while you blow with your mouth and lungs on the pitot probe. (No one said maintenance work is glamorous!)

If you sense resistance to your air pressure and there is no indication, the system is most likely blocked and will have to be cleared from the inside out with the indicator disconnected. If you do not sense resistance and there is no indication, you have either an inoperative airspeed indicator or a leak in the tubing system.

The indicator can be tested for basic operation by applying air pressure (again, lung pressure) directly to the pitot port (center port) on the back of the airspeed indicator. (Note: the off-center port is the static port) The ports on the back of the airspeed indicator are generally marked with a “P” for pitot and an “S” for static. Slight pressure to the pitot port should give some indicator movement.

Blocked tubing or pitot head can usually be cleared by applying air pressure to the line disconnected from the indicator. Caution: Make sure it is the pitot line that you are about to blow on, applying pressure to the static line will cause severe damage to the static instruments! Warning: When applying pressure, ease the pressure on and assure that the area in front of the pitot tube is clear, because the blockage will become a projectile as it is freed from the system.

Another possible blockage could be from frozen water. If conditions exist to make that possible, warming the aircraft and clearing the line as above should take care of it.
There are a number of possible sources for leaks in the tubing system. The system consists of hoses and tubing on an un-modified Comanche. Starting at the indicator, a metal tube and fitting attaches to the indicator. From there, a rubber hose connects the metal tubing to plastic tubing at the left sidewall of the cabin forward of the instrument panel. It’s plastic tubing from there to the leading edge of the left hand wing root where it is joined by rubber hose to the plastic wing tubing.

The wing tubing is one-piece plastic routed along the left wing leading edge passing through small rubber grommets for support to the pitot probe area where the probe is connected with another piece of rubber hose. Cracked or broken rubber hoses or plastic tubing are all possible leak sources. Check the rubber hoses first as they are accessible.

If you find that the plastic tube in the wing is broken, fellow ICS member Charlie Horton has two methods to replace the line without removing the wing. Charlie’s first method (preferred) is to insert a piece of .032 safety wire through the damaged plastic tube. (Hopefully the tube is not so damaged and separated that this can not be done, otherwise on to Method Two) You then attach the .032 wire to a new piece of plastic tubing in such a manner as to not increase the O.D. of the new tubing making it difficult to pass through the rubber grommets. A suggested method would be to glue (epoxy) a length (about 3 inches) of a metal rod inside the tubing and attach the wire through a hole in the exposed rod. The new tube is then pulled from inboard to outboard through the wing, forcing the old tubing out as the new feeds in. Use of a “wire” lube (electricians use this to pull wire thru conduit) may aid the work and should not be caustic to the airframe.

“Charlie’s Method Two” explains how to install the tube on an alternate route through the wing.

In the next issue of the Comanche Flyer, we will publish a full explanation of Charlie’s two methods, accompanied by detailed drawings. (See Technical Articles for Charlie Horton’s Explanation)

Static System Leaks (Aug 2005)

Q Can I tell if my Comanche’s static system is leaking?

A A leak check of your airplane’s static system is usually performed during the IFR altimeter/transponder system check required every two years. Usually you don’t know you have a leak until the shop doing the test tells you. But there is a simple way to check it yourself (with the help of a friend).

The Comanche static system, starting from the back working forward, consists of two “static” ports (holes) located on each side of the aft fuselage. Inside the fuselage tail area these ports are joined with tubing and rubber hoses and routed to near top center. A single tube is routed from there forward along the left hand side of the cabin to the area forward of the instrument panel, and (usually) into the static port of the airspeed indicator, with a tee fitting, then on to the altimeter through a tee fitting, then on to the rate of climb (VSI) indicator.

Since the requirement for encoding altimeters, the original system on all of our Comanches have been modified to provide for the encoder's static connection.

Many of our static systems have had "alternate" static ports added also, this usually consists of a valve mounted at the instrument panel that, in the case of blocked external static ports, opens the static system instruments to the inside cabin air. This is not as accurate as the external ports but is better than no valid static information, (which BTW also makes the airspeed invalid) or breaking the glass of the VSI to make an alternate static source.

A quick and simple way to check the static system for leakage is by blocking one of the static ports on the fuselage (with electrical tape or modelers clay or chewing gum or ??). With a friend looking at the airspeed, altimeter, and VSI, you draw a little suction with your mouth on the other port and stick your tongue over the port, sealing it off (sounds nasty but if your airplane is clean it's not too bad!).

Don't draw too hard (in excess of 80 to 90 mph on the airspeed or about 1,000 ft above field elevation on the altimeter). This makes it pretty hard to talk, but what your friend should see (if the system is without leaks) is the airspeed, altimeter, and VSI should go up, the VSI should retreat back to zero, the airspeed and altimeter should hold steady. If the a/s and altimeter drop off and the VSI shows a decent then you have a leak.

There are many places that are prone to leaks on the Comanche static system. All of the rubber hoses and their connections are suspect, fittings can and do crack and leak, the stem of the knob on true airspeed indicators are known to leak, the ports themselves can crack and leak. I have even seen instruments leak around the glass. To find a leak will most likely require a static test box that maintenance shops have for testing the system and knowledge of your plane's system (how the alternate static port and/or encoder are connected) along with the use of a methodical process of elimination.

Manifold Pressure Gauge Not Working (Aug 2005)

Q My engine manifold pressure gauge has repeatedly stopped working, each time it is found to have "goop" at the fitting on the gauge. The "goop" is cleaned and it works fine for a while then it stops up again.

A The manifold pressure gauge is connected to the Lycoming cylinder head at the intake port (usually the left rear cylinder). A metal line attaches to the bottom of the port and goes down and aft to a fitting where it is changed to a flexible rubber hose to go to the firewall fitting, from there it is routed to the gauge. The metal line at the cylinder should have a small hole at its lowest point. Many of these tubes have been replaced through the years and the hole has not been drilled.
Check to make sure your engine has a hole in this tube and it is clear of obstructions. The hole should be somewhere in the size of a #50 to #60 numbered drill. Exact size is not critical, the small hole keeps the "goop" from plugging up your indicator and does not affect the accuracy of the indication.

Autopilot (Aug 2011)

Q My Altimatic III autopilot doesn't seem to want to hold altitude, though it does seem to "grab" the elevator trip when altitude hold is engaged. Any tips about where I should look first to correct this problem would sure be appreciated.

A The Altimatic III autopilot sounds like it is the original one Piper installed in the plane and it is, in reality, a Century 2 autopilot. Not surprisingly, Century no longer supports the Altimatic III/Century 2, so you need to talk to a shop that repairs autopilots. I prefer Autopilots Central in Tulsa; they still work on these older units. However, if you want an autopilot that lives up to your expectations in both performance and ease of maintenance, you will probably have to upgrade to a modern one.