PANEL MODIFICATIONS - PART IV

DINOSAURS, DUMPSTERS & DOLLARS

BY DENNIS WOLTER, AIR MOD, BATAVIA, OHIO

Writing about the next phase of building this panel presents me with a dilemma. My wife Cynthia is always telling me that women are multitaskers and men are monotaskers. I tend to agree with her. That said, to some degree I think she confuses monotasking with a man's desire to be uninterrupted while working on a complex task. To my way of thinking, the complexity of the custom design and building panels involves integrating several related variables as the fitting, fabricating and layout of the panel takes shape. That sounds like multitasking to me!

For this particular project, we started with a D'Shannon Aviation panel kit to get a large shock-mounted flight panel, a usable fixed main panel, glareshield, and all the floating-panel mountings and supports ready-made. In the spirit of retaining some of the original classic Beech design, our plan was to retain the existing piano keys, wiring, and especially the lower mounting structure.

Since the D'Shannon panel kit is designed to replace the piano keys, the subpanel and related components that we wanted to retain, our first step is to cut down the long full panel to fit along the original lower sub-panel structural truss located just above the original piano keys and center quadrant.

I'm a big proponent of mounting these .090" aluminum panels with structural 8-32 countersunk machine screws and nut plates. This mounting system has some distinct advantages. First, the entire panel can be painted and placarded outside the airplane. Second, all wiring and instrument plumbing can be easily fit, installed, tested and tied up on the bench. And last, if in the future a major panel change is planned, the whole panel can be easily removed.

We have tried building these panels every way known to man and, regardless of the type of panel we're building, we definitely feel that mounting with machine screws is the best way to go.

With the new fixed panel cut to fit the original piano keys and center throttle quadrant, we temporarily cleco this panel in place. It is then time to confirm the layout and fit of the customer's panel design.

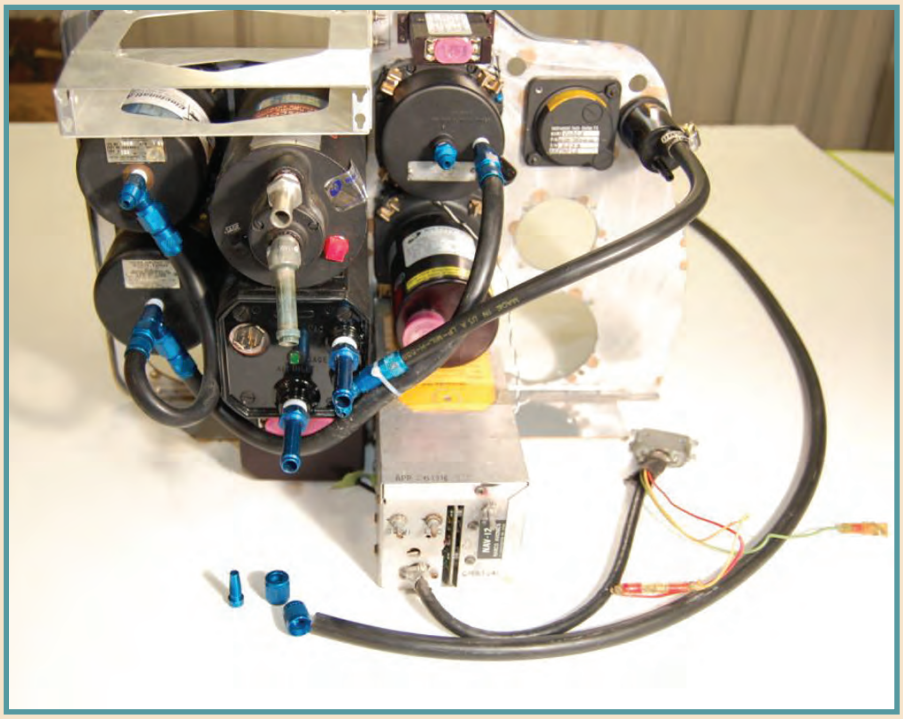
Armed with the original panel drawing made while the customer was here, and what we call our "six-point awareness list," we start to locate the various components. This list actually consists of things one must consider when laying out a new panel.

SIX-POINT AWARENESS LIST

1. All structural components must meet the requirements of FAA AC-4313 1B.
2. All instruments, radios, defrosters, etc. must clear all controls, structure and systems.
3. One must provide for electrical wiring, instrument plumbing, securing of clamps, etc.
4. Lay out all the instruments, switches, circuit breakers and controls in an ergonomically correct and intuitive manner that also includes the owner's input and priorities.
5. Locate components to ensure that everything can be seen by the pilot with little or no parallax. To meet this very important requirement, the FAA also has specific limits as to how far to the left and the right of the pilot's yoke certain instruments can be mounted. We call this the primary cone of vision. It's important to realize that some electronic screens can only be seen if you're viewing them from an almost straight-on angle.
6. Be constantly aware of making the new panel as maintenance-friendly as possible. Mounting the whole thing with machine screws and nut plates, leaving "work loops" of extra long wire and plumbing leads allows instruments and radio stacks to be pulled out and unhooked from the front of the panel. Those are just a few maintenance-friendly and cost-saving features that come to mind.

At this point we need to address an important structural issue. Beech secured the original thin aluminum instrument panel overlay to the structural truss that held the piano key switches with a very minimal aluminum angle. In the interest of creating additional

The full height D'Shannon panel, cut to accommodate original piano keys and center throttle quadrant.



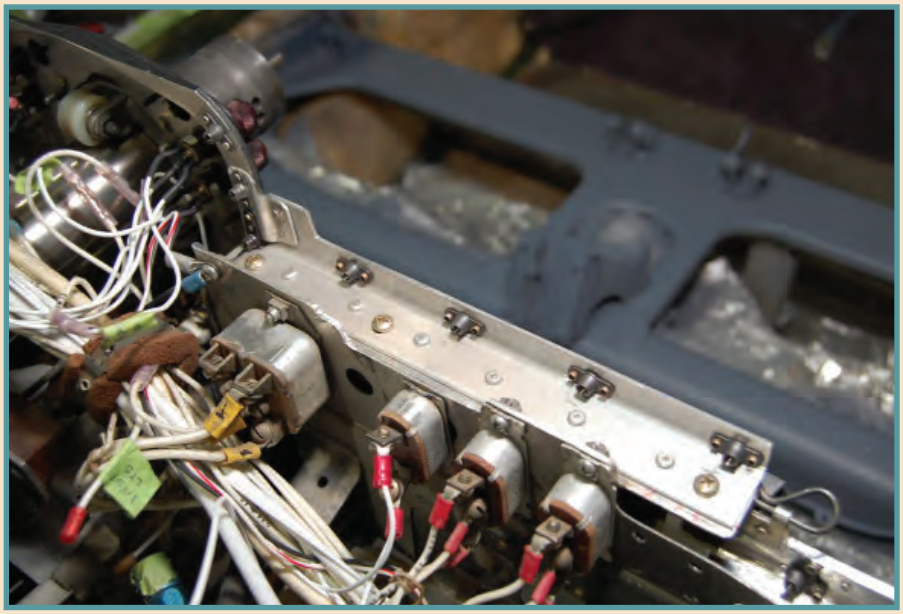
Instrument plumbing being installed with the flight panel out of the airplane.

strength at this weak point, we add a 1¼" x ½" x .125" 2024T3 structural aluminum angle secured to the original structure with both cherry max rivets and machine screws. This will ensure lots of structural integrity between the new panel and the original lower panel truss.

With the structural mountings in place we can temporarily install the hard-mounted fixed panel, shock-mounted flight panel, defroster and glareshield.

MULTITASKING BEGINS

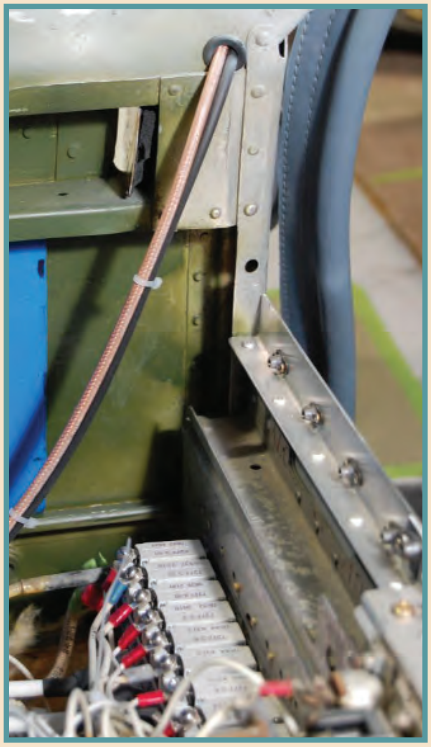
We begin by having every component on hand and holding each instrument, radio, dust cover and defroster hose in their respective locations, making sure all six contingencies on our multitasking list are met. As we made our way through this process on the panel, two very critical problems presented themselves.



Stronger mounting angle and nut plates (pilot's side).

First was that the Garmin 530 would have to be high enough in the center of the main fixed panel to clear the behind-the-panel radius scissors control linkage. This meant that we would be able to mount only the two 3⅛" tach and manifold-pressure gauges above this large screen. It was possible to build the whole panel taller, but we had initially sat customer Rob in the pilot's seat to determine the maximum height that he would be comfortable with. Well, we had to cheat a little as it was, so after several phone conferences we decided to give up on the original design concept and move in the direction of one long single row of engine instruments located above a shortened radio stack.

A complication in this design change involved the original non-sloped windshield structure. As built, the location of the M35 non-sloped windshield lower hat structure allows for about 10" clearance between the top of the new panel and this immovable hat section. Here is the frustrating part – we needed 10¼". So that eliminated our idea of mounting the 530 close to the top of the center section of the fixed panel.



Copilot lower panel mounting angle and nut plates.

Always leave enough space between components to allow for the option of a future replacement of an instrument with one made by a different manufacturer. As hard as the industry has tried to standardize the dimensions of these instruments, variations do occur.

The other consideration that had to be included in this fitting process was the glareshield. Initially, in the classic spirit of this project, we wanted to retain the original non-sloped two-piece windshield. It soon became obvious that with the additional height of the new panel, the glareshield-to-windshield clearance could be an issue.

Since we were pushing the dimensional envelope in almost every direction, our Plan B was to install a speed-sloped windshield conversion. The sloped windshield modification does move the windshield forward enough to give us the glareshield clearance we needed. But we still had to extensively modify the speed-sloped windshield glareshield. More on that later…(One must always be prepared to compromise.)

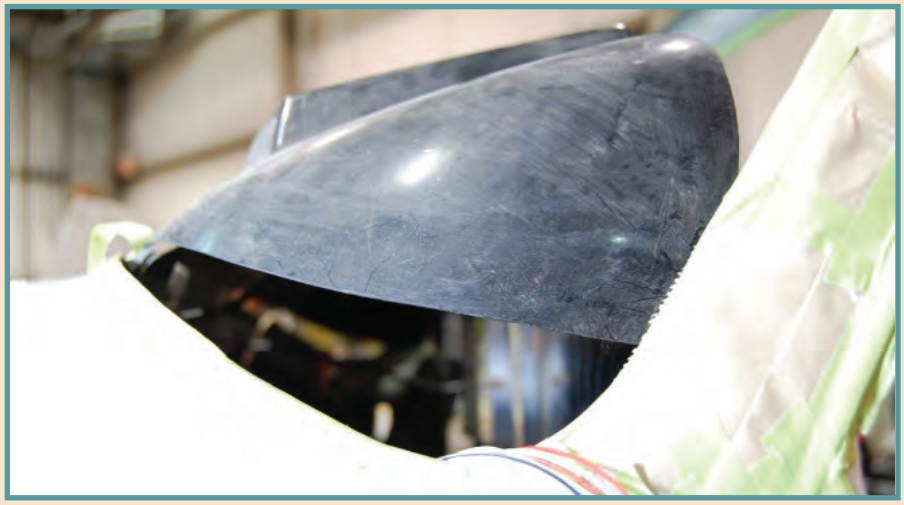
FINAL LAYOUT OF COMPONENTS

With the glareshield issues resolved, it was time to start the final layout of the instrument and component locations. We started by laying the new panel components flat on a workbench and physically positioning the various instrument templates on the surface of the new panel. We are very careful to check for behind-the-panel spacing, as well as lateral and vertical clearance between each instrument.

Here's something else to factor into this layout process: Always leave enough space between components to allow for the option of a future replacement of an instrument with one made by a different manufacturer. As hard as the industry has tried to standardize the dimensions of these instruments, variations do occur.

In light of this reality, I would allow an extra ⅛" of clearance on all sides of every instrument. Horizons and directional gyros are of particular concern. What if you decide to replace a directional gyro with an HSI? Most HSIs are larger than a directional gyro. Extra clearance can save the day.

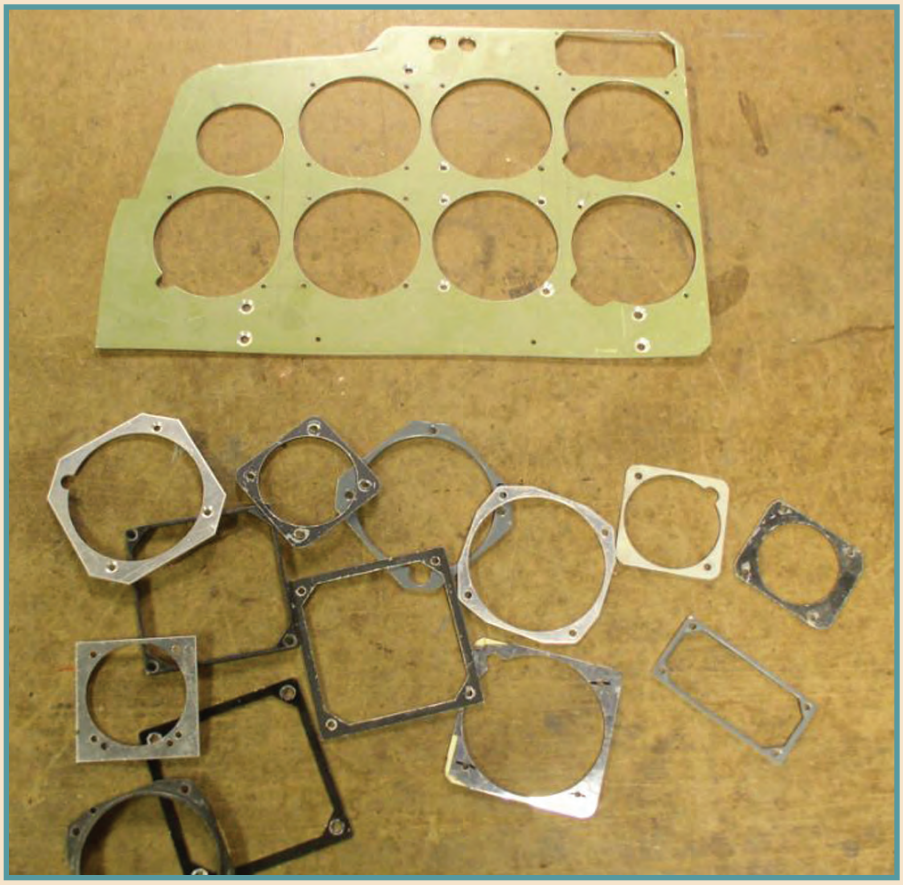
Limited clearance between the upper fixed panel and the original windshield frame.



Not enough clearance for the glareshield and the non-sloped windshield.

Using precision cut instrument patterns to accurately lay out the fixed panel.

USEFUL TIP: Never throw out an old instrument panel. We cut them up to create accurate instrument and panel component templates. The old holes are already perfectly cut, so all one needs to do is use the instrument as a template to outline the component's footprint. With this perfect pattern, just shear along the scribe line and "Voila!" you have a precision pattern of the components.



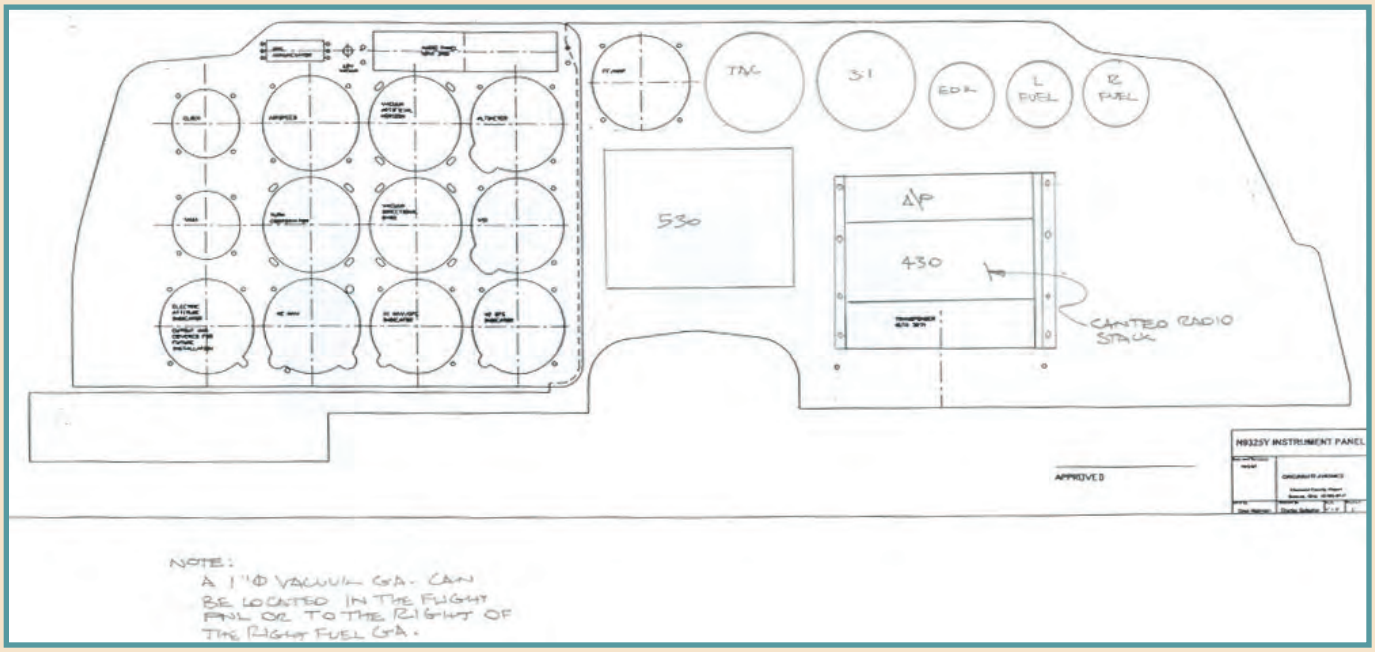
Precision instrument patterns cut out of an old panel.

After a couple days of measuring, moving and phone conferencing, we had a design that Rob liked and that functioned for him. As I stated earlier in this series, this was a very nonstandard installation. We had to do a lot of, as we say in the business, "cutting to fit and wiring to work."

SOME SPECIAL DETAILS

The layout of the shock-mounted flight panel was fairly straightforward. The only unique detail was locating the switching panel *above* the horizon, something we had done several times because many owners like having the marker beacon and radio switching right up front. This also helps keep the height of the traditional canted radio stack as low as possible. We also cut holes for the future installation of an electric backup horizon and circuit breaker.

In the fixed panel below the shock-mounted flight panel, we installed (from left to right) the radio master switch; a backup avionics buss tie circuit breaker that can be pushed close to supply power to the avionics buss in the event of a radio master-switch failure; and then the autopilot and electric trim power switch. Finally, we installed the glareshield lights rheostat and selector switch.



Final panel design drawing. Third time's a charm!

Primary radio and glareshield lighting controls and avionics breakers.

All the main ship's buss circuit breakers are laid out in one accessible location.

Another switching detail worth doing is to convert an unused piano key to the pitot heat switch. I have never understood why Beech installed the pitot heat switch in a little add-on bracket stuck below the subpanel truss.

As panel layout and fitting projects go, this one had its issues. I feel the results are worth the effort and Rob got everything he wanted. The result was a panel where all the flight instruments are where they should be; his primary nav screen as close to the flight instruments as possible; all the engine and fuel gauges logically located in one place; and the electrical and vacuum monitors right in his basic IFR scan. Included was a pullable circuit breaker for each electrical circuit, logically laid out in an easy-to-access panel, plus future spaces for additional breakers and switches.

CUTTING HOLES

With the panel layout confirmed, it was now time to begin the process of cutting all the radio and instrument holes. In the good old days, we would cut these holes with fly cutters and files. Today, it's a whole new world. We partner with Cincinnati Avionics on panel projects, and have them create a very accurate computer-generated drawing of the entire panel.

After the drawing is approved by the customer, this data is loaded into a numerically controlled milling machine that will magically machine-cut perfect holes. This process increases quality, saves time and money, and looks great. Another advantage of this computer-controlled system is that it allows us to quickly make a test-cut in .040" aluminum to confirm any tight clearances we may encounter.

MORE TO COME

While the panel drawing and cutting is being done, we continue with wiring, plumbing and insulating, which will be covered in detail in the next segment. Until then, fly safe!

Dennis Wolter is an A&P, IA and a 3,000-hour instrument pilot who started Air Mod in 1973 to bring innovative design and high-quality renovations to the general aviation market. Dennis has a degree in industrial design from the University of Cincinnati.

The NC milling machine at Cincinnati Avionics cuts very accurate instrument panels and holes.