

## PANEL MODIFICATIONS - PART II

# DINOSAURS, DUMPSTERS & DOLLARS

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As I mentioned in Part I, building a new instrument panel in an old airplane can be done on many different levels. You can choose to do a bare minimum of work installing a new panel, or you may choose to go for broke and upgrade everything: circuit breakers, electrical monitoring systems, engine instruments, fuel gauges, panel and switching. The sky is the limit.

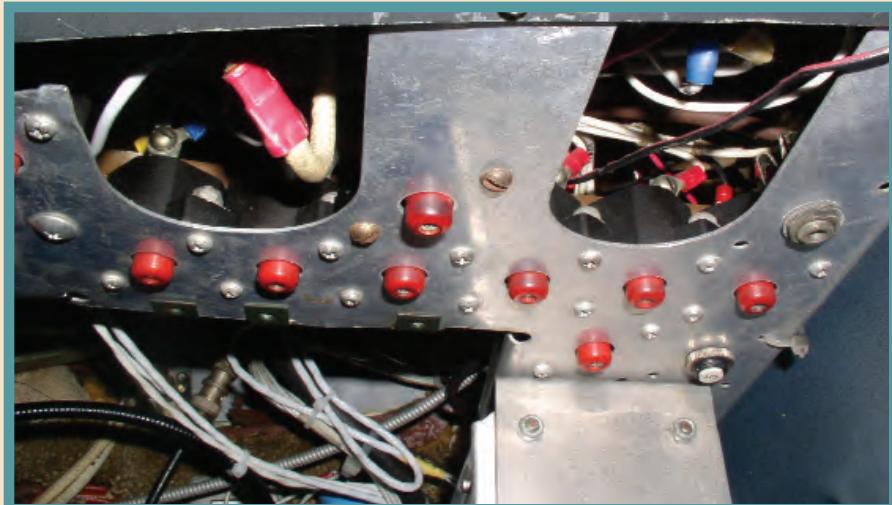
The bare bones installation of the various panel design options was discussed in last month's article. But very few owners choose to do a panel installation on such a minimal level. Moving beyond bare bones, we get into the "should-also-do" items. Some choices are based on condition, and some are a benefit vs. cost issue.

### CIRCUIT BREAKERS

Beech used two types of circuit breakers in the old panels. First is the red button, non-pullable, manual-reset type, some of which were mounted behind the trap-door cover located at the lower right side of the panel. Some airplanes even had a second hidden breaker panel under the right side of the subpanel.



Non-pullable original circuit breakers in an M35.



More original breakers hidden under the copilot side of the instrument panel.



Hidden automatic reset (mostly hidden) on the back side of the glove box.

As for the second type, Beech went so far as to install totally hidden, automatic reset circuit breakers. These wonders were mounted on the backsides of glove boxes and other structural components behind the panel. Once tripped or opened, they were supposed to automatically reset or close after a cool-down period, thus restoring the flow of power to whatever device they were protecting.

They probably were OK when new, but Old Man Time has taken a toll on these bad boys. Once tripped, they would often only partially reset, or worse, not reset or close at all. Talk about mysterious electrical issues. Curiously enough, these are the same circuit breakers found in my childhood Lionel electric train transformers. (Woo-woo!)

The point is, if you are really interested in a truly functional panel upgrade, you should install new Klixon or Potter Brumfield high-quality pullable circuit breakers that allow you to proactively manage your electrical system. More on this in a future article.

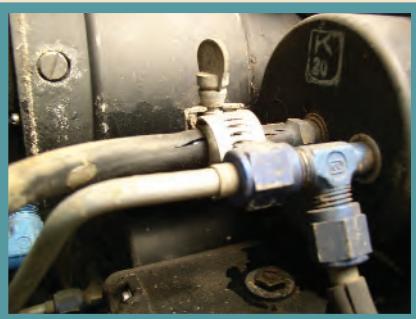
### STATIC SYSTEM

The second consideration in this should-also-do group is the static system. Beech originally used good-quality aluminum tubing, aluminum AN fittings and rubber flex hoses to plumb the pitot static systems in these older airplanes. Time and bad maintenance have made these systems suspect.

The photos tell the story. You need to be prepared to re-plumb this system properly. We like to avoid using Tygon



Re-worked circuit breaker panel with pullable Klixon mini circuit breakers.



Original well-aged pitot/static plumbing in a B35.

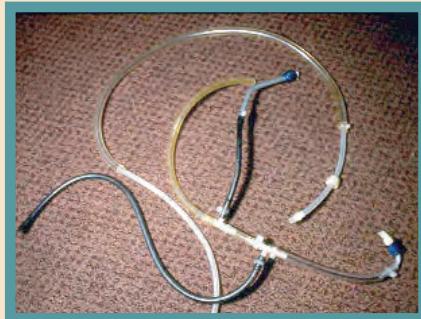
plastic tubing and fittings and stick with aluminum lines and AN fittings. I'll cover this in a future article as well.

## GEAR-INDICATOR LIGHTS

On a panel mod that leaves the throttle quadrant and piano keys intact, there is another issue that is a good also-do item. I refer to those hard-to-see, difficult-to-service flap and landing-gear indicator lights. You know, the ones with the surgical rubber tubing holding the bulbs in from behind the panel.



New Dialco front serviceable dimmable gear and flap indicator lights.



This eclectic collection of approved and non-approved pitot/static plumbing came out of a B35.

Throw those feeble things in the dumpster and replace them with FAA-approved PMA'd Dialco push-to-test, dimmable, front-serviceable indicator lights (available from Aircraft Spruce). You can see them in bright sunlight, dim them for night operation, and you can easily change the bulb from the front of the panel—convenience as well as a safety enhancement.

## FUEL & ENGINE GAUGES

The final should-do item worthy of serious consideration is to replace the original (no longer available) fuel and engine gauges. The fuel gauges can be replaced with Mitchell fuel gauges that



New Mitchell fuel gauges and AIM 3-in-1 oil pressure, oil temperature and cylinder-head temperature gauge.

are compatible with original Beech fuel senders.

Next is an R.C. Allen 3:1 engine gauge that replaces three old gauges: oil pressure, oil temperature and cylinder-head temperature. If your budget allows for installing these current-production, FAA-approved, serviceable components, I think it just makes good sense to do it.

## AND THEN THERE ARE SAFETY ITEMS

There are some very important safety enhancements to consider. First and foremost is a *back-up electric attitude indicator with a slip-and-skid ball*.

After many years, the FAA has finally allowed us to replace the turn coordinator with a life-saving electric horizon. Not many pilots are good enough to shoot a needle & ball approach in actual IFR conditions in a Bonanza. Sorry, but it's true; studies have been done that verify this eye-opening reality.

If the money isn't available when your new panel is being installed, make some provision for the back-up horizon to be installed in the future. But definitely plan on it!

The second important safety feature is to install a *low-vacuum or pressure warning light located near the horizon*. You need to know the instant your system fails. Often, by the time the horizon has spooled down to the point that it is beginning to present false information, you are already entering into the initial stages of an inflight upset. In a high-performance, fast, powerful airplane like a Bonanza, this quickly becomes serious.

Another benefit of a low-vac warn-



Electronics International VA1A digital volt amp meter with warning lights.

ing light is the fact that it might give you a heads-up on an impending vacuum pump or regulator failure. If the light usually goes off at 900 rpms, and it suddenly takes 1,100 rpms to extinguish it, something has changed in the system. Check it out.

The final safety enhancement I recommend is a *good electrical-system monitor*. I think the information provided by an amp meter in monitoring the health of your electrical system is little more than confirmation that your alternator or generator is working.

So for my money, I recommend installing an Electronics International VA1A digital volt-amp meter. This little jewel shows voltage or amperage flowing between the alternator or generator and the main electrical buss. As an added bonus, an amber warning light comes on if the voltage drops too low, and a red light illuminates if the voltage goes too high. This is a tremendously helpful troubleshooting and warning system.

I like to mount this instrument somewhere near the basic flight instrument group, up front and in your face. Electrical failures are serious business when flying IFR. You need to know about such an event immediately!

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Six Beech Bonanza and Baron cockpit lighting options.

## PANEL LIGHTING

This instrument panel design and modification article would not be complete without discussing panel lighting. Anyone who has attended Adrian Eichhorn's wonderful night-vision seminar will appreciate the value of good instrument and cabin lighting.

Currently there are six lighting options. Usually a complete instrument panel upgrade will include two or three of these.

The first system is the *good old floodlight*. The original panel lighting in older Bonanzas consisted of a two-bulb red-lens floodlight installed in the overhead speaker cabinet. This minimal system had two major flaws. One is that we become less sensitive to red light as we age. The second drawback is that, being three feet away from the panel, the light illuminates almost everything but the panel and the instrument faces.

The idea is to put as little light as necessary as close as possible to the instrument or control panel. (The ideal situation is internal back-lighting built into each component, but cost and com-

plexity have kept this from being a practical option.)

The second system is to install a regimen of *small incandescent light bulbs in a reflective rack* mounted under the glareshield. Here at Air Mod, we like installing a combination of red and white bulbs with a selector switch, a rheostat and a dedicated circuit breaker. It's important to wire each lighting system to its own dedicated circuit so if one should fail the other will still function as a backup.

Having both red and white lights enhances your night-vision experience. When flying VFR at night, red panel lighting not only provides adequate illumination for your instruments but also does not degrade night vision as much as white light, increasing your ability to spot and identify other inflight traffic as well as faintly lit ground details.

When flying IFR, your world is your instrument panel. In this case, the white lights best illuminate instrument information, especially for older eyes. Since outside traffic would not be seen anyway, the retina over-stimulation caused by the brighter white light isn't a factor. And if a lightning flash would occur near the airplane, white instrument lighting will greatly reduce the time it takes for your eyes to recover from the flash, allowing you to more quickly see your instruments.

**One advantage of post lights is that you can easily change a burned-out bulb from the front side of the panel. If you already have post lights, keep them.**

Back to old technology, let's talk about *traditional, easily serviced post lighting*. I still like them. Properly installed and with a little maintenance, post lights can be very reliable and do a good job of lighting each instrument. To enhance reliability, we install a ground harness on the backside of the panel. This eliminates the often flaky ground created by relying on the brass post-light housing, hoping to get a good ground from the aluminum panel. (Remember, dissimilar metals equal corrosion, and corrosion causes electrical resistance.)

Another advantage of post lights is that you can easily change a burned-out bulb from the front side of the panel. If you already have post lights, keep them.

Moving up the food chain of instrument lighting, we get to *light rings*. These are the translucent plastic rings that back-mount between the instrument and the instrument panel. These work great and very precisely illuminate the instrument face only.

The only potential drawback to light rings that I see is having to replace a burned-out bulb. Unlike a post light, you will have to remove the instrument

and install a new \$40 or \$50 ring light, as opposed to simply installing a \$1 or \$2 light bulb in that front-serviceable post light. Having said that, I do think the reliability and cleanliness of installation makes ring lighting an attractive and functional option.

## INTERNAL LIGHTING

Now for the big banana. In my opinion, *internal lighting* is the most effective way to light an instrument or control panel. The down side is the initial cost as well as the cost of repairing or replacing this type of lighting. The instrument must be removed and often disassembled to access the lighting.

In later years, Beech employed an internal lighting design that can be serviced without having to open the instrument. They added a translucent light bezel with a small, two-bulb \$40 light tray, held in place on the top-side of the instrument by two small screws.

The final player in the instrument panel light game is *auxiliary lighting*. We often install independently powered FAA-approved dimmable gooseneck map lights, great for reading charts. In the event of a panel lighting failure, you

can aim one of these lights at your instrument panel. Sure beats flying an approach with a flashlight in your mouth. (Been there, done that.)

One last piece of advice about instrument panel lighting. I do not recommend any form of *electroluminescent lighting*. I'm referring to the internal glowing subpanel lights common to 1970s and newer Beech airplanes. Powered by a 110-volt alternating current inverter, keeping these lights working in older airplanes can be troublesome. Trust me; keep it simple.

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So now you have my overview of panel mods and options in older Bonanzas. In the next article we will tear into an M35 project we did that included some of this new glass equipment. We will cover a lot as we follow this project through to completion.

Until next time, fly safe.

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Typical gooseneck light and dimming rheostat installation in the pilot's armrest of a G35 Bonanza.