



BY JULIE K. BOATMAN

A new spark

Upgrades
to your
Cardinal's
electrical
system

An airframe lasts a long time, if it's maintained with care. But besides the spar, ribs, and skins, a lot of moving pieces and critical connections go into even the lightest of light airplanes. Aircraft systems age along with the metal and composite structures enclosing them. And when it comes time to refurbish or restore your airplane, you must do so with an eye to vital areas such as the fuel system, the pitot-static system, the environmental system, and (if you're so equipped) the electrical system.

The same holds true for your 1977 Cessna 177B Cardinal that we're waist deep into refurbishing for AOPA's 2007 Catch-A-Cardinal Sweepstakes. As our team in Griffin, Georgia, delved into the airplane, each system underwent a thorough inspection, led by our chief inspector Danny Rexroad. Most areas held up well under the microscope, especially when viewed through the lens of the airplane's three decades of service.

But some components have been replaced in production aircraft over the years with better materials and solutions. For example, the Cardinal's ventilation system uses two- and three-inch-diameter tubing to route air from the fresh air

scoops to the cabin vents, and this gets brittle over the years. Plus, the black *cat* tubing, made from fiberglass-coated neoprene rubber, has been replaced in new-generation aircraft with orange *scat* tubing (the S stands for *silicone*), which stands up better to the moisture of condensation inherent to such systems. When we put your airplane back together, new scat tubing will handle the job, and help minimize the possibility of corrosion near the main spar.

Once the efficient team from Air Wrench pulled the Cardinal's floorboards and instrument panel, on-site project manager Dan Gryder, of The Av-Net, saw a big place for improvement—the electrical system's hundreds of feet of wiring, piles of connectors, and rows of well-used switches and circuit breakers. In conjunction with our avionics installation folks at Sarasota Avionics International, he'd address the components clearly ready for retirement after years of dedicated service. In fact, we promptly decided that we would take the opportunity to replace the airplane's entire wiring scheme.

With our level of restoration, what good would a new panel be without new wires to faithfully deliver the juice?

Gryder's talent for strategizing the overhaul of aircraft electrical systems and developing innova-

The team lays out the panel for the Cardinal: (left to right) Bill Koens, Arleigh Yeomans, Danny Rexroad, Dave Clarke, and Dan Gryder. Yeomans (below) mocks up a template for the pilot's side.



day. And depending on the way your system is wired, a single component failure could bring

tive panel layouts took shape during the restoration of a Cessna 210 that he undertook 12 years ago, and hit full stride as he envisioned the best possible changes and updates for our sweepstakes airplane. And these are concepts that you can put into play should you ever want or need to refurbish the central nervous system of your airplane, and take it into the future with the latest safety advances.

The essential bus

If you just hop into the newest Cessna off the line—or Cirrus, Diamond, or Mooney, or virtually any new IFR-certified airplane—you may not notice the electrical system improvements underlying all the flashy avionics. One of the most important has to be the inclusion of an *essential bus*, which is a separate bus within the electrical system that ties together a handful of the most critical devices and powers them through a second source—or in our case, a second set of wires that bypasses the battery relay, in the event that relay opens or a complete short to ground of the main DC bus results in high current flow.

Case in point? Everyone who's had an engine failure, raise your hand. OK, how about everyone who has had some piece of electrical equipment fail (whether it was the clock or the alternator or something in between)? I know the electrical gremlins carry the

down the whole system. We have batteries to carry emergency loads, but, the way the Cardinal was previously built, if a complete short to ground occurs in the main bus, all the battery power in the world won't power your nav/coms. The Cardinal didn't come with a separate essential bus—no aircraft of its class built in the 1970s did, to my knowledge. We're upgrading this Cardinal.

In designing the essential bus, Gryder took into account the crucial tools that a pilot needs to get on the ground safely in instrument conditions and in air traffic control contact. So the bus on your Cardinal includes the number-two Garmin GNS 430 (with both nav and com capability, plus a moving map), the GTX 330 transponder (so you can get vectored onto an instrument approach—a great workload-reducing technique), the Honeywell Bendix/King KI 525 horizontal situation indicator (which includes both a directional gyro and your number-one nav indicator), and the Castleberry Model 300-14EL electric backup attitude indicator.

The HSI also has a separate switch, so it can be isolated if it's the culprit—the HSI is a relatively high-current-

Tools from the trenches

When to wire? Three clues

1. You're installing new equipment.

Any upgrade in the radio stack typically means a new wiring harness for that component. This isn't window dressing—it actually saves money in most cases, because the cost of the new wire is cheaper than the labor cost to trace and reuse the old wire.

2. You find evidence of aging or degradation of the wiring.

Wiring is installed with an eye toward eliminating any chafing points—but maintenance in other areas, and environmental effects, such as vibration, can cause wires to migrate and rub in places. Also, if corrosion sets into a wire, it can rapidly run the length of that wire, although this situation is rare.

3. You're embarking on a detailed restoration.

Modern aircraft electrical systems come with copper-core wire rather than aluminum-core wire. Copper-core wire conducts better, so a thorough refurbishment of the system might change out the wiring for this reason, in addition to those listed above. —JKB

draw item. The other hungry component is the transponder (when it's being interrogated), and it can be turned off through the power switch on the unit, as can the 430—which draws fairly little current unless you transmit.

So if you're flying our Cardinal and the panel goes dark, with the flip of a switch to energize the essential bus you're in business again. You can elect to do the same electrical system upgrade with your airplane; at this point, you'll have to go through a field approval process, as we are, to accomplish it.



Featured contributors

Precise Flight

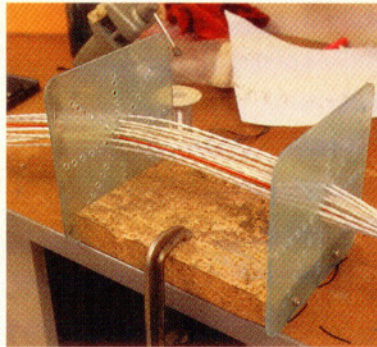
Essentials for safety and performance—that's the foundation upon which Precise Flight, based in Bend, Oregon, was launched in 1980. Since then, the company has developed several well-targeted products for the general aviation market that address specific safety concerns. Two of these innovations are part of our sweepstakes package this year: the PulseLite system and a portable Precise Oxygen system. "Many pilots are out there flying hypoxic and don't know it," says company spokesman Steve Crenshaw (see "Big Gulps: How Not to Become an Oxy-Starved Moron," February *Pilot*).

In addition, Precise Flight creates SpeedBrakes for several popular singles and its latest foray into improved aircraft lighting, the PreciseLite HID (high-intensity discharge) landing and taxi lights. Visit Precise Flight's Web site (www.preciseflight.com) or call 800/547-2558.

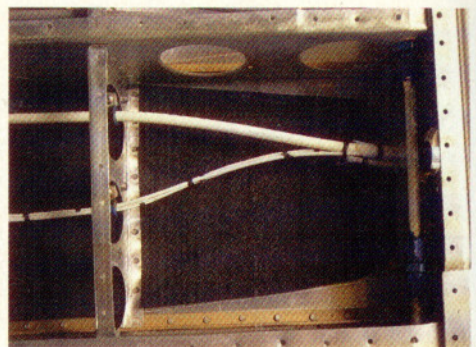
Cobham, plc: Comant and Artex

You may not have heard of Cobham, but chances are you've flown with at least one of its products—such as the Comant antennas and Artex emergency locator transmitter (ELT) installed on the Cardinal. Cobham, based in the United Kingdom, is an international company engaged in the development, delivery, and support of advanced aerospace and defense systems.

Comant Industries, of Fullerton, California, in the antennas division, creates an entire line of navigation, communication, and datalink antennas for general aviation, including the VHF com, transponder, and marker beacon antennas for the Cardinal. Artex, of Aurora, Oregon, in the avionics and surveillance division, designs and manufactures next-generation ELTs, such as the ME406, a small-footprint ELT that transmits on both 121.5 and 406 MHz. Visit Comant's Web site (www.comant.com) or call 714/870-5133. Visit Artex (www.artex.net) or call 800/547-8901.



Technicians block out sections of the avionics harness on the bench (above left); wiring bundles string neatly under the floorboards—the installation made easy with the airplane's interior removed.



Stamp it out

Another think-ahead item on the Catch-A-Cardinal aircraft involves the many bundles of wiring used to power all the cool stuff in the panel and throughout the airplane. Aircraft wires are required to be easily identified so that technicians can locate the correct wire for a component. Typically, on an aftermarket avionics installation in light aircraft, most shops label new wires in a couple of places along their length.

With your airplane, we're taking the concept a step further and doing what manufacturers of production aircraft do now—we have used a wire-stamp device to permanently mark each wire at periodic intervals along its length. Sarasota Avionics has this capability, and it means that down the road, a technician can identify any wire on the airplane in seconds, at virtually any station on its length. The time savings and increased accuracy during maintenance that this makes possible will be a boon to our winner.

You'll be able to see the electrical system upgrades as we showcase the airplane at the Sun 'n Fun Fly-In in Lakeland, Florida, from April 17 through 23. The avionics gurus from Sarasota will be there to answer your questions, along with engineers from Cessna, and a host of other contributors to the project.

It all goes together

Those wires extend to the far reaches of the Cardinal, connecting other new safety systems from the nose to the tail.

From Precise Flight we were thrilled to receive its latest PulseLite landing light system, complete with supplemental type certificate for the Cardinal. The PulseLite system flashes the landing and taxi lights in unison to create an eye-catching display in the air that's hard for other pilots to miss. Because these lights are located adjacent to each other in the nose, our hard-working

avionics team figured that we would pulse them together, rather than alternated, for the most dramatic effect. The system also can be set to respond to traffic alerts from the Garmin GDL 90 ADS-B (automatic dependent surveillance-broadcast) datalink system.

Adorning the wing tips and tail are brand-new strobes from Whelen Engineering, and an LED-lit rotating beacon. The LED (light-emitting diode) system features longer bulb life and greater visibility than stock systems. If

Who's behind us?

Classic Aircraft Maintenance's Danny Rexroad

When Danny Rexroad retired from his career as a mechanic, inspector, and quality assurance auditor for a major airline and 26 years in the Naval Air Reserve, it opened up his schedule so that he could concentrate on what he really enjoyed: taking care of GA airplanes. Of course, we're making great use of his talents as an inspector and parts manager on the Catch-A-Cardinal project.

Rexroad, based at the Newnan Coweta County Airport in Newnan, Georgia, is a single-engine Cessna specialist, who has on his client list a variety of airplanes for which he is responsible on an ongoing basis. "I really like the 206 on down," says Rexroad, who owns and flies a 1966 150F. Rexroad also has considerable experience overseeing the maintenance programs on a couple of very special Douglas DC-3s.

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CONTACT

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you fly in congested areas, these are two great improvements to make to your airplane.

Not to be missed, if you look on the belly and the top of the Cardinal, you'll see a host of new, low-profile antennas, provided to the project by Comant (see "Featured Contributors: Cobham, plc: Comant and Artex," on page 114) and Garmin. With the airframe open for business, precise installation of the antennas was easy—and during removal of the old antennas, we found the GPS antenna had been improperly bolted to the airframe.

With all of the groundwork completed, the panel stands open for the installation of the flight instruments and avionics stack—and you'll like what we've chosen, because they are among the favorites you have reported to us at *AOPA Pilot* over the years. **AOPA**

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▶ *Links to additional information about the Catch-A-Cardinal sweepstakes may be found on AOPA Online (www.aopa.org/sweeps).*

INTERACTIVE ▶

AOPA PILOT ONLINE



See photos from the avionics wiring process, the Nuvite treatment of the firewall, and the latest updates to AOPA's 2007 Catch-A-Cardinal Sweepstakes aircraft on *AOPA Pilot* Online.

www.aopa.org/pilot/sweeps0704