

Aero SUV



1999 sweepstakes

Take the long view of AOPA's 1999 sweepstakes airplane, the Aero SUV, and you'll see that there are few truly groundbreaking technologies introduced by way of the airframe modifications or the engine installation. But come around to the front door of the Aero SUV and gaze upon the brand-new instrument panel. There, you'll see genuine improvements in ergonomics, utility, and capability. What's

Panel Fancy

Making the most of tomorrow's avionics technologies

BY MARC E. COOK

more, our substantial avionics redesign comes with ample precedent. Today's high-end sport-utility vehicles (SUVs) are packed with modern amenities including GPS-based navigation systems, built-in cellular telephones, entertainment systems to soothe the savage adolescent, and computer-driven engine controls that allow some of these truck-based utes to meet ultra-low emissions standards. Having been lavishly equipped with the newest electronics, the Aero SUV is in good company. ■ Our goals for the Aero SUV's avionics rework were straightforward: to tweak the instrument panel layout for improved utility; to fit the very latest in avionics; to eliminate the irksome plastic overlay by using a new, all-metal panel;







Amazing, isn't it, the transformation possible with an infusion of new technology and old-fashioned hand labor? The stock Cessna panel (left) is reasonably well laid out, but the Aero SUV's new arrangement is far easier on the pilot's scan.

ing in installation work.

As the Aero SUV was undergoing airframe refurbishment in Santa Maria, California, the Kieszes began planning the avionics installation. We decided to make useful but not radical changes to the Cessna's panel layout. A 1976 Cessna 206, like the 182 and 210 of the period, has the pilot's-side instruments centered one hole to the left of the yoke shaft. As a result, the attitude indicator and directional gyro are not in the center of the pilot's view; the altimeter and vertical-speed indicator are there instead.

In the panel rework, Airborne moved the attitude and horizontal situation indicators to the positions immediately above the yoke shaft. Squeezing the sacred six to the right opened up much space to the left and helped the main instruments move more sensibly into the pilot's scan. In addition, the reorganization helped to reduce the scan distance from the main panel to the radio rack—an important factor, given the dual moving maps we had planned for that space.

Randy and Rich accepted our suggestions and produced a preliminary layout. Using a first-generation CAD program—or, as Rich calls it, “cardboard-aided design”—the brothers positioned the instruments for a minimum amount of wasted space and in accordance with our desires to snug up the gyro panel in front of the pilot. They managed to clear enough room for a trio of 2.25-inch holes immediately left of the turn coordinator. A rectangular cutout was designed to house a backlit switch panel, and other cutouts were placed for the autopilot's remote annunciator panel and the ELT controller.

On the right side of the panel, the Kieszes left well enough alone, positioning the Cessna engine instruments in essentially the standard locations and making room for a J.P. Instruments Slimline supplementary tachometer display. Among the better ideas here: Rich's trick of cutting circular holes in the panel through which the stock Cessna cluster peeks. With this, the instruments look more modern and fit into the overall styling scheme without the expense of finding up-to-date replacements.

Laying out the panel was easy. Building it was not. Airborne started with sheets of 0.125-inch-thick aluminum and cut and filed them into

and to fit these new toys with an eye toward serviceability. In addition, we wanted to have the best of both worlds with this avionics package—the latest in features mated to proper redundancy for in-flight safety and high dispatch reliability. After all, if a primary component rolls over and dies in the backwoods, you'll still want to be able to fly out to get it fixed. These intertwined requirements dictated the choice of components and their

placement in the panel.

In many ways, choosing the right installer is as important as picking the right radios. We scored extremely well with Airborne Electronics in Sacramento, California. A family operation started in 1976 by father Nat and son Randy Kiesz, Airborne Electronics began by emphasizing radio repair over new installations. That started to change when Randy's brother, Rich, came aboard, specializ-

MIKE BEZIER

shape. A big part of Rich's panel design is a measure of softness, perhaps best described as a more organic shape than that of holes with sharp edges stamped in metal plate. All of the cutouts where the instruments meet the panel are slightly radiused, as are the screw holes. In concert with the off-white, powder-coated finish, the panel is more akin to a Lincoln than to a Boeing.

Behind the panel, the basic Cessna structural members remain, but little else does. Major surgery removed every bit of unnecessary metal; new reinforcements and panel pickups were fabricated and installed. That the basic layout is much like that of a stock 206 disguises the tremendous amount of work that went into making it look this way.

Many of Airborne's cleverest touches are not even evident from the pilot's seat. There are numerous sub-assemblies that help make the panel neater *and* easier to work on. Take the tip-tank fuel gauges as an example. Normally these Stewart Warner automotive gauges are installed through the front of the panel, leaving a conspicuously raised edge. Rich fabricat-

Life with the Garmin GNS 430

If public response is any indication, Garmin International has driven home a Greg Norman-style putt with the GNS 430. This all-in-one box contains not only a color moving map and an IFR-approved, 12-channel GPS receiver, but also a 760-channel com (selectable to 8.33 kHz spacing) and a VHF nav section with VOR, localizer, and ILS capabilities. It's a sophisticated, capable navigator and communicator that's set the avionics world on its ear. No matter how hard Garmin tries, it appears that it may be the end of the year before supply catches up with demand.

Our initial impressions of the 430 are overwhelmingly favorable. Despite its tremendous capabilities, the 430 is stone simple to use. Garmin has honed its operating systems over the years and the 430 shows the earmarks of long-term development. All of the main functions are easy to find and use, even those associated with GPS instrument approaches.

A main complaint of other GPS/com combinations is often that the transceiver takes a subordinate role to the navigator; many combi units require a button push or two just to get the active and standby frequencies on the display. Not so on the 430. Both the com and

VHF nav frequencies are always in view, and the main tuning knob—the large concentric pair at the lower left corner of the fascia—is always hot to the standby com. A single push of the inner button makes the nav standby active; after a few seconds, the entry field reverts to the com side. Com performance, at least on our installation with new antennas and coaxial transmission cables, is superb.

Garmin eschews so-called soft keys—buttons whose job changes within various sub-functions as depicted by on-screen menus—for permanent, dedicated function keys. Changing the moving-map range is as easy as jabbing the RNG toggle switch, for instance, and important functions like direct-to navigation, the nav-source selector, and the flight-plan filer all have dedicated buttons. So intuitive and clear are the functions that it's possible to begin working the GNS 430 without ever having lifted the manual.

A common complaint of IFR-approved GPS centers on difficult approach-setup routines. The Garmin couldn't be easier. There's a single button marked PROC that handles the setup and activa-

tion of all instrument approach procedures, VHF- or satellite-based. Hit that switch, and the 430 will walk you through the setup procedure. You can either have the destination as the final waypoint on a flight plan or as the direct-to waypoint. You'll be asked which of the available approaches you want, and then how you expect to get there—by the charted transition to a listed fix, for example,

ing map is a standout. Easily readable under all normal cockpit conditions, the map uses its multiple colors to good effect. It's amazing how much more useful is airspace depiction with color. Picking airports from VORs from topographic features is made almost shamefully easy with these graphics. We would, however, like to see Garmin divine a MOA from a restricted area by color; now, they're both painted green.



or by vectors. Not only will the 430 draw the approach on the vivid map, it'll clearly depict published holding patterns and procedure turns as well as the missed-approach waypoint and its associated holding pattern. Flying a full-procedure approach with a holding-pattern entry is stunningly easy with the 430. Better yet, the Garmin 430 is smart enough to auto-sequence you down the approach, so there's no need to tell it to hold as you track outbound on the racetrack. For its part, the color mov-

With the GNS 430, Garmin has well and truly upset the avionics applecart. It's fully worthy of replacing a conventional nav/com and loran or GPS in your stack—at 2.65 inches tall, it leaves behind 1.35 inches of valuable panel space from the typical swap—and is designed for simplified installation. You don't need external switching or annunciation, for example, and the 430 interfaces easily with most HSIs. The suggested retail price is \$9,250, but many shops are advertising the 430 installed at about \$9,000.

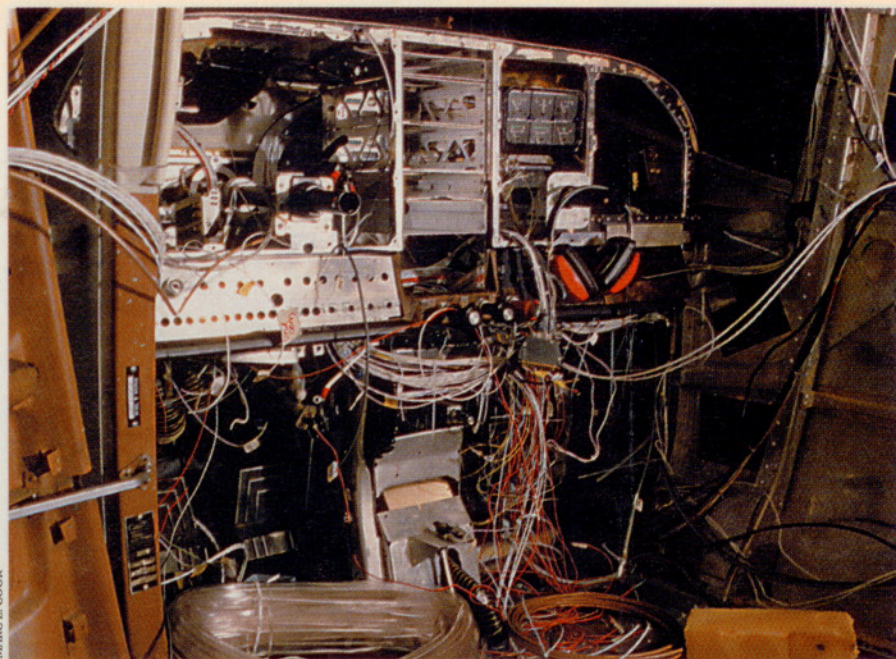
—MEC

ed a small sub-mount that stands the gauges away from the panel on the back side, allowing only the last one-eighth-inch to protrude; the transfer switches are incorporated into this assembly, which is in turn engraved and backlit. Rich won't admit to how many hours this kind of detail consumes, but his efforts are well worth it in the end.

Choosing the avionics that would be the centerpiece of our forward-thinking panel was actually quite easy. When we started the Aero SUV program, Garmin was just spooling up with the GNS 430, a stunning GPS/com with VHF nav capabilities and a color moving map. Had to have one. Correct redundancy calls for a secondary nav source, but Garmin doesn't yet make a conventional VHF nav/com. If we wanted to stay with an all-Garmin stack—and we did—then the logical choice would have been the GNC 300 XL, an IFR-approved GPS/com box. Somehow, putting all of the VHF nav eggs in the one GNS 430 basket seemed out of place in a ready-for-anything kind of airplane. That's why we took the arguably extravagant route and put two GNS 430s aboard the 206. (For more on their operation, see "Life with the Garmin 430," page 78.) Continuing to pull from the Garmin catalog, the Aero SUV also received the GMA 340 audio panel with six-place stereo intercom and the solid-state GTX 320 transponder. No DME, no ADF. Out with the old, in with the new.

The top-of-the-stack Garmin 430s drive another innovative piece of avionics, a Sandel SN3308 electronic HSI. (See "Pilot Products: Sandel SN3308 HSI," February *Pilot*.) This projected-image-LCD HSI is being hailed as a poor man's EFIS because it can do nearly everything an airline's glass can on a price tag amazingly close to that of a mechanical HSI. The Sandel is an impressive piece of work, able to take navigation information from both Garmins via conventional composite signals or through a newly configured ARINC 429 data bus. (Ours is wired both ways because of ongoing software development during the installation period.) Future installations will benefit from the flexible 429 network by a sharp reduction in wiring.

In addition to having its own database and moving-map software, the Sandel is capable of displaying information from the BFGoodrich WX-500 Stormscope. This is the first time



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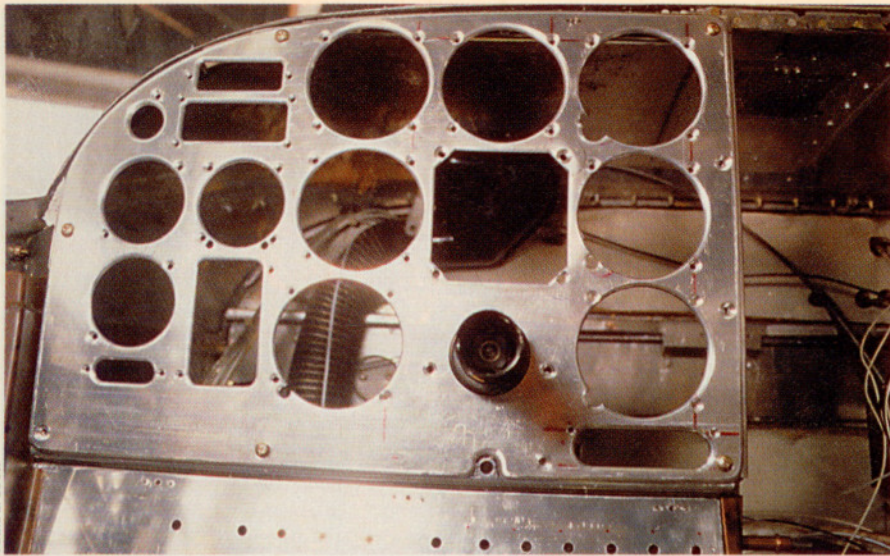
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For an upgrade of this nature, comprehensive stripping down must take place first. Rich Kiesz lays out panels by hand and cuts the majority of the portals with a simple fly cutter.

we've tried the 500, which is a "blind" box intended to present its data through another product. It is, essentially, the working guts of a WX-1000 without a dedicated display. It ports data to the Sandel through an RS-232 hookup shared with the HSI's data loader. Airborne installed remote switches for the WX-500's power and clear-display functions. We'll let you know how it works once summer comes around.

Because the Sandel is potentially a

single-point failure—if the bulb blinks out, the Sandel goes black—we planned carefully for soft, or non-mission-critical, failures. (Before you fret about this failure mode, consider that inside the Sandel there's some extraordinary software and monitoring dedicated to projector-bulb health. Our considerations might well be along the same lines as the Y2K scare turning suburban families into proto-survivalists.) In addition to the new Sigma-Tek attitude gyro—with



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Fabricated panels are test-fit before being sent out for finishing (top). It's this stage—filling and trimming and making sure the clearances are *just so*—that consumes so much time. Randy Kiesz (above) puts the Garmin GNS 430 through a burn-in on the bench; all of the major avionics were pretested this way.

integral vacuum-warning flag—we installed immediately beneath the turn coordinator the company's similar DG as a backup. Together with the number-two Garmin's dedicated CDI, the Aero SUV is perfectly legal and capable of IFR flight if the Sandel becomes inoperative. In fact, because the pilot's panel layout is so much improved, both the DG and the number-two Garmin's CDI are well within the normal scan.

Every traveling airplane needs a capable, trustworthy autopilot, and we've got a fine one in the S-Tec System 55. Essentially the same box used in AOPA's Ultimate Arrow sweepstakes airplane in 1997, the 55 is unusual in the S-Tec lineup in that it

has a vertical-speed-hold mode in addition to the normal altitude-hold function. It'll also track a nav indicator and perform coupled approaches. Because it's a totally electric unit—it gets roll information from the turn coordinator—the System 55 will not suffer from the loss of the ship's vacuum pump. And to make sure *that* is never an issue, an Aero Safe Guardian backup vacuum system is installed on the firewall. This electric motor spins a conventional dry vacuum pump and is controlled by a dedicated switch.

Because engine health in a single is a critical concern, we positioned the J.P. Instruments' EDM-700 engine monitor on the main panel. Most

installers stuff this instrument where the stock exhaust-gas temperature gauge came out, next to the manifold-pressure gauge; we wanted it right under the pilot's nose. With this installation, the winner of the Aero SUV will get all-cylinder (EGT) and cylinder-head temperature monitoring, as well as outside-air temperature, oil temperature, and fuel flow. After some careful calibration, our Aero SUV's fuel computer can predict how much the fuel truck will pump in to within a gallon of actual usage. That, and having 106 gallons' usable on board, helps banish fuel worries. Finally, the EDM-700 in the Cessna is fitted with JPI's internal data logging; its contents can be transferred to a laptop computer through a front-panel jack for nearly effortless trend monitoring.

While the Garmins and the Sandel HSI invariably earn the majority of the *oohs* and *aahs* on the flight line, it's the collection of other goodies that makes this airplane so relaxing to fly. Start with the Avionics Innovations' CD player/radio. Designed for rack mounting, the CD player appears to be quite robust and provides excellent audio quality to the Garmin audio panel/intercom. The inclusion of an AM/FM radio is a surprising benefit; you can listen to the ballgame in true high fidelity—try that, ADF romantics—or catch up on the day's edition of *All Things Considered*.

To keep track of both time and atmospheric conditions, we installed a Davtron M877 four-function chronometer and an M655 multifunction air-data computer. The M655 takes information from one of two ACK blind altitude encoders—each Garmin has its own encoder, one of which is shared with the transponder—and an underwing temperature probe to give you outside air temperature in Fahrenheit and Celsius, as well as pressure and density altitude. It's also got an internal voltmeter.

When you see the Aero SUV in person, you may not believe that the airspeed, altimeter, and vertical-speed indicators are all 1976-vintage originals. Indeed, The Gyro House in Auburn, California, so successfully overhauled and remarked the gauges that the only indication they're not new is the data tag on the back. Similarly, this firm overhauled the Cessna's manifold-pressure/fuel-flow

Aero SUV assistance

AOPA would like to thank the following companies that donated or discounted their products and services to refurbish the Aero SUV instrument panel or otherwise assisted in the project.

Avionics installation

Airborne Electronics
6365 Freeport Boulevard
Sacramento, California 95822
Telephone 916/428-3392
Fax 916/428-4366

Analog clock

Mid-Continent Instruments West
16555 Sherman Way A-1
Van Nuys, California 91406
800/345-7599 or 818/786-0300

Annunciators

Avionics International Supply, Inc.
1750 Westcourt Road
Denton, Texas 76207
Telephone 940/566-0035

Avionics: dual IFR-approved GPS/com/nav, audio panel/intercom, transponder

Garmin International
1200 East 151st Street
Olathe, Kansas 66062
Telephone 913/397-8200
Fax 913/397-8282
www.garmin.com

Circuit breakers, antennas, couplers

EDMO Distributors Inc.
Post Office Box 11878
Spokane, Washington 99211
509/535-8280

Control yokes (salvage)

Dodson Aviation
Municipal Airport
Ottawa, Kansas 66067
Telephone 913/242-4000
Fax 913/242-7312
dodson@avion.com

Electronic HSI

Sandel Avionics
2401 Dogwood Way
Vista, California 92083
760/727-4900
www.sandelavionics.com

ELT and dual altitude encoders

ACK Technologies Inc.
440 West Julian St
San Jose, California 95110
Telephone 408/287-8021
Fax 408/971-6879

Engine analyzer and fuel computer

J.P. Instruments
Box 7033
Huntington Beach, California 92646
800/345-4574 or 714/557-3805
Fax 714/557-9840
www.jpinstrument.com

Entertainment system

Avionics Innovations
2450 Montecito Road
Ramona, California 92065
Telephone 760/788-2602
Fax 760/789-7098
www.concentric.net/~aidave

Flight control system

S-Tec Corporation
One S-Tec Way
Municipal Airport
Mineral Wells, Texas 76067
Telephone 940/325-9406
Fax 940/325-3904
www.s-tec.com

Gyroscopic instruments

Sigma-Tek Instruments and Avionics
1001 Industrial Road
Augusta, Kansas 67010
Telephone 316/775-6373
Fax 316/775-1416
www.sigmatek.com

Instrument overhaul, remarking, and lighting

The Gyro House
2389 Rickenbacker Way
Auburn, California 95602
Telephone 530/823-6204
Fax 530/823-5875

Multifunction atmospheric computer, chronometer

Davtron, Inc.
427 Hillcrest Way
Redwood City, California 94062
415/369-1188

Screen printing (instrument panel)

D&K Specialties
11359 Sunrise Gold Circle, Suite B
Rancho Cordova, California 95670
Telephone 916/851-0282
Fax 916/851-0288

Weather avoidance: WX-500 Stormscope

BFGoodrich Aerospace
5353 52nd Street SE
Grand Rapids, Michigan 49588
Telephone 616/949-6600
Fax 616/285-4224
www.bfgavionics.com

gauge and marked our new Mitchell tachometer. In addition, The Gyro House added small lighting wedges to all of the instruments that were previously unlighted.

Hallmarks of Kiesz craftsmanship include backlighted lower panels cut from acrylic, painted, and engraved; they're all built by hand. And those nifty Beech-style circuit breaker/switches on the lower panel? Customized Potter & Brumfield pieces, not store-bought Raytheon bits. Fits and tolerances are computer-perfect, even though all the panels were made by hand. A good many airframe manufacturers could learn a thing or two from the almost painfully humble Airborne staff.

For that matter, we also learned a lot about a forward-thinking installa-

Be prepared to be wowed: General aviation is truly on the precipice of exciting new avionics technologies.

tion. First, expect it to take longer than planned. We could have put in another week just fine-tuning and troubleshooting. Second, don't be surprised to pay for some on-the-job training if your favorite shop is installing a particular radio for the first time. There's a lot to be said for familiarity. Third, and perhaps most important, be prepared to be wowed. General aviation is truly on the precipice of exciting new avionics technologies. Radios like the Garmin GNS 430 have helped to pave the way for ever-more-capable boxes to come. We doubt that many pilots, after flying with the 430 and the Sandel HSI, would willingly go back to steam gauges.

Perhaps it is appropriate, then, that a rugged airplane such as the Cessna 206 should be the vehicle to explore the wilds of future avionics, to blaze a trail over untrodden ground. It is, after all, what sport-utes do best. □

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