PART 2

DESIGNING YOUR PANEL

Here's what you could do with today's hardware.

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Figure 2. Vision Micro Systems' VM1000 engine monitor saves panel space and provides limit warnings and alarms.

Figure 3. Rocky Mountain Instrument's Micro-Encoder compresses many displays and functions into one unit.

Welcome back to our discussion on cockpit ergonomics. This month, we will apply ergonomic principles to a homebuilt cockpit in an attempt to build a better panel while saving money. We will use current technology only; glass cockpits come next month. The rules we will follow are:

1. Reduce the number of instruments, controls and switches;

2. Prioritize the placement of instruments, controls and switches; and

3. Make switches and controls distinctive.

Building an ergonomic panel is a little like losing weight; you know it's good for you, but some old habits might have to change. All I ask is that you read along with an open mind. Take what you like and discard the rest. Only you know your needs. It's your airplane, and the ultimate objective for the cockpit should be a perfect fit.

Reduction Part I: Install Only What You Need

The single most effective method of decreasing cockpit complexity, cost and weight is to not install what you don't need. Avionics sales people should now move on to the next section. Avionics consumers read on.

To start, consider our air navigation system. U.S. taxpayers currently fund four distinct navigation systems used by general aviation. Chronologically, they are: 1. NDB; 2. VOR/ILS/DME; 3. loran; and 4. GPS. To plan your panel, consider what is likely to happen with these systems in the future.

As we all know, GPS is the navigation system of the future. At this moment, there are approximately 3300 "GPS overlay" approaches in existence. An overlay approach is a standard VOR, VOR/DME, localizer or NDB approach in which a GPS receiver is used as the sole navigation instrument. To do an overlay

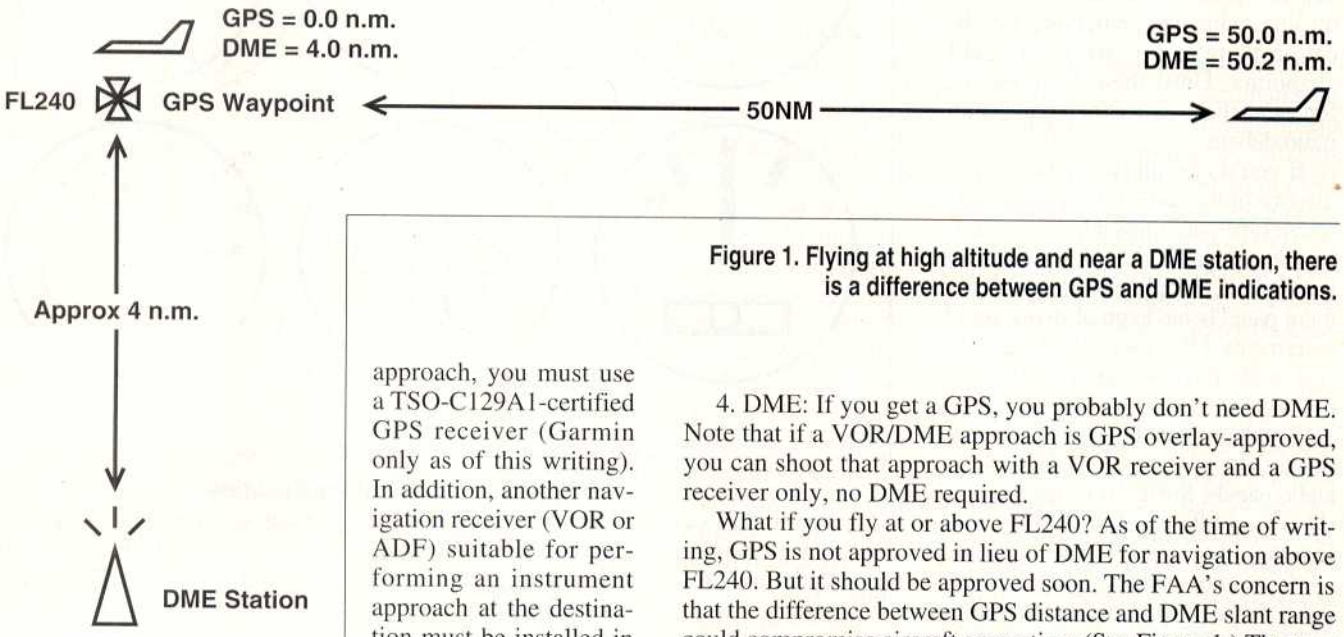

Figure 1. Flying at high altitude and near a DME station, there is a difference between GPS and DME indications.

approach, you must use a TSO-C129A1-certified GPS receiver (Garmin only as of this writing). In addition, another navigation receiver (VOR or ADF) suitable for performing an instrument approach at the destination must be installed in the aircraft (but not necessarily turned on!).

Beyond the GPS overlay program, FAA is developing nonprecision GPS approaches and preparing to implement DGPS (Differential GPS—a system that corrects the degraded signal provided by DOD). DGPS will allow the creation of precision approaches to any airport within range of a DGPS correction transmitter. The FAA's goal is a GPS-only navigation system around 2003. The FAA hopes to begin decommissioning VOR stations in 1998, and NDBs before that.

Keeping future trends in mind, let's analyze our needs:

1. ADF (NDB receivers): If ADF were a person, it would be retired by now. Belying its age, it is probably the most difficult navigation instrument to use. Proper use of ADF requires continuous monitoring and interpretation. Besides its difficulty of use, it is also the most infrequently used instrument in the panel. Most pilots don't use ADF for en route navigation, and they only use it for instrument approaches if no other navigation aid is available.

I checked my logbook the other day and found that out of 225 actual instrument approaches logged, not one was an NDB. Accordingly, there will not be an ADF in my panel. Obviously, I don't fly IMC to airports that only have NDB approaches. If you do, you might need to include an ADF in your panel.

Note that nonprecision GPS approaches are in the works for many of those NDB-only fields.

2. Loran: Go with GPS. Enough said.

3. GPS: Required. Look for the following features: TSO-C129A1 certified, moving-map display, and DGPS-upgradeable. If you are a VFR pilot, the right choice might be a handheld GPS, which is also an excellent backup navigation device. However, no handhelds are currently TSO-C129A1 certified.

4. DME: If you get a GPS, you probably don't need DME. Note that if a VOR/DME approach is GPS overlay-approved, you can shoot that approach with a VOR receiver and a GPS receiver only, no DME required.

What if you fly at or above FL240? As of the time of writing, GPS is not approved in lieu of DME for navigation above FL240. But it should be approved soon. The FAA's concern is that the difference between GPS distance and DME slant range could compromise aircraft separation. (See Figure 1.) The new standards will probably provide for 15-mile separation between GPS- and DME-equipped aircraft and 10-mile separation between two GPS- or two DME-equipped aircraft.

5. VOR: Until DGPS comes on line, ILS is the only way for us to fly a precision IFR approach. VOR is also likely to be around for quite a few more years. Compared with ADF, VOR is relatively easy to use, and it complements GPS as an independent source of en route navigation. You probably need a VOR receiver.

The question is: Do you need two? The classic well-equipped panel had two VOR receivers for a couple of reasons. First, VOR equipment of old was not very reliable and pilots became accustomed to having a backup. But with modern solid-state avionics, the reliability concern is unfounded. If you really must have a backup VOR, buy a handheld navcom. They are rugged and provide true redundancy, independent of the aircraft electrical system.

Second, two VOR receivers allowed pilots to get a position fix by simultaneously tuning different VOR stations. Yet this function is done much more accurately by GPS. In short, I can think of absolutely no reason for having two VOR receivers in a 1995 panel.

6. Com: One is required. See FAR 91.205(d)(2). As with VOR receivers, the question is whether we need two. One of the reasons the traditional panel had two communication radios was reliability. As previously discussed, though, modern solid state electronics are far more reliable, and a handheld transceiver is the most redundant backup of all. [For reliable com range of more than 10 miles, however, you may need to attach the handheld to an external antenna. —*Ed.*]

Still, there are other reasons for having two radios. Two radios allow you to monitor ATIS while talking with approach

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