

***Retiring the
Nav-o-Matic
400B Autopilot***

Retiring the Nav-o-Matic 400B Autopilot

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It's time to squawk 7700 on behalf of domestic tranquility. My new Garmin GFC500 autopilot has been installed for a scant month. But in even that limited time my mostly-sainted wife has become thoroughly disenchanted. Apparently, I now return to the hacienda raving about this astounding hunk of digital magic. Last week she gave me the Glare of Death. "Tell it to your readers," she instructed me, eyebrow and voice slightly raised. "I simply can't bear it anymore." That seemed a bit shrill but I'm a sensitive soul. What follows is less a review and more marriage counseling.

40 Years with My 400B

My trusty aerial steed, Centurion 7591N, rolled off the Wichita assembly line in 1979 equipped with state-of-the-art avionics. Those systems were a rugged mix of electrical, mechanical and vacuum-based instruments. Amidst all this mechanical magic, N7591N came with a sexy option: the Nav-o-matic 400B two-axis autopilot.

The Nav-o-matic products came from Airplane Radio Corporation, a division of Cessna. Initially there were the simple rate-based Nav-o-matic 200 and 300 systems and the top-of-the-line pitch-based 400 system. Things got exciting with the "B" revision. These used robust Apollo-era electronics with

enhanced functionality. They have been trusted on tens of thousands Cessna airplanes. They are a reasonable choice even today (a) if the system already is installed, (b) is working satisfactorily, and (c) your mission requirements are not terribly demanding.

My 400B soldiered on loyally for exactly four decades, which is pretty amazing. But it wasn't flexible and it certainly wasn't sexy: the white knobs had faded brown, the plastic chipped, the paint worn. Gradually it developed a touch of dementia and would unpredictably kick itself off. Sometimes I could re-set it and get back to my Tom Clancy; sometimes I could not. Most recently, it stopped operating at all.



The control head of the Nav-o-matic 400B was a sturdy, robust design five decades ago, but the years have not been kind.

Repeated excursions to different avionics shops failed to find a fix but successfully emptied my wallet. I became very skilled at hand-flying old '91N, even in hard IFR on long cross-country slogs like from Calgary to North Carolina. It can be done. It is exhausting. It is borderline unsafe. My flakey 400B meant I was "pushing the envelope" farther than I should have.

Options Considered

Of course, I wasn't sitting on my hands. I looked at the STEC 55 and their newer 3100 system. Avidyne has a hot product line. Dynon offers elegant, sophisticated choices. Salespeople at Oshkosh kept wiping my drool off their displays but many were not STC'd for the Centurion. Then Garmin rolled out

the certified new Garmin GFC500 system and I snapped at it like a chicken chasing a June bug.

The GFC500 is Garmin's autopilot offering for legacy single-engine aircraft. With modern, solid-state circuitry enabling brainy operations it can track your magenta course, even one with more squiggles than a reef knot. It's a sweet design.



The GFC500 control head is the GMC507. It uses excellent ergonomics to maximize safety and performance. It offers a variety of controls and options including "Approach Mode" which can automatically intercept a localizer and a glide slope and fly right to minimums.

The heart of the autopilot is the G5 digital flight director. It talks to the GMC507 panel-mounted control head in the avionics stack and "smart" GSA28 servos. Thankfully for this fumble-fingered pilot, Garmin voted against a touch-screen interface. The GMC507 control head has large buttons, just two knobs, and a control wheel. Easy-peasy, even in turbulence.

The new Garmin G5 digital displays replaced both my old attitude indicator and HSI. Good-bye and good riddance. Old-style vacuum instruments are a constant source of vulnerability. "Vacuum instruments do not have the reliability of electric instruments," agrees aviation writer and avionics expert

Tom Rogers. “That pesky vacuum pump has a habit of failing without notice and at the worst possible time.”

Brain Surgery

I dropped '91N off at VIP Avionics in Hartford, CT for the transmogrification. Ed Rollins owns the shop and Dave Kocak manages the avionics side. Dave is head-over-heels for the Garmin GFC500. He reports the system is extremely well documented, the installations flow smoothly, and the systems don't generate many return visits. We agreed on five weeks for the job. I flew home commercial and kept my fingers crossed.



Have you ever noticed when somebody is recuperating in a hospital they age overnight? The same happens to airplanes — my lithe and noble 91N suddenly looked like a hangar queen. I doubted even all the king's men would ever get her back together again.

The first step was the scariest. The plane was opened up and old parts removed. My beautiful panel was reduced to a pile of spaghetti. As when making of sausages and legislation, there are some things it's best not to see. Kocak sent me photos anyway; like watching a NASCAR race I could not turn away.

“Everything forward of the firewall stays the same, this is almost all done in the wing and the tail,” Kocak advised me. “The bridle cable comes out, the servos come out, and we find places to put in the Garmin pieces.” I puzzled over that — why did my panel look as if it had been visited by Hurricane Sandy?

Installing the twin G5 displays was tricky because the panel on '91N has an electrically-active imitation walnut overlay which needed to be cut without

being shorted-out. “We also had to modify the underlying metal instrument panel to get the G5s centered in the six-pack,” Kocak reported. “We moved them a little from their original holes, just a hair, to be centered in the panel.”

The next big issue was installing the magnetometer. This is the digital lodestone which keeps the HSI calibrated to magnetic north. Obviously, magnets love big iron Continental engines, but the new magnetometer is much more sensitive than the old unit. Garmin specified a magnetism test of the entire airplane. Eventually the computer and Dave agreed on a spot near the far-right wingtip.



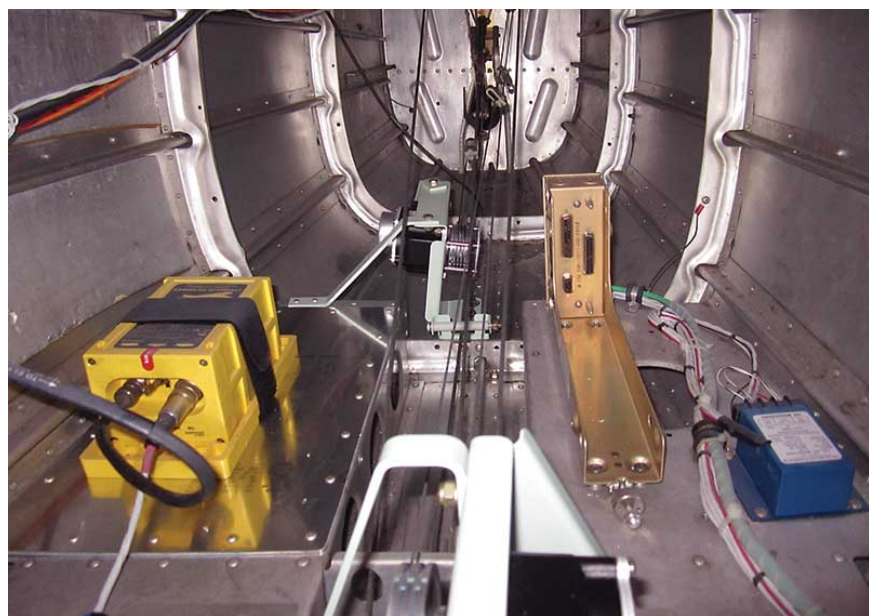
The old autopilot filled a bushel basket and weighed 32 pounds including magnetometers, servos, computers, gauges, and cables. Parts of the old autopilot system were scattered all over the plane: in the right wingtip, above the co-pilot, under the co-pilot, under the third seat, and in the tail, all of which made maintenance a challenge. The new Garmin servos are smaller, more reliable and half the size. The entire system weighs just eight pounds.

Then Dave’s team started installing stuff. The roll servo went inside the right wing, next to the new magnetometer. “The roll servo is the worst [to install],” Dave said. “There’s no room in the wing; the only access are the little round inspection panels. The roll servo, the servo motor and the mounting brackets typically have to be assembled inside the wing through the hole

because you can't get [the assembled device] through the access panels. It's not fun."

Conversely, working in the tail is a snap. They removed the old trim system, installed a new elevator servo and got a mechanic busy installing the new Garmin trim system. "This job is more than just avionics," Dave told me. "There's rigging involved, you know, degrees of trim up, trim tab down, all that fun stuff, and we wanted to make sure it's perfect." The new servo is half the size of the old unit.

Somewhere along the line, Dave's team realized the now-removed HSI was my last vacuum-operated instrument. "You really don't need your vacuum



Avionics techs loath working through tiny inspection ports inside the cramped wings, but the tail is positively roomy. The control cables, servo, and computers are easily mounted and calibrated, and everything is nicely protected from debris or passengers. Some airplanes — not Cessnas — also use this space for the optional Garmin yaw damper system

system anymore," Dave told me by phone. "You can lower your gross weight and remove a maintenance sore-spot." That was an exciting option but because of the cost we decided against it. We'll do that little chore when I swap out the engine in another couple of years.

Thirty days after I dropped off the plane, Dave and his team rolled it back out into the sunshine for a run-up and diagnostics. I showed up a few days later and, after several hours of orientation and a speed-dating test flight, I brought her home.

Operations

The system is deceptively simple. After a test flight but prior to my departure from Hartford, I configured the GPS in my usual manner. The course instantly appeared on both the G530W and the G5 display. How sporty.

Departing in vivid VMC, I turned on course and gave the new autopilot a try. I tapped “AP” — which wakes up the autopilot — and then “Heading.” Obediently, the plane briskly rolled in the wrong direction.



Dave Kocak has been with VIP Avionics for more than two decades and has installed several Garmin autopilots. We spent almost an hour in the cockpit on ground-power, testing the systems and their operations before enjoying a short test flight to confirm system operations. “You’re going to be so impressed with this autopilot,” Kocak said. “I’m even impressed with it. It just makes your airplane so much more capable it’s unbelievable.”

I used two hands, one to disconnect the autopilot and the other to slap my forehead. Ah, the heading bug! I dialed the proper heading into the new HSI and tried again. Much more agreeably, the plane gently turned to the right and we began the long ride home.

Nearing Groton, another gingerly button push set the GFC500 into “Nav” mode. Nothing fell out of the sky. Feeling more confident, I tapped “ALT” hold. Old '91N politely pirouetted and we trucked down Victor 16, right over the heavy metal parked at JFK. After just 45 minutes together, the GFC500 and I were getting along just fine.

ATC often gives you a new altimeter setting when you check-in. It is easy to re-set the local altimeter using the G5: one knob does the trick. Magically, the GFC500 automatically and imperceptibly corrected my altitude. One less thing to worry about.

GPS steering is elegant. With the G530W and the G5 singing in harmony, the plane approaches fixes like a laser. The GPS flashes a 20 second warning. Nearing the turn, the G5 moves the needles. The autopilot follows, hitting waypoints like a sledgehammer on a thumbtack.



Here's the latest iteration of the avionics stack in Centurion 91N. At the top is a PS Engineering audio panel which has served very capably for nearly two decades. The Garmin 530W is the principal navigator, followed by a new Garmin nav/com radio and the ADSB in-and-out Garmin transponder. The GMC507 control head completes the set. Notice the black plastic spacer at the bottom of the stack — these new systems are far smaller, lighter, cooler and less energy-hungry than the older designs

Of course, there's the rest of the world still out there, and evening thunderstorms popped up. Don't they always?

Approaching Richmond, I requested a diversion to Williamsburg, Virginia, about 60 miles east. The controller gave me an initial fix while he coordinated. I punched that into the GPS, hit "Direct" and the autopilot gently slewed to the



The software elves at Garmin jammed an enormous amount of information into the small G5 digital displays. The top instrument is an integrated flight director while the bottom gauge is a digital HSI. The green arrows highlight my command to the G5 autopilot to descend at 500 fpm. The red arrow shows the old analog gauge agrees with the computer exactly. In all the cross-comparisons I have tested, the digital and analog instruments matched perfectly.

left. I set a downhill "VS" (vertical speed) of -300 feet per minute. The autopilot obliged and we floated towards KJGG, effortlessly, while I dug out the approach plates.

The new system has several newsworthy features. "Envelope protection" keeps the aircraft within normal speeds and bank angles. If those limits are exceeded the GMC507 kicks in to keep the plane safe. Amusingly, this system lurks in the background even when the autopilot is off.

Another clever idea is the "Level Mode" button on the control

head. This bright-blue "get out of jail free" button is used when a challenged pilot is fighting turbulence or disorientation. One push disconnects the autopilot, levels the wings and gives a harried pilot a few minutes to catch a breather. I have tested the feature in VMC and it works flawlessly. I hope I never have to use it.

Lastly, I'm very fond of the "Go Around" button on the yoke. I've performed a handful of real-world IMC go-arounds and they are stressful. The go-around button instructs the autopilot to safely fly the missed approach. In a few years Garmin will have a set of handsome thank-you letters on their office walls, guaranteed.

All of which brings us to an important point, one upon which John Frank, Richard Collins and probably a million other experienced flyers would agree. A reliable autopilot is not a "nice to have" luxury. It is not a crutch for rusty pilots. It is not a get-out-of-jail card for sissies. It is an essential tool for long-haul IFR operations. A good autopilot reduces workload and minimizes fatigue. It allows the breathing pilot to concentrate the important stuff: the approach to be flown, the weather blowing in, or the fuel not in the tank. Anybody flying hard IFR absolutely should invest in either a rock-solid autopilot or a skilled friend who likes to fly in the muck.



The GFC500 flies marvelously. On a very hot and very bumpy summer afternoon, with density altitude over 2,000 feet, the Garmin comfortably maneuvered old '91N over to the initial approach fix of the ILS-5 at Pinehurst Airport (KSOP). The Garmin 530W shows the plane flew the procedure turn and zipped down the ILS to minimums. (Yes, I switched from GPS navigation to the localizer when the procedure turn was completed.)

They Could Have Done Better

Is the GFC500 perfect? Pretty close, but not quite. The system has a variety of audio alerts, such as when you approach within 1,000 feet of your selected altitude. But there's only one common alert, a very loud, passenger-alarming doorbell chime. Could they not

have hired that lovely British lady who calls out traffic alerts on my Garmin transponder? Or the American tart in the G5 who scolds me with “Airspeed!” warnings? Her voice drips disdain.

The Pilots Guide is 78 pages long and completely inept. The GFC500 system isn’t even introduced until page 36. The manual features long indecipherable tables of setting and “modes” such as on pages 4, 11, 44 and 47. All in all, the manual tells you what to do, but not the “why” behind it. You get better instructions with a toaster oven.

Another slightly annoying choice: Garmin only allows one nav source to be coupled to the new autopilot; I suspect this is a limitation of the G5 display. Obviously, we chose to link to the Garmin 530W GPS but it really would have been nice to have a choice. Loran, anybody?

And then there are the cosmetics. I’ve just spent a silly amount of cash making the interior and exterior of the plane as handsome as can be. Mr. Garmin helped with that, because all Garmin avionics use the same color plastic, same size buttons, same typeface and fonts... except the GMC507 control head. On it, the typeface is big



Here’s another instrument approach, displayed on the dual G5s. The plane has just crossed the initial approach fix on the LPV-23 at KSOP and I have activated the APR (approach) mode on the GFC500. The Garmin flight director (top) offered horizontal guidance (the magenta triangle inside the black bar at the bottom of the display) and vertical guidance (the magenta diamond on the black bar on the right side of the display). The lower display presented that same information in a more traditional HSI format. All the captain needs to do is adjust the power, lower the gear and awake up the co-pilot.

and blocky. It's almost as though Garmin felt the need to speak loudly to the dunce in the left seat.

All that aside, I'm thrilled with this investment. It's powerful, smart and far more capable than the pilot behind it. I'm eagerly looking forward to many more flights with maximum performance, safety and comfort.

About the Author

Mike Jones is a 4,000 hour commercial-rated pilot who has more than 50 aircraft types in his logbook. His pride and joy is a Cessna T210, which has carried him to every corner of the U.S. and Canada for more than twenty years. He's always accessible at PilotMike2012@gmail.com.

