STEADY AS SHE GOES

Market success has been an elusive affair for autopilots designed for light helicopters — and, for that matter, even for light helicopter stability augmentation systems (SAS). Since the limited, instrument-flight-rules-approved Collins autopilot came out for the Bell 206L-1 LongRanger decades ago, there really hasn't been a light helicopter autopilot design brought to market that has had any significant impact. But all that could be about to change.

Over the last little while, Cobham Avionics has been working with Edwards & Associates to obtain United States Federal Aviation Administration supplemental type certificates (STCs) to install the HeliSAS autopilot and stability augmentation system on the Bell 206, 206L and 407 series helicopters. It has also been working with Metro Aviation to install HeliSAS on the Eurocopter AS 350 series helicopters. To give the market a full look at this soon-to-be-available new product (the Bell model STC approvals are expected by the end of 2010), I was provided with the opportunity to give the system a full evaluation in a Bell 206 JetRanger at the Edwards facility in Tennessee.

MAKING THE INTRODUCTIONS

HeliSAS is a visual flight rules, two-axis attitude hold, attitude command, flight control system with two basic functions: SAS to aid with aircraft stability; and autopilot modes for heading, altitude hold and fully coupled navigation, including GPS, VOR (VHF omni-directional radio range) and precision approach capabilities.

Initially created by Southern California's Hoh Aeronautics Inc., and further developed by Cobham, HeliSAS was originally intended (and STC approved in November 2009) for the Robinson R44. However, due to liability concerns related to Robinson's self-insured status, Cobham made an 11th-hour decision to not offer the R44 based product — at least for now.

Advances in electronics and lightweight component design really stand out when reviewing the HeliSAS package. In fact, there are only four major components to the whole system: a panel-mounted HeliSAS control panel (HCP), which is the only component the pilot actually sees (except for some cyclic buttons); the flight control computer (FCC); and two servos — one for pitch and one for roll. There is no connectivity for the pedals or collective.

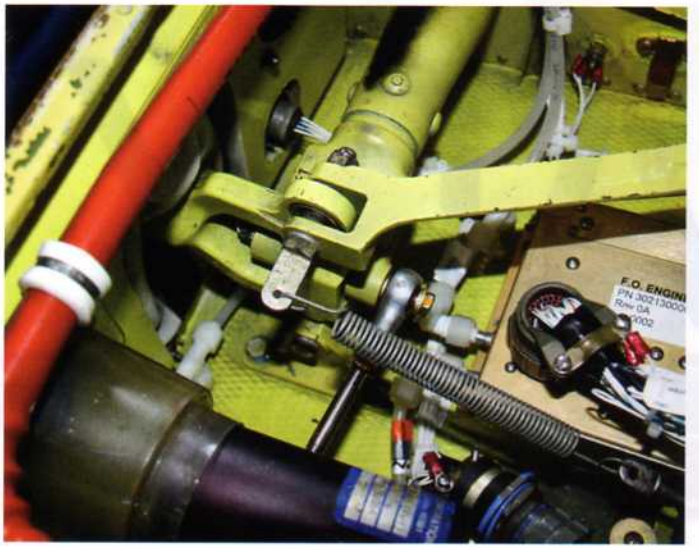
HeliSAS is an attitude-based system, requiring an attitude source either from a Castleberry attitude gyro or from most electronic flight instrument systems (EFIS) with attitude and heading reference systems already installed. The same goes for the navigation functions — an EFIS or a legacy horizontal situation indicator (HSI), such as the Bendix/King KCS-55A installed in the test aircraft, will be necessary for traditional navigation and heading functions. However, this is not required if you only want GPS nav functions and no heading command.

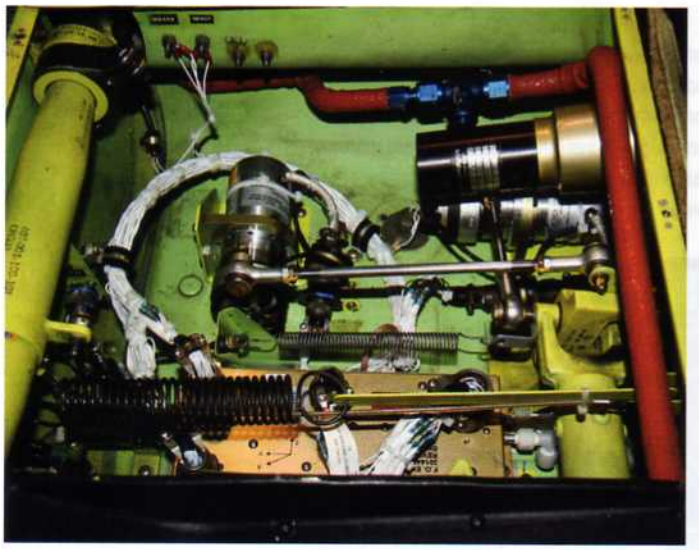
The whole system installation weighs less than 15 pounds. Additionally, the overall installation does not require the removal of the flight controls, as the HeliSAS servos are mounted in parallel with the existing controls. This feature, along with pre-fabricated wiring harnesses, helps to significantly reduce installation downtime.

Prior to my flight, Edwards personnel pulled up the pilot

OPPOSITE Edwards & Associates has worked with Cobham Avionics to develop a HeliSAS installation for the Bell 206 series. A demonstrator version was installed in Edwards' signature Stars and Stripes JetRanger.
Mike Reyno Photo

LEFT The HeliSAS held a solid, hands-free hover — it even tried to compensate for drift. It's not Doppler hovering, but it's certainly impressive. The red button on top of the cyclic is the AP DISC switch.





TOP LEFT In the Bell 206 installation, the roll servo and FCC are installed under the left seat (the pitch servo is under right seat). Note that the servo control arm is easily mounted in parallel by just lengthening the attaching bolt in the roll control arm.

TOP RIGHT The HCP is installed at the top the avionics stack. The display here shows the SAS is engaged with the navigation (NAV) and altitude hold (ALT) autopilot functions in use. The newer HCP design is even slimmer than the prototype shown here.

BOTTOM RIGHT Cockpit of the Bell 206 installation.

BOTTOM LEFT In the Bell 407 installation, all three components — pitch servo, roll servo and FCC — are mounted under the pilot's seat.

and co-pilot seats to reveal the servos and FCC. It was amazingly simple and tidy. Of course, that simple appearance doesn't reflect the massive amount of research, development, testing and paperwork it takes to obtain that coveted STC.

The HCP is an attractively slim component, neatly mounted on top of the avionics stack. There is an LED above each mode-select button to indicate their status. On the cyclic, there are two buttons — one for force trim release (FTR), one for autopilot disconnect (AP DISC) — providing various functions soon to be described. So, enough with the introductions... it's time to go flying.

GETTING FAMILIAR

During helicopter start-up and warm-up, HeliSAS performs a self-test where all of the LEDs on the HCP flash alternately between white and green. Upon completion, the system enters standby mode, evidenced by all the LEDs showing white.

Prior to takeoff, the pilot performs a series of simple checks. The SAS mode can then be engaged either through the button on the HCP, or if the pilot depresses the FTR button on the cyclic for more than 1.25 seconds. No autopilot modes should be engaged prior to takeoff, as the airspeed must be at least 44 knots for them to be used.

With minimal Bell 206 experience, I would not only be getting comfortable with the HeliSAS on this flight, but with the host aircraft, as well. To that end, the HeliSAS was even more impressive. With Edwards' sales/program manager and pilot Michael Milhorn as my guide and safety net, it was time to go.

In the hover, I alternated between having the HeliSAS engaged and disengaged, and the hover was noticeably more steady and solid with it engaged. Not only that, but Milhorn prompted me to establish a hover and then take my hand off the cyclic: the 206 just sat there — rock steady. Neat!

One point to remember when hand-flying the HeliSAS: *don't* depress the FTR every time you want to make a control input. This was counterintuitive to my 18 years of Bell 412 flying, but if you do fly with the FTR always depressed, you lose all the enhanced stability of the HeliSAS. Instead,

apply cyclic pressure as needed, not using the FTR, then momentarily use the FTR to re-center the stick. It's easy and smooth, with no "bump" in the helicopter when the stick re-centers.

We then left the Edwards facility to do some basic maneuvers. Just flying some normal turns and getting used to the 206 was a nice warm-up to see how easily the pilot can enter and exit the flight loop. What I mean by this is that out of the loop, I just let the HeliSAS do its thing, keeping the helicopter where I wanted it with my hand barely touching the cyclic. Entering the loop is a simple matter of just exerting force as needed on the cyclic, again leaving the FTR alone until the stick position is where you want it.

Another thing to be aware of is that, although the HeliSAS assists in any attitude you select, it will not stay in an attitude, hands-off, that has more than five degrees of bank, six degrees of nose down or 11 degrees of nose up. This is an excellent safety feature that we'll address a little later.

GOING AUTOMATIC

Just the SAS component alone makes the system worth the installation. However, as those "lame" infomercials always say, "But wait, there's more!" At this point, we started to incorporate the autopilot functions... and this is a true autopilot.

I started by engaging the heading and altitude modes. All autopilot modes must be engaged by pushing the appropriate buttons on the HCP. There is no way to engage them through the cyclic or collective, although it would be nice if one could. However, you can disengage the autopilot functions from the cyclic by momentarily depressing the AP DISC button; you will hear a single beep in the headset when you do. The downside of using the AP DISC button is that you lose all of the autopilot functions, leaving only SAS. (If you continue to hold the AP DISC button down, or depress it a second time, it will disengage the SAS, too; you'll hear four beeps when that occurs.) If you want to disengage only certain autopilot functions, then you must use the HCP.

With heading and altitude modes on line and green lights confirming such, the HeliSAS precisely flew to and held assigned headings via the heading bug on the HSI, and maintained a perfect altitude hold, as well. It will do the same for a heading bug on a primary flight display if you have any kind of glass cockpit.

The altitude function is limited to holding the altitude at which the function was engaged. There is no altitude preselect function, nor functions for vertical speed or airspeed, although the SAS mode does do a great job in holding those parameters.

Next up was testing the navigation mode. This mode can track an active GPS course or the course on the HSI if VLOC (VOR/localizer) is selected. If no HSI is installed, then the navigation mode will only track the active GPS course. If the heading mode is active when the navigation mode is armed, the autopilot will continue to fly the selected heading until the course is intercepted. The light above the navigation mode button on the HCP will display

white until intercept, then it changes to green. If the heading mode is not active when the navigation mode is armed, the autopilot will intercept the active course on a 45-degree angle. All of the intercept attempts that I tried were spot on.

The HeliSAS, with its built-in GPS steering, guided by a Garmin GNS 530W in the 206, nicely flew hands-off courses, as well as full procedure turns. The system is fully capable of flying non-precision, back-course and precision approaches.

When flying a GPS VNAV (vertical navigation), an LPV (localizer performance with vertical guidance) glidepath or a traditional glideslope, the vertical navigation mode button must be selected. The vertical navigation mode should be armed prior to intercept of the glidepath. The autopilot uses pitch attitude to maintain glideslope, so the pilot sets the power for the appropriate speeds. Flying both a GPS VNAV approach and a full instrument landing system approach, the HeliSAS perfectly captured and flew the course and glidepath to minimums.

THE SAFETY ADVANTAGE

So, what about the HeliSAS's ability to save one's bacon in an unusual attitude/inadvertent instrument meteorological condition situation? When I explored that envelope, I wasn't disappointed.

First, I tried the normal stuff — descending and climbing banked turns. With the HeliSAS already engaged, the helicopter smoothly returned to the attitudes at which I last hit the FTR — so long as they were within the pitch and roll limits mentioned earlier.

Then, I turned off the SAS completely, entered an unusual attitude and re-activated it. On the first attempt, I had a pretty-high nose attitude. Because of the 11-degree upper limit to the pitch range, the helicopter didn't lower itself to a completely nose-level attitude, but stayed at the higher pitch angle, because it was nose-high when I had engaged the system. However, it did remove the bank angle I initially had to within its five-degree limit.

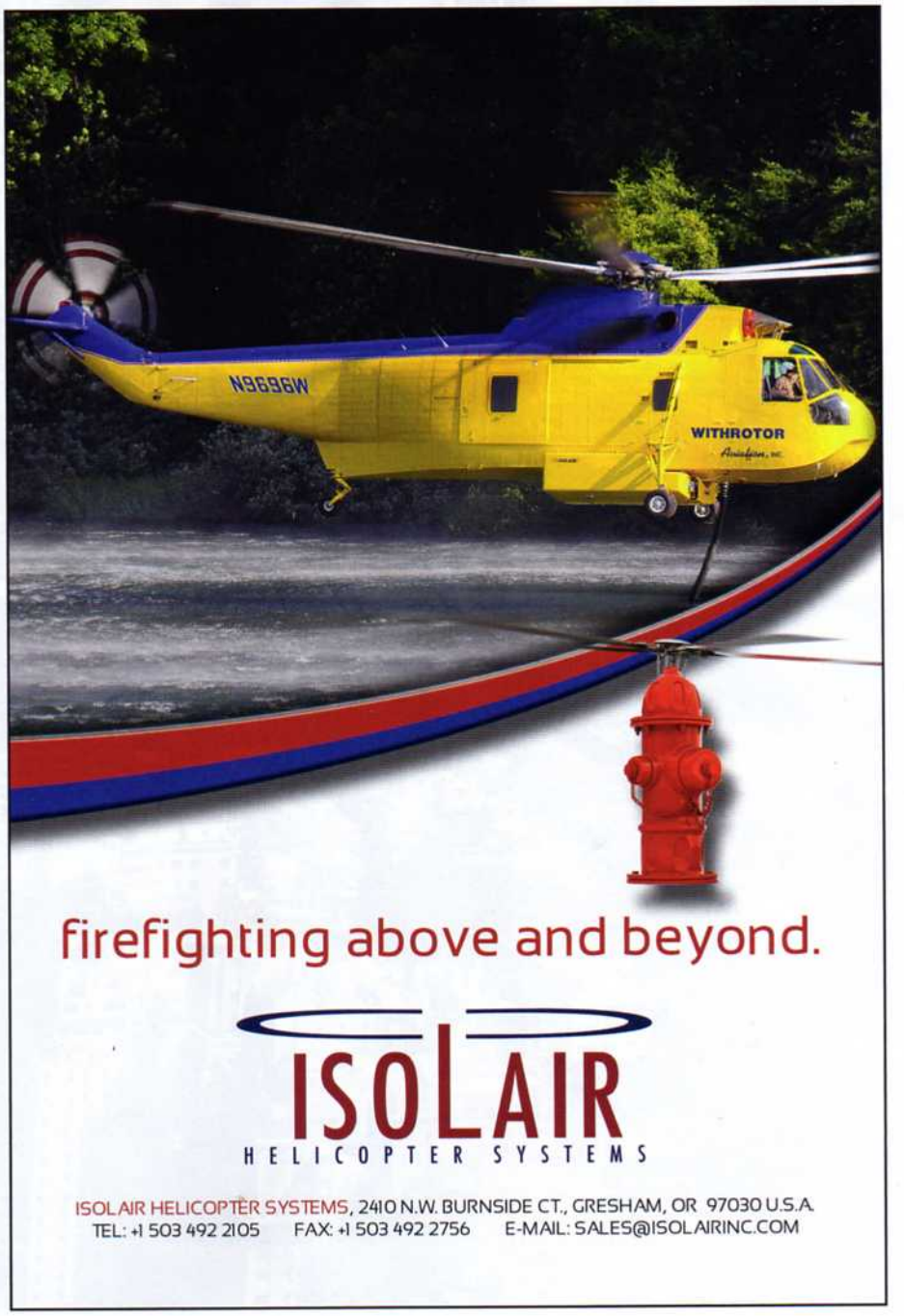
The next test was the "biggie" for me. Here I was in a two-bladed helicopter, where mast-bumping on hard-recovery pitch-over is a real concern. With the SAS engaged at level flight, I raised the nose up to a fairly high attitude and let it go. The system gently lowered the nose — never with any hint of low-g pushover — to the original level attitude. Nice.

A couple of visual approaches to the Edwards pad sealed the deal, further proving just how much more solid and secure the 206 felt with the HeliSAS engaged.

Without a doubt, besides the overall workload relief offered by the HeliSAS, the added safety component is significant. Inadvertent instrument meteorological conditions (IIMC)? Just leave it alone. Need assistance on an approach to get out of IIMC? Just set up your radios, push a couple more buttons and leave it alone. Air medical operators should be lining up at the door for this device.

Although the parts may seem simple, the process to get them to work properly, and — just as importantly, to get them approved — was highly complex. The proof of success, though, is in how well the HeliSAS does its thing. Make no mistake: this is a true, fully featured autopilot that I found incredibly intuitive and easy to use.

Installation in the Bell 206 runs around $110,000 US, not including an attitude gyro or HSI, if they are not already installed. That buys a huge amount of reduced workload and fatigue — plus the significantly enhanced safety benefits that go along with them.



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