

A Buyer's Guide: Standalone Instruments

Backup Flight Instruments: They Stand Up When Standards Stand Down

BY DAVE HIGDON

Most pilots remember significant events in their flying lives: their first solo; their first cross-country flight; check rides; and flights significant because they don't fit the desirable description of "uneventful."

A newly minted instrument pilot's first trip in actual instrument meteorological conditions (IMC) usually stays with him. And few events imprint as strongly as the first time a primary instrument fails while flying inside the egg-shell. Flying IMC, pretty much any failure of a primary system or primary instrument makes the flight "eventful."

Instrument pilots learn to use the so-called "standard six-pack" of instruments dominant in our predominantly analog panels — three of them gyro indicators — to successfully execute instrument flight.

Most of our success hinges on our ability to become competent by trusting a mechanical attitude indicator (AI) in defiance of and ignoring completely the attitude indications of our inner-ear mechanisms. Loss of this AI, the most primary of our primary instrument flight tools, greatly challenges our odds of success in IMC.

The track record from both real life and objective research con-

curs: For pilots in IMC, loss of the AI, for whatever cause, too often results in an unhappy outcome. The odds-on favorite for such a problem is the dry-air vacuum pump dominant among aircraft suction systems.

The related parallel failure of the directional gyro (DG) adds to the pressure of partial-panel flying in IMC. The single-point loss of the DG, in contrast, doesn't threaten attitude control to the degree of a loss of attitude indication; ditto for the turn direction and rate information delivered by the electrically driven turn gyro, whether a turn coordinator or turn indicator.

Outside the ultimate IMC failure crisis, that of an engine, no other component loss stresses piloting skills and compounds the risk equation of instrument flight like the loss of attitude indication in IMC or, a close second, in night VMC.

PARTIAL PANEL: Points for Difficulty

One of the benefits of modern glass cockpits spins off, if you will, from the shift to solid-state, no-moving-parts sensors and electronic displays with miniscule failure rates. These technologies allow the elimination of problem-

atic spinning-iron gyros and suction pumps.

Still, the Federal Aviation Administration requires modern digital electronic panels to employ a backup set of instruments — often a compact, but old style, spinning-mass attitude indicator, plus an airspeed indicator and altimeter. Typically, the standby AI is electric and the aircraft sports a secondary source of electrical power.

Owners of older aircraft have options for adding attitude-indication redundancy to their panels, regardless of whether it's a standard six-pack panel, all glass or a hybrid of glass and analog.

For the instrument pilot, incorporating standby instruments can help ensure an instrument failure in IMC remains validly described as "uneventful." Several manufacturers offer standby instrument equipment created to relieve at least the stress of an instrument failure.

Some pilots opt to add a secondary suction source to their airplane, a relatively low-cost option offering the dual benefit of keeping the DG and the AI functioning. Many pilots have added both a secondary suction source and a secondary, standby electricity source to provide maximum sys-

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tem redundancy to their cockpits. But only a secondary indicator of attitude information can give an instrument pilot the fullest hedge against the possibly catastrophic outcome of a primary AI failure.

In recognizing the lower priority of turn gyros in the instrument cockpit, the FAA issued Advisory Circular 91-75 several years ago to make adding redundant attitude indication easier than ever.

In essence, according to AC 91-75, aircraft weighing no more than 12,500 pounds, use a second AI in place of a turn gyro, either an AI powered electrically or an air-powered unit with an available standby suction source — not as appealing a change as going to an electric secondary AI.

STANDING BY WITH STANDBY INSTRUMENTS

In this “Buyer’s Guide,” we examine equipment designed primarily to serve in a backup role in today’s general aviation panel. In some cases, the products described can serve as the primary, allowing the aircraft owner to move older instruments elsewhere in the panel and adding a layer of redundancy differently.

Because turn gyros typically employ electric power, AC 91-75 makes swapping in an electrically

driven AI a minor change — but it’s a minor piece of work with a huge implication for the instrument pilot facing the failure of a primary AI.

The cockpit also must have an inclinometer — the trusty old slip/skid ball — to comply with the AC.

By adding a second, alternatively powered AI — regardless of whether or not it replaces a turn gyro — the pilot essentially keeps a full panel to work with in instrument conditions.

Some important issues require consideration when planning an upgrade to add standby instruments to the panel. One of the primary considerations is, whenever adding an instrument or system that increases electrical need, be sure your generating system can meet this need.

Independent power for standby instruments provides the greatest redundancy, allowing the instrument or box to function for some limited time in the event of an electrical-system failure — this is time a pilot needs to either find visual conditions or on the ground as quickly as possible using the nearest practical instrument-approach option.

Even with its own standalone power source, a self-powering standby device still needs ship’s

power to maintain the integral battery’s charge. For standby instruments lacking the ability to self-power, be sure you either can shed load to keep the instrument running until you’re down or that it’s on a standby buss to give it power priority. And don’t let a shortage of mounting space hold you back.

The industry has advisory circular AC 91-75, in large part, because of the long-term efforts of Sporty’s founder Hal Shevers. He petitioned the FAA for nearly two decades to allow replacement of the turn coordinator with a backup electric attitude indicator.

In 2003, Shevers’ efforts finally bore fruit with the issuance of AC 91-75, which in turn makes finding space for a backup AI as easy as replacing the turn coordinator or moving it to another location, allowing for a much safer panel layout in case of vacuum failure or failure of the primary AI.

Shevers’ efforts also helped launch production of an electric attitude indicator with inclinometer, which was redesigned with improvements and helped drive development of other standby products.

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CASTLEBERRY INSTRUMENTS

Model 300-14EL

This is the attitude indicator Sporty's revived in Hal Shevers' quest to convince the FAA that an electric AI was a safer choice than the turn coordinator found in standard IFR panels.

After the issuance of the AC, Shevers found no competitively priced, high-value options that would convince pilots to make the safer choice.

After combing the manufacturing community with his specifications and committing the marketing power of Sporty's, Shevers convinced Castleberry Instruments to update and produce this AI. Sporty's initial commitment was for 1,000 units, which sold out almost immediately.

Castleberry found the enterprise launch profitable enough to continue building the 300-14EL as a high-value electric AI with inclinometer and failure-warning flag.

The 300-14EL is available either 14- or 28-volt compatible, in versions to mount either on straight or tilted panels, and in versions for fixed-wing aircraft and helicopters.

Castleberry also offers an option that enhances this AI's appeal as a standby instrument: a dedicated power supply to keep the AI running in the event of an electrical-system failure.

For more information, visit www.ciamfg.com.



KELLY MANUFACTURING CO.

RC Allen RCA 2600

Digital Horizon

Introduced in April 2009 during the annual AEA International Convention & Trade Show, this brand-new, digital-display horizon/attitude indicator allows the addition of an optional inclinometer, making it a candidate to replace a turn gyro to serve as an electric backup unit to a standard suction-powered AI.

Designed around an all-solid-state digital sensor system, the RCA 2600 fits in the same standard 3-inch opening, or in a smaller opening for the 2-inch model.

The RCA 2600 works on any voltage from 9 to 32, and it draws a fraction of the current required for conventional spinning-mass electric gyros.

Kelly's newest RC Allen AI also weighs a fraction of a traditional electric gyro, at 16 ounces for the 3-inch and 8.5 ounces for the 2-inch.

The full-color, liquid-crystal display is sunlight-readable and fully adjustable. It takes a standard connector, which should make installation a plug-and-play affair.

For more information, visit www.kellymfg.com.

L-3 AVIONICS SYSTEMS

L-3 Communications Avionics Systems, an increasingly innovative, diverse company offers hazard awareness and avoidance gear considered staples in the industry.

And company elements now incorporated into L-3 long have offered some of the industry standards in standby instruments: J.E.T. standby AIs; AIM Gyros; and the GH-3000 series for business-turbine aircraft.



Trilogy ESI-1000

L-3's Trilogy ESI-1000, the first solid-state integrated standby system created specifically for Part 23 aircraft, is designed as a backup for glass cockpit avionics.

So complete in its capabilities, it's easy to imagine some aircraft owners considering the Trilogy for a compact conversion to a glass primary flight display — defined these days as an electronic system essentially serving to provide all the information of the entire standard six-pack in an IFR panel.

The name, Trilogy, comes from the instrument's integration of all three functions the FAA requires as a minimum backup stack for a glass panel: attitude, airspeed and altitude.

The cleverest aspect of L-3's newest standby offering comes in its presentation: The Trilogy employs a single, large active-matrix liquid-crystal display, which presents all three pieces of information in a format mimicking those employed by the primary flight display of a glass panel. This means the full width of the display presents the horizon line, while

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vertical-tape readouts on either side provide airspeed (left) and altitude data (right).

Add an optional remote magnetometer, and the Trilogy also supplies gyro compass indication, making the unit a suitable standby unit for four of the standard six-pack instruments. Drop one into the place of the turn gyro, add a slip/skid ball, and you've got high-tech redundancy for even analog panels.



AIM Gyros

It's been just six years since Goodrich sold its avionics line to L-3 Communications, and many a user of BFG's formidable standby instruments should appreciate that L-3 Avionics Systems continues to make and support legacy products like the AIM line of standby gyros.

Today's four AIM models from L-3 offer a variety of features, power configurations, tilt angles and, in the case of the AI models, size. All sport a warning flag to alert a pilot of a problem.

The AIM 520 fills the need for a compact, 2-inch electric attitude indicator, a popular choice for new and newly upgraded glass cockpits. Options for the 520 include a range of three tilt angles (0, 8 and 15 degrees), internal lighting (5 or 28 volt) and the ability to mount to the panel front or rear.

The 3-inch AIM 1100 offers

an optional slip/skid ball, making it eligible to replace a turn gyro under AC 91-75. The 1100 also works on either 14 or 28 volt, with lighting available for 5-volt lighting systems.

The top-end AIM 1200 offers the same benefits of the 1100 in a 28-volt-only model, which has optional HIRF and lightning-strike protection.

L-3 Avionics also offers a rarity among standby gyros, an electric standby directional gyro available for both 14- and 28-volt aircraft. The 3-inch AIM 205 sports its own striped failure-warning flag to alert a pilot should voltage drop below a set level. Options include integral lighting and an autopilot bootstrap. This electric DG and any number of electric AIs provide a path to converting an aircraft to an all-electric analog panel.



J.E.T.

Durability, flexibility and independent describe some of the traits of L-3 Avionics' J.E.T. line of standby attitude indicators.

Tops among the features for many instrument pilots are the J.E.T. line's integral power supply, which can provide about 9 minutes of power to the gyro after a total electrical-system failure.

All but one are 3-inch models; the fifth of five is a 2-inch model. They all sport integral lighting and power-off warning flags.

The 3-inch models also employ wheel-speed monitors to flag the pilot if the gyro spins below a pre-

determined speed and threatens to denigrate accuracy.

The top three 3-inch models add to their capabilities cross-pointer indicators for localizer and glideslope signals, as well as requisite warning flags to alert the pilot to failure of either signal.



GH-3000/GH-3100

Picture a full-size, pilot-side primary flight display with attitude and heading displays, navigation information, HSI and air-data functions. Now, imagine this in a system mounted in a single 3ATI opening and weighing no more than 4 pounds.

You are picturing the GH-3000 or GH-3100 electronic standby instrument systems. These ESISs are all solid-state with an option to add a solid-state air-data card, which plugs directly into the unit ready for pitot- and static-line connections.

The GH-3000/3100 products represent the pinnacle of L-3 Avionics' standby system offerings, perfectly suited to serve as a single-point standby for either an analog six-pack stack or an all-glass wonder panel.

For more information, visit www.l-3avionics.com.

MID-CONTINENT INSTRUMENTS

4300 Series Lifesaver

Arguably a value leader in standalone gyro and flight-instru-

ment hardware for the FAR 23 market, in particular, Mid-Continent Instruments continues to refine its standing in the standby instrument field with its aptly named top-of-its-line product: the Lifesaver.

The Lifesaver 4300 attitude gyro boasts a design with a posted mean time between failure of 7,500 operating hours – higher than typical for an electric gyro and a promise of value competitive with some lower-cost alternatives.



The 4300 series runs on 10 to 32 volts. The optional slip indicator makes the Lifesaver a legal replacement for a turn gyro per AC 91-75.

But it's the integral battery that gives this AI its main claim to fame and is the foundation of the "Lifesaver" name. Thanks to a custom-design, lead-acid cell array compactly tucked into the package, the Lifesaver can deliver at least an hour of run time in the event aircraft power fails.

A bezel-mounted button also gives the pilot the option of switching power to the standby battery in the event a generating-system failure necessitates a reduction in electrical load.

The same electric indicator is available without the battery option; however, employing this option gives the pilot an instrument that can partially backup its own operation.

For more information, visit www.lifesavergyro.com.

Comparison chart on following page...

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Comparison of Standalone Instruments

MANUFACTURER	MODEL	DESCRIPTION	LIST PRICE
Castleberry Instruments*	300-14EL	Electric standby attitude indicator; optional standby power pack; applicable to any airplane as replacement for turn gyro (with inclinometer); 14, 28 volt.	\$2,295 (\$3,995 w/stand-by powerpack)
Kelly Manufacturing*	RC Allen RCA 2600	2- and 3-inch, all-digital electronic attitude indicator; full-color liquid-crystal display; full 360 roll-and-pitch capability; lightweight; low power; optional inclinometer makes unit eligible for use in place of turn gyro under FAA AC 91-75; applicable to any aircraft; 9-32 volt.	\$2,495 (both sizes)
L-3 Avionics Systems*	AIM 520	2-inch, FAA-approved electric standby attitude indicator; applicable to any aircraft; FAA-approved for back-up use; 28 volt.	\$7,900
	AIM 1100	3-inch, electric standby attitude indicator; applicable to any aircraft; FAA-approved for back-up use; 14, 28 volt.	\$4,860
	AIM 1200	3-inch, FAA-approved electric standby attitude Indicator with HIRF; lightning protection available; applicable to any aircraft; 28 volt.	\$5,990
	AIM 205	3-inch, FAA-approved directional gyro, with available autopilot bootstrap and heading bug; applicable to any aircraft; 14, 28 volt.	\$5,820
	J.E.T. (general information)	This line comes with integral standby power system and power-off warning flags; options available for analog or digital systems, with and without CDI and LOC/GS.	Prices start at about \$20,000
	J.E.T. AI 804	2-inch, FAA-approved electric standby attitude indicator; applicable to any aircraft; 28 volt.	-
	J.E.T. AI 330	3-inch, FAA-approved standby electric attitude indicator with integral back-up power; applicable to any aircraft; 18-30 volt.	-
	J.E.T. ADI 330/331	3-inch, FAA-approved standby electric attitude indicator with integral LOC/GS indicators; applicable to any aircraft; 18-30 volt; 330 is analog; 331 is digital.	-
	J.E.T. ADI 332/333	3-inch, FAA-approved standby electric attitude indicator with choice of ARINC 500 or ARINC 429 interfaces; back-course LOC capability; VOR and GS indication; applicable to any aircraft; 28 volt.	-
	J.E.T. ADI 335	3-inch, FAA-approved standby electric attitude indicator with digital display of VOR/DME, ILS/BC heading information and cross pointers; applicable to any aircraft; 28 volt.	-
	Trilogy ESI-1000	3ATI all-solid-state emergency electronic standby instrument with option for full compass function, airspeed and altitude; AMLCD display of 3.6 inches diagonal; certification pending as of July 2009; applicable to any aircraft; 14 (with converter) or 28 volt.	\$16,570 (est.)
GH-3000/ GH-3100	Electronic standby instrument system that is a primary flight display in a compact 3ATI package; attitude, directional, nav, approach and all air data on single electronic display; can be used as primary or standby instrument; GH-3100 adds dedicated air-data card with pitot/static connections to eliminate the need for an external air-data computer; applicable to any aircraft; 28 volt.	\$59,990 and up	
Mid-Continent Instruments*	Lifesaver 4300 Series	Long-life 3-inch electric standby attitude indicator with optional battery for standalone redundancy; battery promises at least 1 hour of run time after an aircraft electrical-system failure; various configurations available; applicable to any aircraft; 14 or 28 volt.	\$3,950 w/o battery; \$4,770 w/battery

Manufacturer suggested list prices are subject to change. Contact an authorized dealer for current pricing. * Denotes Aircraft Electronics Association Member Companies