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WINDVANE VS AUTOPILOT

Below is an article that I wrote. It appeared in the January 2004 Cruising World magazine. I hope it will be useful to yachties contemplating the installation of a self steering system.

Albert Takes on Otto

Offshore Sailing by Tony Gooch.
On a circumnavigation, a solo sailor has his windvane duke it out with his autopilot to see which reels off the miles more rapidly.

In 1995, my wife, Coryn, and I sold the Arpège 29 we'd sailed for 16 years, during which time we'd crossed the Atlantic and Pacific oceans. In her place, we bought a 42-foot German-built aluminum sloop, named her Taonui, and proceeded to log more thousands of miles. Then in September 2002, I set off on my attempt to sail solo, non-stop around the world, starting and finishing in British Columbia. On that voyage, which I intended to complete as quickly as I prudently could, I planned to make extensive use of an autopilot. Based on my experience two years earlier on a solo voyage from Cape Town, South Africa, to England via Cape Horn, I felt that a good, powerful autopilot would do a better job than a windvane, particularly when running before the westerlies in the Southern Ocean. With this in mind, I upgraded Taonui's Simrad autopilot drive unit to the manufacturer's HDL2000L model. To drive it, I installed the latest Simrad. AP22 and J300X control units, and I also added the necessary electronics to enable the AP22 to steer a course relative to a chosen apparent-wind direction.

When we bought Taonui, she had a Monitor windvane that had already seen 30,000 sea miles. Taonui has a long keel, a keel-hung rudder, and tiller steering, and this windvane, which we affectionately called Albert, did a fine job of keeping a steady course in all manner of seas and winds. I have a great regard for Albert, but without wanting to seem disloyal after many thousands of miles, I felt that the upgraded Simrad autopilot, nicknamed Otto, achieved longer daily runs.
The force of wave action on the hull and changes in the apparent wind will cause a windvane to steer a course that weaves from side-to-side. In theory, because it's set to follow a chosen compass heading, an autopilot steers a dead-straight course. I even installed a new RFC 35 fluxgate compass that would give the control unit more accurate information. In fact, of course, the actual track steered by the autopilot also weaves from side-to-side. A soft key on the new Simrad control unit allows you to view the actual course (as distinct from the chosen course), and I was surprised at the amount of yawing it displayed. In the early days of singlehanded ocean racing, the boats were steered by windvanes, but as the yachts became longer and faster and able to accelerate more quickly, the changes in the apparent wind became too rapid for a windvane to handle. Today, these racing machines regularly hit sustained speeds of 20 to 30 knots and need sophisticated electric/hydraulic autopilots acting directly on their rudderstocks.

Taonui is 42 feet long and displaces about 15 tons, fully-loaded with her full bilges and deep, long keel, she's a very comfortable offshore cruiser, and Albert can certainly handle any speeds she's likely to achieve, even "surfing" downwind in a Southern Ocean gale. Albert follows the apparent wind. If I set the sails for maximum speed for the wind that's blowing, Albert will keep Taonui sailing at her fastest speed for that wind. The wind rarely blows steadily from exactly the same direction; it always oscillates five to 10 degrees, and of course, it's subject to actual shifts in direction. None of which troubles Albert. Otto follows a chosen compass heading. He doesn't know about wind shifts, and when they do occur, the boat will be sailing at less than its maximum speed. I felt that when wind oscillations are small, these probably wouldn't have a big effect, but a 10-degree wind shift would certainly result in a loss of speed, which, if I were asleep, would go unnoticed until the change in the boat's motion woke me.
Under the influence of the wind and waves, both Albert and Otto deviate from side to side of the desired or, in Otto's case, the selected course. Albert's deviations are wider, but he delivers a higher speed. The objective when passage making is to maximize the number of miles made good toward a selected point. So which system is better?

The Contest

On a six-month nonstop circumnavigation, I had plenty of time and opportunity to compare the performances of the two steering systems. I ran tests in which I would set Taonui on a steady course relative to the wind, with first the windvane (Albert) steering for an hour, then with Otto the autopilot at the helm for an hour.
If the wind strength or direction changed, I abandoned the test and started again. I wanted to see which steering system yielded the most miles made good in an hour in as near as possible the same wind and sea conditions. If the wind was between 38 and 85 degrees apparent, I set the autopilot to steer a course relative to the apparent wind. The autopilot can't steer off the readout of the apparent wind if it's aft of the beam, so with the apparent wind between 90 and 180 degrees, I had the autopilot steer a compass course. I tracked Taonui's performance by GPS, and to get a readout of miles made good to two decimal places, I set a course to a waypoint that was less than 100 miles away. Before I started the clock running, I would trim the sails for maximum speed, then not touch them for the two hours of the test.

Observations

Although the autopilot steers a straighter course, in most of the tests, the windvane yielded more miles made good. The windvane reads the small oscillations in the apparent wind and adjusts the course to keep the sails driving at maximum efficiency. With the wind aft of the beam, the autopilot tries to steer a compass course, and the changes in the apparent wind result in the sails performing at less than maximum efficiency. The differences are small, but over a long passage, they do add up: If my average speed for the circumnavigation had been 5-percent slower, I would have taken 186 days instead of the actual 177 days
With the wind forward of the beam and the autopilot steering to a set apparent-wind angle, there wasn't much to choose between the autopilot and the windvane, though it was clear that the windvane yielded more miles made good at the smaller apparent-wind angles. If the wind was between 85 and 95 degrees apparent, it was better to set the autopilot on a fixed compass course, and with this, the autopilot yielded more miles made good than the windvane.
I also ran a number of tests, which aren't recorded here, in which I sailed on a close reach and closehauled with Otto steering a compass course. The autopilot's inability to "read" the wind reduced the speed and miles made good, when compared to those achieved by the windvane, by about a third. The reason for this is that a windvane acts like a helmsman and keeps the sails performing at maximum efficiency by following the wind as it oscillates and/or as the boat rides up and over the waves. The autopilot tries to force a fixed course, and the sails are inevitably luffing or

overtrimmed relative to the changing wind.

Bottom Line

Boats up to about 30 feet can be steered by an autopilot that connects directly to the tiller, and some models of light-performance autopilots can be connected to the hub of a steering wheel. These units are adequate for motoring, but they¹re not strong enough for extensive use offshore. Ocean-going boats longer than 30 or 32 feet will typically have an electric or hydraulic linear-drive ram connected to the rudderstock below decks. This requires fitting a strong mounting base, running electrical cables, and mounting control units cost of Taonui's upgraded Simrad system was $4,300, not including taxes. Installation cost only $450 because the mounting place was built when the boat was constructed and we could use much of the old wiring. To fabricate and install a mounting base, run wiring, and fit the autopilot components would take 25 to 30 man-hours and cost roughly $1,500 to $2,000, for a total cost of around $6,000. By contrast, a new Monitor windvane costs $3,500 to $3,800, depending on whether the boat has wheel or tiller steering, you can fit it on the stern of almost any sailboat, and it's a do-it-yourself installation. An autopilot draws a current of 3 to 5 amps, which on most boats is generated by the engine-driven alternator. Most windvanes are reasonably bulletproof in construction, but if something does fail, they're relatively easy to repair. The sacrificial tube between the pendulum strut and the water vane is designed to break in the event of a collision or excessive load. Its easy to replace.

I had only one such breakage on this trip. During 110,000 miles of sailing, Albert's only other breakages were; a worn out bushing, a compression fitting on the actuator shaft, which as an easy fix on a drill press and the loss of the water vane. Before my first circumnavigation, I replaced the pendulum, and every three or four years I've replaced the turning blocks for the control lines. In contrast, a couple of years ago, a hydraulic seal broke on my old Simrad, and I had to return it to the factory for repair. Since then, I've carried a spare drive unit (costing $2,150). An autopilot's electronic control units are usually trouble free, but if they do fail, they're black boxes. Aesthetically, a windvane is more pleasing. It makes no noise, requires no feeding, and works in harmony with the wind and the waves. An autopilot makes a noise, requires the running of an engine or generator to supply its energy, and uses force to overcome the pressure of the wind and the waves. Based on the tests I ran, a windvane delivers more miles made good. On a long passage, this is what it's all about.

Having said all this, I would always carry both an autopilot and a windvane, if for no other reason than an autopilot is needed when motoring. For shorthanded sailing, it's essential to have two independent self-steering systems in case one fails. But, if I could have only one, I'd choose a windvane for offshore passagemaking.

Test Results

Point of Sail	Wind Angle (degrees)	Wind Speed (knots)	Miles Made Good in an Hour- Albert	Miles Made Good in an Hour- Otto	Percent Advantage- Albert	Percent Advantage- Otto
Closehauled	38	16	6.61	6.24	6%	
Close	55	20	7.30	7.13	2%	
Reach	85	12	4.97	5.00		
Reach 0.6%	95	20*	6.56	7.08		
Reach 8% Broad	120	25	6.93	7.14		
Reach 3%	130	30	7.00	7.14		
Broad Reach 2%	165	22	6.85	6.23	10%	
	175	20	6.72	6.42	5%	

Broad Reach Running Running	180	30	7.50	7.21	4%

* Seas were large and confused from an earlier frontal passage.