I have a great job. Although my primary responsibilities with the company lie elsewhere, as part of my employment I fly a turbocharged Beech Baron. One of the first things my new employer asked when I came on board, was whether I thought adding vortex generators (VGs) to the Baron would help with the airplane's short-field performance—we fly out of a 3300-foot runway in the east Tennessee hills, long by most lightplane standards but on the ragged edge of performance in a loaded Baron on a hot summer's day.

What Are Vortex Generators?

As a wing flies at higher and higher angles of attack, airflow begins to separate, reducing lift and increasing drag. At the point where airflow separation is far enough forward on the wing that sufficient lift is no longer produced, the wing stalls. For a given g-load, the slower the airplane is flying, the higher its angle of attack—so, assuming a one-gee glide down final approach, slowing the airplane too much will lead to a stall. The lower your landing speed, the less distance it will take to bring the airplane to a stop. The trick to short-field landing, then, is to fly at slowest speed that is still safely above stalling velocity.

How can vortex generators affect landing distance? VGs are small, metal tabs scientifically located on the forward edge of the wing, which create a series of "tiny tornadoes," or vortices, in the air flow. VGs force the air to adhere to the wing at higher angles of attack than is normal. With VGs, then, the speed of a stall on final approach is reduced. The pilot can fly a slower final approach speed, and still have a safe margin above the stall. Fly slower on final and, voila, you take less runway to stop. VGs, then, promise to reduce landing distance.

The same works for takeoff. You can rotate and lift off at a slower speed, owing to the greater amount of lift created by VGs. Since you don't have to accelerate down the runway as long as it takes to reach the "normal" takeoff speed, you can lift off sooner, and climb above obstacles more easily, with vortex generators.

In multiengine airplanes, VMc, the speed at which directional control is impossible with the failure of the critical engine, determines climbout angles and single-engine performance. VGs on the wing provide more lift at slower speeds, improving single-engine climb; VGs mounted on or forward of the airplane's rudder create improved air flow and therefore control authority at slower speeds also, reducing VMc. In fact, with VGs installed the VMc speed is often slower than the stalling speed of the airplane—meaning that the pilot can safely climb out at a slower speed, and a better climb angle, in the event of an engine failure.

But Will They Really Work?

Companies selling VGs for light twins stress the changes in single-engine performance. I was investigating them instead for their short-field performance effect. Depending on whose research you read, you can go either way on the benefits of vortex generators. On behalf of the U.S. Forest Service, for instance, the University of Tennessee Space Institute conducted a study which showed little benefit to VG installation on the Forest Services' 58P Barons; in fact, the Space Institute found that pre-stall warning was reduced, and stalls themselves were more pronounced, with vortex generators installed. The American Bonanza Society's BPPP training program, further, has noted four cases where inadvertent opening of the forward passenger door in flight (for various reasons a relatively common occurrence) led to rapid and dangerous "pumping" of the elevator and yoke in VG-equipped Barons. And of course, Raytheon Aircraft disputes the value of aftermarket vortex generators on their products, colored no doubt by the recent, multimillion-dollar judgment against Raytheon resulting from the crash of a VG-equipped Baron.

Nonetheless, owners of VG'ed airplanes love them. Neil Pobanz of the American Bonanza Society (ABS) told me, for short-field performance, "you'll like them." Past ABS President Ron Vickrey, who own a VG-configured B55 Baron, told me the best thing about VGs is that it makes the airplane "more stable," with "more control authority at slow speed" U.S. Forest Service 58P pilot Gordon Harris said that he thinks his agency "should use them (VGs)," for slow-speed handling. And retired Forest Service Chief Pilot Rick Watkins said the University of Tennessee report "should be taken with a grain of salt," that vortex generators were "not an enhancement to (the Forest Service's) particular application," but that the UT report "does not reflect what VGs will do for the airplane."

Questions, Questions

Armed with opposing viewpoints, I contacted the two companies that offer FAA-approved kits to install vortex generators on Beech Barons—Micro AeroDynamics, Inc., and Beryl D'Shannon Aviation Specialties, Inc. I asked each the following questions:

1. Do you know anything about the American Bonanza Society's experience with control "pumping" on VG-equipped Barons, with a door open in flight?

2. Will installation of your kit include a supplement with new, published V-speeds?
3. Can you recommend any VG installation facilities?

Charles White at Micro AeroDynamics was very quick to respond. He had not heard reports of the ABS incidents, but suggested that they were the result of aerodynamics issues not limited to the VGs themselves. He told me that the Micro AeroDynamics Beech 58TC kit did not include remarked airspeed indicators or revised published v-speeds—he reports that "there are many Baron 58s and only a few Baron 58TCs, and we could not amortize the cost of certifying new numbers on the 58TC. We did however use the same flight tests to gain STC approval for the58TC and the kit is identical to the VGs on the Baron 58." White said that his kits could be installed by just about any mechanic in the field, but recommended a shop in Ohio as one that had a lot of experience installing his design.

Soon afterward Scott Erickson at Beryl D'Shannon returned my call. He had forward my questions to Director of Research Mike Trudeau and, sure enough, I received a detailed letter from Trudeau the next day. He, too, had not heard of the "control pumping" problem; he said he had not been asked by anyone about it before, including ABS instructors, and that Beryl D'Shannon is "unaware of how or why VGs would cause such an adverse effect." "On the subject of airspeeds," Trudeau wrote, "all Baron kits we produce offer reduced (v-speeds). All except the 58P/TC kit (airspeed reductions) are FAA approved. The reason for this is simple. The pitot-static system on the test airplane was leaking during (certification) flight testing. Hence, the results were invalid. (The speeds were) never retested with an FAA pilot…so, the kit was FAA approved as an improvement, but the lowered airspeeds were not." Therefore, VG kits for model 55 and 58 Barons include a remarked airspeed indicator, with lower v-speed values, while 58P/TC kits do not have the revised indicators. D'Shannon, too, claims a kit easily installed by mechanics in the field.

The Decision

So, what to do? I put blanket feelers out on internet Beech owners' pages. I read Mike Busch's rave reviews of VGs on AVWEB. I asked my mechanic at Stevens Aviation at Nashville, and found he'd installed a number of D'Shannon kits on Barons already. The end result was that everyone I spoke with that flew a VG-equipped airplane loved them. I decided that they were worth a try, thinking we could always take them off if they didn't work out. Now I had to decide which brand to buy. Micro AeroDynamics was quicker to respond to my questions, but

Beryl D'Shannon replied with less marketing hype and more precise data. I jotted the pros and cons on a sheet of paper:

	Beryl D'Shannon	**Micro Aerodynamics**
Design Test	wind-tunnel tested	recently updated design, flight tested but not wind-tunnel tested
Company	specialist in Beech modifications	few Beech mods; mainly a Cessna modification firm
Installation	by my local mechanic, who has significant experience with the kit	done locally by someone with no experience with the kit, or at some distance by experienced mechanic
Answers to my questions	addressed my short-field concerns with hard data	kept steering answers back to the improved single-engine performance
Kit cost:	$1500	$1715

My decision then became fairly easy—I would get the Beryl D'Shannon kit, wind-tunnel tested on Beechcrafts, installed locally by an experienced shop, and for less money. I'm certain I would have been as happy with the performance results of the Micro Aerodynamics kit, but the advantages of D'Shannon won out.

Installation and Testing

The kit came shortly after ordering, in a deceptively small box—one hundred and four little metal vanes, painted to match the wings and tail of our airplane, with installation instructions, bonding agent, and the STC paperwork that made it all legal. Stevens Aviation installed them in a day.

To see what performance increase we had really bought, I did some flight testing of the Baron before modification, and repeated the tests afterward. I loaded the airplane to weights as close to identical as possible for "before" and "after" tests, and each time performed four successive full aerodynamic stalls, entered at 15 inches manifold pressure, propeller controls fully forward, with landing gear down and flaps fully extended. I chose this configuration to simulate an "over the fence" final approach situation at what for me would be a typical landing weight. The stall testing was followed by two successive VMc demonstrations using the technique specified in the FAA Flight Training Handbook. Following the tests, landing approach speeds were calculated as 1.3 times the indicated stalling speeds. The results:

	Test	Before	1.3X	After	1.3X	V (1.3)
Stalling speed (KIAS)	1	61	79	60	78	-1 knot
	2	62	81	58	75	-6 knots
	3	59	77	59	77	none
	4	58	75	57	74	-1 knot
average (1-4)		**60**	**78**	**59**	**77**	**-1 knot**

	Test	Before	After	Δ
VMc speed (KIAS)	1	78	62*	-16 knots
	2	79	60*	-19 knots

*note: after v.g. installation, VMc speed approximately coincides with stalling speed in the tested configuration. Therefore, the VMc scenario has effectively been eliminated.

My testing, as tabulated above, indicates that a VG-equipped approach and landing can (and perhaps should) be made at a lower indicated airspeed on final approach, than is recommended in the Pilot's Operating Handbook. Aircraft control "feel," however, prevented me from landing at an average 78 knot final approach speed prior to installation of vortex generators. Although the Beryl D'Shannon VGs had virtually no measurable effect on aircraft stalling speed in the tested configuration (a one knot average reduction in indicated stall speed), it did in my opinion significantly improve the control "feel" and response at these slower speeds. This makes it far more comfortable flying to the limit of the airplane's performance.

Following post-installation flight testing, I made several approaches and landings at an "over the fence" speed of 80 knots—about 1.3 times the stalling speed as tested, with a solid control feel and a significant margin above stall. In practice, I found I could consistently stop the Baron with about a 2500 foot ground roll, approximately 20% less than before modification.

In fact, I've found that the vortex generators tend to *increase* landing distance when the airplane is landed at the "book" airspeed, probably because of the drag-reducing effect of VGs.

Other issues to consider at the high nose-up trim resulting from an 80-knot landing, which requires careful acceleration to a safe speed while avoiding excessive pitch-up on a go-around.

I conclude that, since improved control feel at slower airspeeds allows for better short-field performance, and since VMc has been effectively eliminated, that installation of vortex generators in our company's special case of regular, short-field operation was a good investment.

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