"Ryszard Zadow" ryszard@earthlink.net On Short rough field performance with modifications:

Due to many circumstances we live on an airport with less than desirable runways. Rather than get rid of my Varieze, I flew it until it became obvious continued operation would eventually damage the gear. A lower takeoff and approach speed would really help. I was inspired by Jim Price’s success using vortex generators to achieve low indicated airspeeds during his high altitude record flights. Using the WAG scientific method taught me at Texas A&M, I copied the placement and pattern of what he did on his Long EZ. WOW! I've never been so excited about my airplane flying slow!

Prior to the vg's my takeoff technique was to accelerate to 50 mph IAS, then rotate the elevator full aft. The canard would continue the rotation until I reached a maximum nose high attitude then I would have to stop the rotation until 70mph when the aircraft would unstick. At about 900 lbs. this would take about 1100 feet

My minimum approach speed, at light weights was 85 mph. On our paved runway, landing south there are 50-foot pine trees at the approach end displaced 87 feet from the threshold. There is a 200-foot asphalt patch 1836 feet from the approach end of the runway. The patch has a thick edge to it and hitting it at high speed creates enough force to bounce the nose of the aircraft back into the air. A 3-degree glide slope would give me 1092 feet to get completely stopped before "hitting" the patch. I’m flying more like a 5 degree glide slope. Usually, weight and temperature limiting, I could get the aircraft stopped before the patch. Anything other than perfect technique, weight, temperature or wind and I would roll over it at 30 mph or less. This required maximum braking to the point it once bubbled the paint on the brake side of the wheel pants. (No other damage.)

Original stall performance was 65 mph IAS, power on or off, 500 fpm VSI respectively. No wing rock or other adverse characteristics where exhibited. It has vortilons and winglet "thumbs". Due to the approach obstacles slipping the airplane has always been a required maneuver. Slips done at approach speeds where normal. In tests, when cross-controlled at 65mph, (power off) the airplane would do what I called a "scalloping" maneuver. The canard would stall, fall and rise concurrent with the nose turning about 20 degrees into the direction of the rudder. The turn and nose movement would continue all the way around the compass until the control inputs where taken out. This is a very mild and controllable maneuver.

I put 10 sets of vg's on each main wing between 4.5 inches inboard of the winglet and the root of the wing at the wing attachment point. They are 20% aft of the leading edge, 20 degrees off the centerline of the airflow, 1.5 inches apart. Even though my canard is shorter than a Long EZ, I spaced out 6 sets for each side. However, I ran out of vg's so I wound up with 5. I left the outboard one off.

In the true spirit of homebuilding I made my vg's out of plastic corner protector. The stuff used on sheet- rock walls. It comes in 1/2 inch extruded 90-degree clear strips. I was walking through Home Depot and saw this stuff and the light bulb came on. I can cut it with scissors or an Exacto knife! I trimmed it down to 3/8 on each side and made each side trapezoid shaped. This differs from the tapered/half arrowhead shape. It’s what I remembered being on the A-4 and I just did it. I attached them with carpet tape.

First flight with the vg's I did a normal takeoff and climb. It was about 65f, and we weighed 900 lbs. At 4500 ft I started to slowly input aft elevator. The airplane continued to decelerate while climbing to an IAS of 55mph. At 55 the canard stalled. Still climbing at 500 fpm. This was a big change!

I continued to 8500 feet and started more testing. The minimum canard speed was 55mph. The most significant change was the break at the canard stall. Previously it was very docile. Now I had a pronounced break at the canard stall, yet it recovered quickly, but with more degrees of downward nose movement prior to the canard stall recovery. In turns the stalls acted normally. Full deflection rudder and aileron pulses at stall speed acted normally and displayed good static stability.

Cross-controlled inputs to the right where normal with the same scalloping as before. Cross-controlled inputs to the left however produced amazingly different results. At first canard stall and yaw appeared normal but the airplane rolled RIGHT. Then both the pitch and yaw oscillations became greater and divergent. At the third scallop the airplane broke sharply the left!

Now knowing my limitations on cross control inputs I proceeded to do landing tests. I did all the landings without any slip input at all. I started with normal approach speeds of 85 backing off 5 mph, as I became more comfortable with the new speed and attitude. There was a light wind from the north so I was landing on our grass runway. (Because of runway condition I land north on the grass and south on the pavement) The grass runway is 3000 feet but 2002 feet down the runway it becomes very bumpy. It also has power lines 235 feet from the approach end. In no wind conditions and/or a little excess speed I would roll through the rough. Not a good ride. My house is 470 feet before the rough stuff and I usually had to use max braking and then back taxi some to the house.

I was able to make good approaches and landings as slow as 65 mph!! I found 70 to offer a good compromise between visibility and stopping distance. I was able to get the plane stopped and turned off right into my taxiway at the house. Shortening my landing roll by 500 feet!!

The next day there was no wind so I was able to make takeoffs and landings on the pavement. For takeoff I used full aft elevator from the application of power. The airplane made one smooth rotation from canard liftoff to mains leaving the ground. All below 60 mph. I was airborne in less than 800 feet. Landings at 70mias I was able to stop 250 feet before the patch. 1586 feet total runway used over a 50 foot obstacle.

For flight #3 I added the sixth vg to the canard. Only full power tests where accomplished. What a difference that sixth vg made. I was light, around 850lbs and it was cold, @ 45f. The aircraft behaved normally on takeoff and climb. Passing 4500 I started programming the nose up. The canard still stalled at 55 mph IAS but the pronounced stall break was gone. The aircraft stalled the same at 55 mph IAS as it did at 65/no vg’s. I went through my hole card of power on maneuvers, including full rudder and aileron pulses with a stalled canard. Roll exhibited good static stability but yaw was a little less than desired. After a few oscillations the aircraft tended to recover about 20 degrees off the original heading. There was no tendency to prefer either side, it just seemed random left or right.

Now came the real surprise! Recall I had a sharp left wing drop with full right rudder and full left aileron at stalled canard aoa. With the 6th vg the aircraft still yawed and rolled right, but there was no divergent roll or opposite break to the left. Most significant was that the aircraft continued to pitch up until the airspeed was below 40 mph IAS. I wish I had an aoa gauge! The pitch attitude was extremely nose high, yet I had full control authority. As soon as I released back pressure the nose would fall a few degrees and the airspeed would increase. Cross-controlled maneuvers to the right yielded similar results but without as much high AOA and 50 mph IAS.

These flights have proved that vortex generators will reduce the minimum speed at which you can approach and land at light gross weights. Prior to vg installation, I could just barley fly formation on our J-3 cub. If the Cub started a descent I could not keep from running out in front of it. With the vg’s I could fly very comfortably alongside the J-3 not only in cruise, but climbs and descents.

I have not been able to do any testing at gross weight. Due to the short and rough runways I don’t fly on or off here at gross weight routinely. I have flown from a different airport with a 210 pound passenger and we obviously did not achieve these same results. I have also seen about 4 mph IAS slower cruise speeds. With further testing of vg positioning I hope to achieve a compromise that provides slower speed with less of a high end loss. After all going fast is what’s important!