StolSpeed Vortex Generators on a Harmon Rocket II – Flight Test Report

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Summary

StolSpeed Vortex Generators were installed on a Harmon Rocket II (C-GVRL). Flight test results showed improved stall behavior and a 3 KIAS reduction in full-flap (V_{S0}) stall speed; with a 1.7 KTAS reduction at fast cruise speed. Little reduction in clean stall speed or partial flaps (15 degree extension) stall speed was indicated.

Figure 1. Harmon Rocket II C-GVRL 'Voltar'

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Installation

A set of vortex generators made by StolSpeed Pty in Australia were purchased and installed on a Harmon Rocket II, C-GVRL. Identical flight tests were performed under similar conditions before and after installation. After the flight tests, data logs were extracted and airspeed information was compiled to provide a direct performance comparison.

The VGs were purchased from Aircraft Spruce Canada as the "STOLSPEED VORTEX GENERATORS 80" kit. Installation took about two hours, following the on-line instructions provided by StolSpeed. The kit provides heavy paper installation templates, however, these have a tendency to distort during installation. In order to provide more precision during installation, it is recommended that these templates be copied onto thin, flexible plastic that will not distort with use.

Figure 2. StolSpeed 80 Installation Kit

The wingtips on C-GVRL are the W-715-1 type, with the large light cove. This prevented following the exact installation instructions which required the first VG to be installed 2 inches inboard of the wing tip. Communication with StolSpeed indicated that the first VG should be installed just inboard of the light cove.

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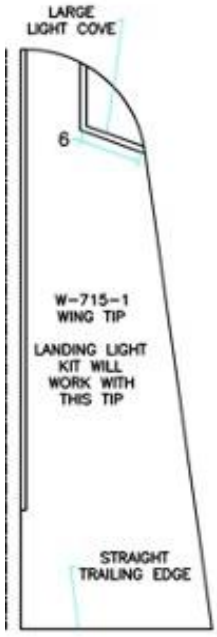

Figure 3. Vans Aircraft Wing Tip

Installation of the VGs normally should be done in warm temperatures (above 72 degrees F) in order for the adhesive to stick. Instead, due to ambient temperatures during installation in the 50's, a warm air gun and rubbing the VGs with a wooden dowel was used. This activated the adhesive and led to proper adhesion.

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Flight Tests

Procedures

Flight test procedures were established for both before and after tests. They consisted of the following:

- TAKEOFF-**NO FLAPS**
  - From a stop, apply full power and accelerate with neutral elevator and take-off trim setting until aircraft lifts off, then climb out normally

- FULL POWER CRUISE AT ALTITUDE
  - At 9000' density altitude and 2650 RPM, lean to maximum airspeed.

- STALL-**NO FLAPS**
  - Idle power, reduce speed at 1 knot per second until full stall break, recover

- STALL-**15 degrees FLAPS**
  - Idle power, reduce speed at 1 knot per second until full stall break, recover

- STALL-**FULL FLAPS**
  - Idle power, reduce speed at 1 knot per second until full stall break, recover

- ACCELERATED STALLS-**LEFT**
  - No flaps, 70 KIAS, 60 degree bank coordinated level turn until stall break, recover

- ACCELERATED STALLS-**RIGHT**
  - No flaps, 70 KIAS, 60 degree bank coordinated level turn until stall break, recover

- AILERON ROLLS-**LEFT**
  - No flaps, 130 KIAS, full control input.

- AILERON ROLL-**RIGHT**
  - No flaps, 130 KIAS, full control input.

- SPIN-**LEFT**
  - Two turn, recover

- SPIN-**RIGHT**
  - Two turn, recover

- APPROACH AND LANDING
  - Full flaps, 78 KIAS (before VGs) 72 KIAS (after VGs), wheel landing.

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Conditions

The weather and loading conditions were as follows:

No VGs:

- Location: CYYJ
- Date: 11/21/2016
- Altimeter Setting: 29.94 inHg
- Temperature 11 degrees C (sea level)
- Wind 26006
- Runway 27
- Fuel: 43 USG at take-off
- Take-off weight 1820 lbs.
- CG location 92 inches. 42 lbs of ballast carried in baggage compartment.

With VGs:

- Location: CYYJ
- Date: 11/28/2016
- Altimeter Setting: 29.92 inHg
- Temperature 8 degrees C (sea level)
- Wind 27002
- Runway 27
- Fuel: 43 USG at take-off
- Take-off weight 1820 lbs.
- CG location 92 inches. 42 lbs of ballast carried in baggage compartment.

Flight Notes

Both flight tests resulted in almost identical conditions . Temperature at altitude was within 1 degree C and the spread between PA and DA was within 76 feet. The second flight (with VGs), did not include the spins due to airspace restrictions.

Stall testing without VGs showed a tendency for a wing drop at full stall for both straight and level stalls and accelerated stalls.

Notably, stall testing with VGs could not obtain a clean break with a wing drop. Rather, a continuous stall buffet and rapid descent rate (1500+ ft/min) was obtained in the straight and level cases. In the accelerated stalls, there was no tendency for a wing to drop.

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Results

After the completion of both flight tests, data logs were extracted from the Dynon SkyView EFIS system and detailed analysis performed.

No VG Results

Speed Run

PA	8469	feet
DA	8999	feet
RPM	2642	1/min
MAP	22.1	inHg
FF	15.9-16.0	USG/hr
OAT	3	degrees C
AOA	2	percent
%HP	74	percent
TAS	204.9 avg	KTAS

Stall Speeds (KIAS)

Clean	60	wing drop
15 degrees	56	wing drop
40 degrees	56	wing drop

With VG Results

Speed Run

PA	8479	feet
DA	8935	feet
RPM	2640	1/min
MAP	22.1	inHg
FF	16.0-16.1	USG/hr
OAT	2	degrees C
AOA	2	percent
%HP	74	percent
TAS	203.2 avg	KTAS

Stall Speeds (KIAS)

Clean	59	no wing drop
15 degrees	56	no wing drop
40 degrees	53	no wing drop

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Sources of Error

As in any flight tests, there are several sources of error. Primarily, the speed runs have errors related to variations in atmospheric conditions between the tests. The logged data show this to be small (within 1 degree C and 76 feet DA-PA spread). Probably the largest source of error is caused by turbulence or small variations in the autopilot altitude hold system. For this reason, the recorded KTAS during these tests were the average speeds obtained in level flight conditions determined by examining the data logs. There is some amount of subjectivity in choosing the data sets and the error is estimated at less than 1 knot TAS.

Conclusions

The installation of StolSpeed VGs on Harmon Rocket II C-GVRL provides a substantial reduction in V_{S0} of 3 KIAS. Very little effect on V_S or partial flaps stall speed was indicated. Both 1G and accelerated stall behavior was improved in all configurations, with no wing drop noted in the tests.

Fast cruise speed was reduced by 1.7 KTAS, with less than 1 KTAS uncertainty in the results.

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