

Re: Mishap 3 June 2017 Garfield WA N255BZ

Andrew,

Thank you for the opportunity to look at the photographs from the investigation at Sonex 255/Aerovee Engine 398. I have looked in my files for both text and pictures that might be helpful to you.

1. I purchased the Aerovee engine quite some time before I began construction on the Sonex, in fact I had originally planned on using it on a VP-1. Center of gravity issues precluded my intended use, and the Sonex kit became available, and I finished it instead. It was clearly a much better plan! (See figure 1, Aerovee 398 partial inventory with purchase date.)
2. As the engine was purchased in 2007, a number of power plant changes were introduced and I made a very specific effort to ensure that they were all incorporated. However unless my notes clearly say that specific task was complete, I simply cannot recall what was completed. I think I incorporated all changes. (See figures 2 and 3. Power plants change and assembly instructions.)
3. In particular, my notes are complete on the fasteners required for the Flywheel, Stator, and Rotor in the Alternator assembly. It appears I acquired and used all the correct fasteners in the assembly. I found no required torque values in the assembly instruction, and am uncertain of the torque I applied, however I am sure it was sufficient. I have built engines, and in the past, none of them have come undone. (See figure 4, assembly instructions.)
4. Your photography showed the distress on the flywheel end of the crank, with egged holes and evidence of working bolts. I have included photos of the flywheel end components, which show that the major parts appear to have moved, with contact and scrubbing between the stator and rotor on the alternator, and rubbing at the magneto magnets. Interestingly enough, at no time did the engine act unhappy, with good power, easy starts, and no indication that it was failing internally. (See figures 5, 6, and 7, showing scrubbing on the rotor, the magneto magnets, and indications of fastener loosening on the housing for the Hall Effect sensor.)
5. As I have mentioned to you before, the departure of the propeller occurred with a significant degree of violence, and the ELT activated from the motion. In fact my first action was to look and see if the motor and the tail were still attached. The airplane was flying fine, but I still had to look; it was a huge transient. How much of the wear on the flywheel end had occurred prior to the event, and what happened as the propeller departed is open to question. I think it is probable that the much of the damage occurred at the moment of the crank failure. (See figure 8.)
6. I did note that the maximum engine speed after the propeller departed was only 4940 rpm (engine log page 27), and when I shut the motor down, it was still running without any load. The propeller was a Prince propeller, 54-44 with p tips, and even with the solid spinner was part of a very light package. The amount of inertia in the assembly was low. I had pulled power at the onset of the major vibration, but at that point, the crank was in the process of disassembling

itself. (See figure 9 for evidence that the fasteners on the rotating end of the crank were loosening and abrading the windings on the alternator stator.)

7. I have reviewed my logbooks, and a couple of items are worth mentioning. First, noting my log entry from 5/16/2016 on page 9, showed that I checked the propeller torque on the aircraft. I was coming downhill to RLD airport, with the propeller pushing the engine, and I noticed (impossible to ignore) a vibration that made me think I had a loose propeller. When I balanced power with speed, the vibration stopped, and never recurred. The propeller torque was good, all bolts were at 140 inch pounds, per specification. (See figures 10 and 11, pages from the engine logbook.)
8. On reflection, it appears to me that the engine was going to fail on one end or the other, and the fact it failed when it did, and where it did was mostly good luck. If I were going to assemble and operate this engine again, I would ensure torque values on the alternator/magneto assembly end were known and used and that Loctite was present.
9. One thing that I would do in any future situation would be to ensure the engine was dynamically balanced, but frankly I think it was a very nice, smooth-running, easy starting little engine. I struggled with cooling and redid baffling multiple times, and 80 horsepower wasn't enough, but overall I had no reservations about building or using the Aerovee 2180. The problems with the engine produced no symptoms until they were fatal, and I certainly would have preferred more warning.
10. Perhaps more emphasis on the importance of assembly on the back of the motor, and torque values for the countersunk hex fasteners would be helpful. Whether the issues at the rear of the crank were causal in the failure of the crank at the hub would be open to question to me, but it is clear that there was a fatal failure mode at both ends.
11. It appears to me from the obviously prolonged fatigue failure in torsion at the front of the crank that something was amiss, and had been for some time. My reaction was that a stress riser at the bottom of the cut for the woodruff key led to a crack that propagated until the shaft failed. I would doubt that the forward crank failure was material related, more likely a manufacturing issue with a keyway square bottom creating a stress riser. Of course, the forward bearing and crank, hub, prop, and spinner were never found, so I am speculating on that mode of failure.
12. The problem at the back of the crank came as an unpleasant surprise to me, and I would credit that issue as a result of improper assembly of the flywheel and alternator components.

Perhaps my input will be helpful in your preparation and analysis. Better images are available if needed.

Paul

Paul Seipt

A vertical strip of a cluttered desk. At the top, a blue binder with the text "SUPERCHARGED! A FASTER RV-8" and "WHEEL PLANES" is visible. Below it, a yellow sticky note says "Pack - click click". To the right, a pink sticky note says "Packing List". Further down, a white ruler shows the number "37.9". A blue pen lies horizontally across the ruler. At the bottom, a small white container holds several small, colorful objects.

37.9 %

Packing List

Plank Clark Clark

Early
 Paul Sept.
 Monahan
 SUPERCHARGED! A FASTER RV-8
 WHEELMANES
 Packing List
 2 wheels. 1 axle
 Frank Rockwell

Sonex Aircraft LLC

SHIP DATE	INVOICE #
10/3/2007	9049

SHIP TO:

PAUL SEIPT

APR

ORDER DATE	P.O. NO.	PLANS NO.	EMAIL	PHONE				
6/28/2007								
PART NO.	DESCRIPTION			QTY	SHPD	BO	EACH	TOTAL
	AeroVee Engine (20 AMP) \$5,995.00							
ACV-A01-01	AeroVee Accessory Plate Group			1				
ACV-A01-02	AeroVee Accessory Assembly Parts			1				
ACV-A01-03	Accessory Secondary Ignition Assembly Group			1				
ACV-A01-07	Accessory Secondary Ignition Pickup Module Assembly, Qty 2/Kit			2				
	32mm Carb (Assembled) Carb- 1.5" OD Spigot Mount			1				
	AeroCarb Hardware Group			1				
ACV-Carb-Discount	AeroCarb Group Discount							

Figure 1

Last Updated: March 13, 2011		
Reference Number:	Description:	
ACV-SB-031312-A	All AeroVee Owners must immediately check the 4 cap screws that attach the Alternator Stator (P/N ACV-A01-15) to the Alternator Mount Plate (P/N ACV-A01-03). If 8-32 thread x 1/2" long Socket Head Cap Screws (P/N ACV-Z01-12) are installed, these must immediately be replaced by a patched 8-32 thread x 5/8" long Socket Head Cap Screws (P/N ACV-Z01-76). McMaster-Carr P/N 91205A195 or equivalent. All AeroVee Engines shipped since 1.1.2012 include the new cap screws along with most from 2011. If your AeroVee Engine Packing List contains ACV-Z01-76, you have the 5/8" length screws. Attached is Page 37 from the AeroVee Assembly and Maintenance Manual, which includes the installation instructions for this Assembly. Download: AeroVeeAssemblyManual_Page37.pdf Additional Information (added to Revision A on 03.23.12): - This service notice does not apply to any AeroVee Engines with the 10 AMP Stator Alternator. - The reason for this service notice is to eliminate the possibility of severe damage to the flywheel, secondary ignition and/or alternator if the hardware is not tightened properly or Loctite is not used. To date there has been one incident of a flywheel being destroyed where the backing out of these screws is a possible cause. - There is some variation in the depth of the hole and threads in the ACV-A01-13 Alternator Mount Plate (ACV-A01-03 Mount Plate Assembly). First install the ACV-Z01-76 screws and ensure the stator is fastened tightly. If the alternator stator is not tightly attached to the plate, the screws may be bottoming out in the mount plate. Modify the Mount Plate per the attached control print. Download: ACV-A01-13 RevA MOD Alt Mount Plate.pdf	support/aerovee_sb.html ver to the Sport Pilot!
ACV-PRN-081911	AeroConversions discovered today (Friday 8.19.11) that incorrect hardware had been labeled as ACV-Z01-36 Flat Head Cap Screws and shipped to customers. P/N ACV-Z01-36 is a 1/4-28 thread x .75" long Flat Head Socket Cap Screw (Fine Thread). This Part Replacement Notice impacts AeroVee Engines shipped between March 2010 and today (Friday August 19, 2011). The entire stock labeled on our Shelves were actually 1/4-20 thread x .75" long Flat Head Socket Cap Screw (Fine Thread).	

Figure 2

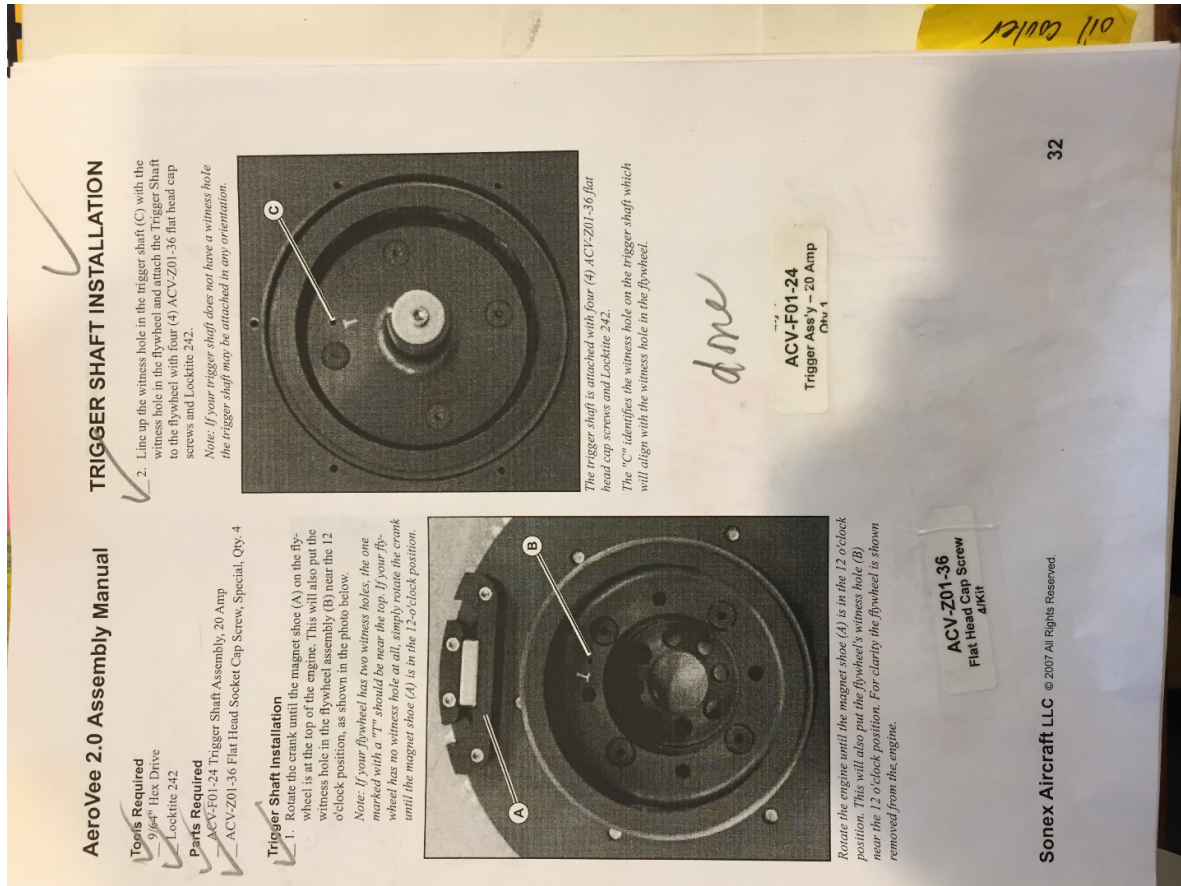


Figure 3

REQUIRED	ALL AeroVee Engines	03.13.12 Rev A: 03.23.12	ACV-SB- 031312- A	Alternator Stator Cap Screws All AeroVee Owners must immediately check the 4 cap screws that attach the Alternator Stator (P/N ACV-A01-15) to the Alternator Mount Plate (P/N ACV-A01-03). If 8-32 thread x 1/2" long Socket Head Cap Screws (P/N ACV-Z01-12) are installed, these must immediately be replaced by a patched 8-32 thread x 5/8" long Socket Head Cap Screws (P/N ACV-Z01-76). McMaster-Carr P/N 91205A195 or equivalent. All AeroVee Engines shipped since 1.1.2012 include the new cap screws along with most from 2011. If your AeroVee Engine Packing List contains ACV-Z01-76, you have the 5/8" length screws. Attached is Page 37 from the AeroVee Assembly and Maintenance Manual, which includes the installation instructions for this Assembly. Download: AeroVeeAssemblyManual Page37.pdf Additional Information (added to Revision A on 03.23.12): • This service notice does not apply to any AeroVee Engines with the 10 AMP Stator Alternator. • The reason for this service notice is to eliminate the possibility of severe damage to the flywheel, secondary ignition and/or alternator if the hardware is not tightened properly or Loctite is not used. To date there has been one incident of a flywheel being destroyed where the backing out of these screws is a possible cause. • There is some variation in the depth of the hole and threads in the ACV-A01-13 Alternator Mount Plate (ACV-A01-03 Mount Plate Assembly). First install the ACV-Z01-76 screws and ensure the stator is fastened tightly. If the alternator stator is not tightly attached to the plate, the screws may be bottoming out in the mount plate. Modify the Mount Plate per the attached control print. Download: ACV-A01-13_RevA MOD Alt Mount Plate.pdf
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Figure 4



Figure 5

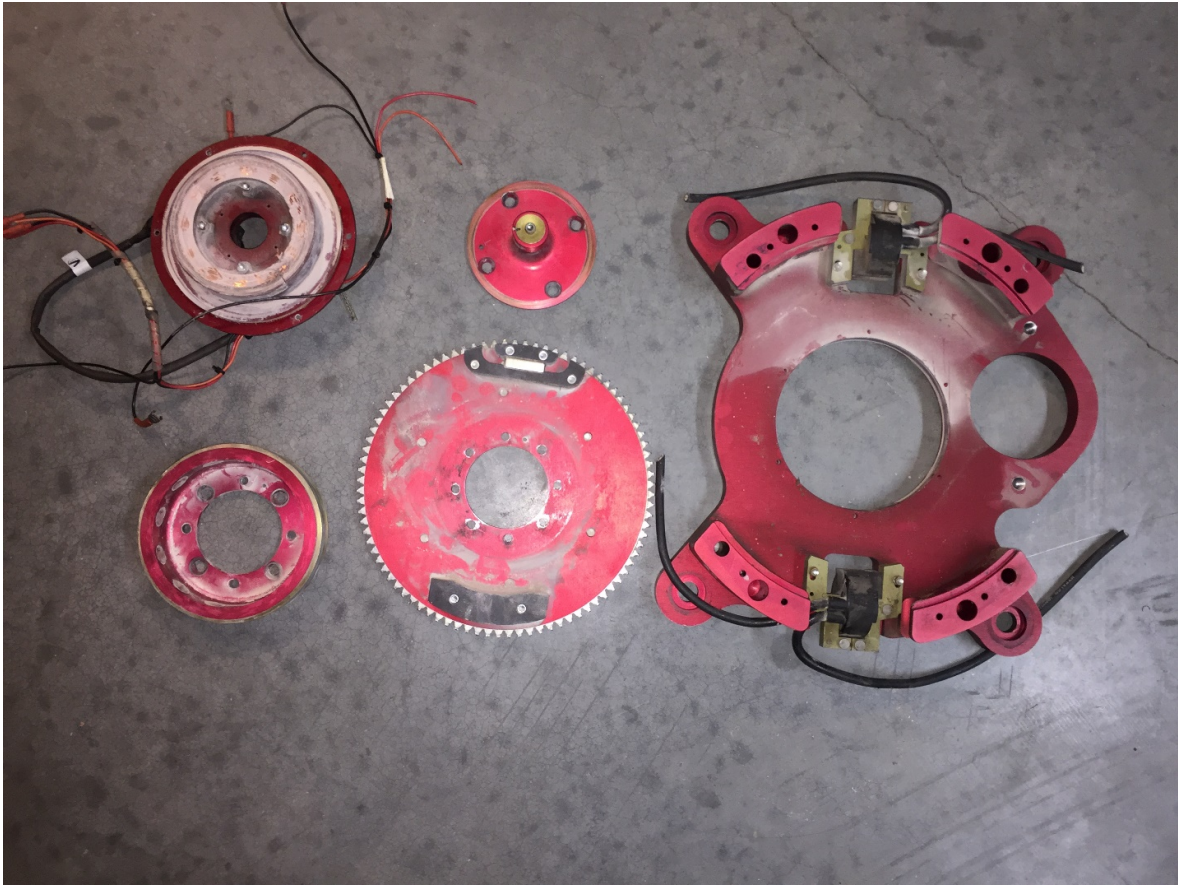


Figure 6



Figure 7

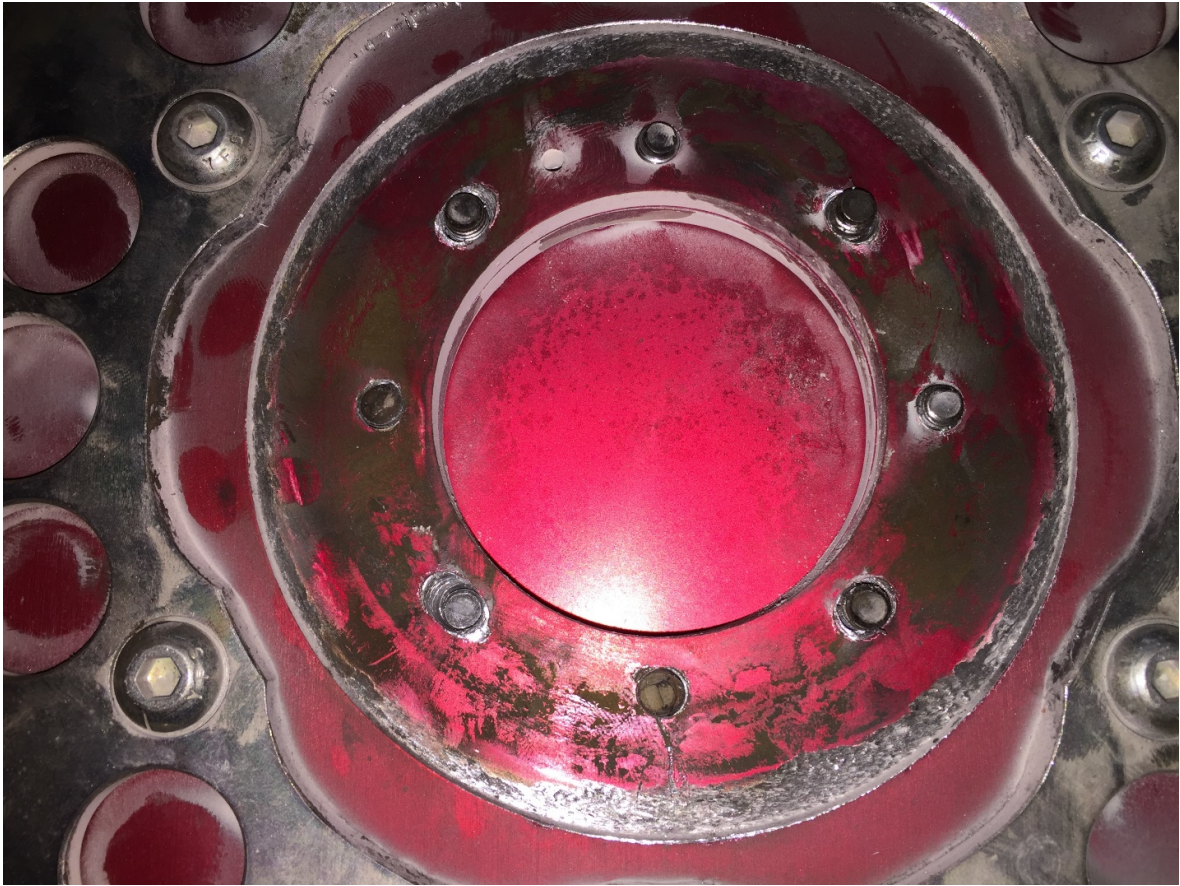


Figure 8



Figure 9

2016

ENGINE LOG WORK

DESCRIPTION OF INSPECTIONS, REPAIRS AND ALTERATIONS

Certified mechanics or repair facilities must endorse all inspections and repairs on type certified aircraft with name, rating & Cert. No.

MO.	DAY	DESCRIPTION OF INSPECTIONS, REPAIRS AND ALTERATIONS	
4	10	adjusted valves, retightened head, ^{oil chg 1.0 hrs} each	B+O
4	12	plugs tightened, checks installed, lower duct off	B+O
5	3	oil leak - slow, drip filter / low press plug	PTO
5	6	changed bottom plate, new gaskets, plug. Screen clean. ^{oil analysis}	
		changed filter to KN HF 3001, added oil 70W-50 VR-1 ^{okay}	
		non-detergent. Ran 0.4, taxied. Ran file waiting 5.2 hrs	B+O
		for any oil leaks. hobs 5.2 tach 3.62	
(F) 5	11	slow hot. Needs more exit area on cowling. CHT #3 got up to 440°F. Rest in limits total for time 0.4,	B+O
5	16	retightened prop bolts 140 in#. No movement	B+O
(F) 5	16	Flew 0.25 hrs. Heated up. appears running & lean. All plugs straw colored, #3 hottest. Suspect fuel most likely. Airflow 29. Drained oil, cut filter, clean no traces of anything	B+O
5	19	added 24 oz to filter, 2.75 qts to engine	B+O

Figure 10

ENGINE AIRWORTHINESS DIRECTIVES						
date A.D. NO.	TT	fit time METHOD OF COMPLIANCE	TT	rmks	signature DATE	SIGNATURE OF MECHANIC OR REPAIR FACILITY
5-19-17	85 ²³	1.16	85 ²³	OK		3250/1225/402/199/100/14 ⁰
5-19-17	85 ⁶⁰	0.37	85 ⁶⁰	OK		3260/1160/417/204/85/13 ⁸
5-20-17	87 ¹⁴	1.54	87 ¹⁴	OK		3360/1160/399/188/92/13 ⁹
5-21-17	87 ⁴⁵	0.31	87 ⁴⁵	OK		3360/424/206/198/142
5-22-17	88 ²⁴	0.79	88 ²⁴	OK		3220/1147/1250/404/203/102/13 ²
5-24-17	88 ⁸⁴	0.6	88 ⁸⁴	no fuel pump		3180/1113/1250/393/176/97/14
5-27-17	90 ⁴³	1.59	90 ⁴³	OK		3440/1194/1250/401/199/141
6-3-17	91 ⁸¹	1.4	91 ⁸¹	OK		3320/1175/383/190/113/14 ⁰
6-3-17	92 ⁴	0.7	92 ⁴	OK strike		4940/1162/390/194/95/13 ⁷
aircraft threw propeller Garfield WA, 1100 6-3-2017						

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Figure 11