

AEROVEE 2.1

\$35.00

ASSEMBLY and INSTALLATION

ACV-R02 Rev AA. 08/05/2015 Applies to AeroVee s/n 0440 and up. Includes top-mounted oil cooler.



Photo for illustration only and does not represent the specific contents of your kit.

AeroConVersions

A Product Line of Sonex Aircraft LLC

Contents

Your feedback is welcome and encouraged as we continue to improve this manual. Please send comments to tech@aeroconversions.com. Comments will be reviewed and considered for inclusion in future revisions of this manual.

Your success is important to us. If you have any questions while assembling your engine do not hesitate to seek technical support by emailing tech@aeroconversions.com.

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Disclaimer and Limited Warranty

THE EXPERIMENTAL AEROVEE ENGINE KIT IS SOLD "AS IS". NO WARRANTY IS EXPRESSED OR IMPLIED!

Sonex Aircraft LLC makes every effort to assure the supplied components of the AeroVee Engine Kit meet high quality and durability standards, and warrants to the original purchaser that these components are free of defects in material and workmanship for the period of one year from the date of purchase. This warranty does not apply to damage due directly or indirectly to improper assembly, misuse, abuse, negligence or accidents, repairs or alteration outside our facilities, or lack of maintenance. Due to the experimental nature of the AeroVee Engine Kit, the end user is solely responsible for determining suitability of application, assembly, installation and operation.

Sonex Aircraft LLC and its agents will in no event be liable for death, injuries to person or property, or incidental, contingent, special, or consequential damages arising from the use of our product.

Sonex Aircraft LLC and its agents will not be responsible for any incidental or consequential damage including direct or indirect labor, repair, medical, or legal expense in any way attributable to the use of any AeroConversions, Inc. product or to the delay or inconvenience caused by the necessity of replacing or repairing any such item.

Engine Monitoring Instrumentation

Sonex Aircraft LLC requires the use of the following cockpit-installed engine monitoring instruments in every engine installation: oil pressure, oil temperature, cylinder head temperature (1 minimum), and exhaust gas temperature (1 minimum). Failure to properly monitor your engine may result in severe engine damage which is not covered under this limited warranty.

EXPERIMENTAL USE ONLY

Not TSO'd for Certified Aircraft

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AeroVee Engine Kit Documentation

This manual is your primary document for the assembly and operation of your Experimental AeroVee Engine Kit. The included assembly DVD is an additional aide, but when there is a discrepancy between this manual and the DVD, the information in this manual takes precedence.

The manuals provided with the AeroVee kit are important documents and should be kept with your aircraft's documents.

Keep Your Packing Lists

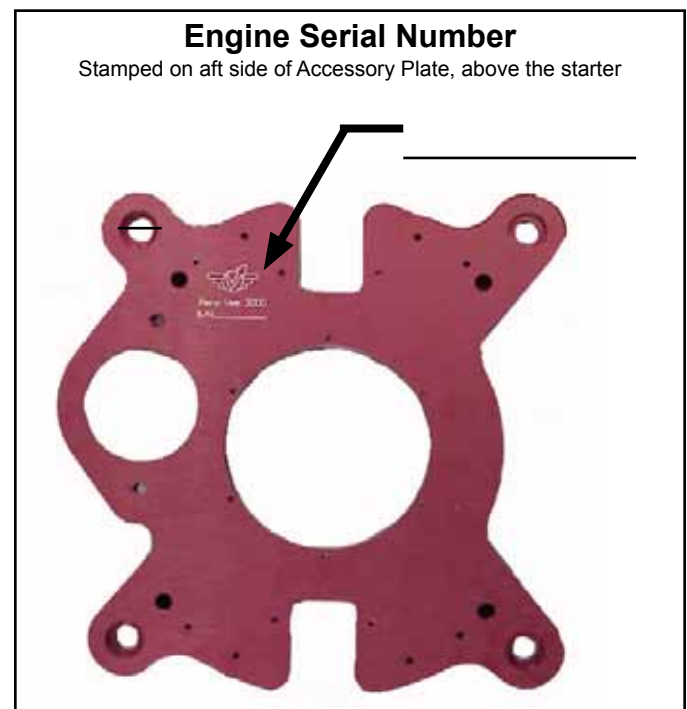
The packing list provided with each AeroVee kit lists the specific parts provided for that specific engine. Please reference your packing list for correct part numbers when ordering maintenance and repair parts for your particular engine.

In addition to the packing list secured to the outside of the engine kit boxes, a duplicate packing list has been attached to the back of the physical manual supplied with that engine.

Copies of (most) packing lists are archived by Sonex Aircraft and you may request an electronic (PDF) copy. To get a copy, provide evidence you own the engine for which you are requesting the original packing list as well as the engine's serial number.

Engine Serial Number

The engine's serial number is stamped on the rear of the accessory plate, above the starter. It is also recorded on your packing list. Record your engine's serial number below.



AeroConversions Resources

AeroConversions continually improves and monitors its products. It is in your best interest to stay abreast of these improvements and implement them as needed.

AeroConversions Website

AeroConversions, Inc. maintains a website which is continuously updated. Perhaps the most important part of the website for an AeroVee builder/operator is the **Service Bulletin** section. You are encouraged to periodically check for Service Bulletins which may affect the performance of your AeroVee engine.

The AeroConversion website is aeroconversions.com

AeroVee Internet Discussion Group

AeroConversions operates an internet discussion group which is open to all owners and enthusiasts of the AeroVee Engine Kit. Joining this list will get you in touch with other engine owners and is an additional form of mass-communication between AeroConversions, Inc. and its customers.

Information on joining this list is located on the AeroConversions website at aeroconversions.com.

AeroConversions Tech Support

AeroVee owners can receive individual tech support by email or phone. We encourage you to contact us via email first, as this allows us the opportunity to formulate a clear, concise answer to your question.

The email address is tech@aeroconversions.com

AeroConversions' Service Bulletins

AeroConversions, Inc. is committed to providing quality products. We do this through the constant improvement of our AeroVee Engine Kit, and also by identifying parts or procedures which we feel require the attention of the existing AeroVee Engine Kit fleet.

When we identify parts or procedures which we feel require the attention of AeroVee owners, we issue a Service Bulletin.

Required Service Bulletins

A Required Service Bulletin, as the name implies, *must* be complied with. It may be a part or a procedure which we feel must be corrected for the continued use of your engine.

Upon compliance of the Required Service Bulletin, an entry must be made in your engine log book.

Required Service Bulletins are posted on the AeroConversions website, announced on the AeroVee Internet Discussion Group, and mailed to the address of record of each AeroVee Engine Kit owner. *It is your responsibility to keep us informed of any address or engine ownership changes, and to check the AeroConversions website for Required Service Bulletins.*

Optional Service Bulletins

An optional Service Bulletin is issued when we identify an area which we feel will contribute significantly to the reliability/longevity of the AeroVee engine. Optional Service Bulletins need not be complied with but we *strongly* encourage all AeroVee owners to implement the suggested change/upgrade.

Upon compliance of the Optional Service Bulletin, an entry must be made in your engine log book.

Optional Service Bulletins are posted on the AeroConversions website and announced on the AeroVee Internet Discussion Group. *It is your responsibility to check the AeroConversions website for Optional Service Bulletins.*

Keep Your Packing Lists

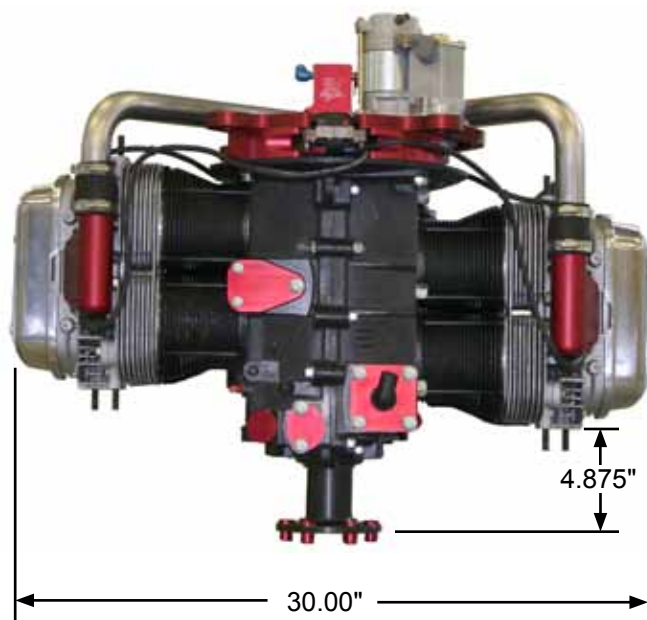
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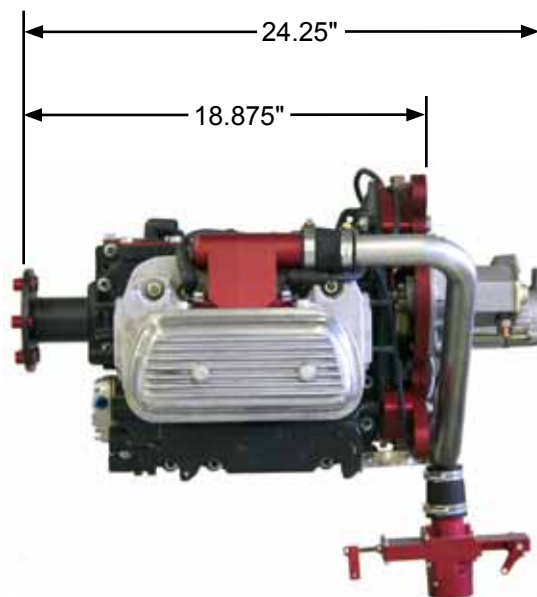
Additional Resources

There are many books, magazines, and videos available for the assembly, maintenance, and operation of "Type 1"-based engines. We highly recommend "How to Rebuild Your Volkswagen Air-Cooled Engine" by Tom Wilson (ISBN 978-0-89586-225-9).

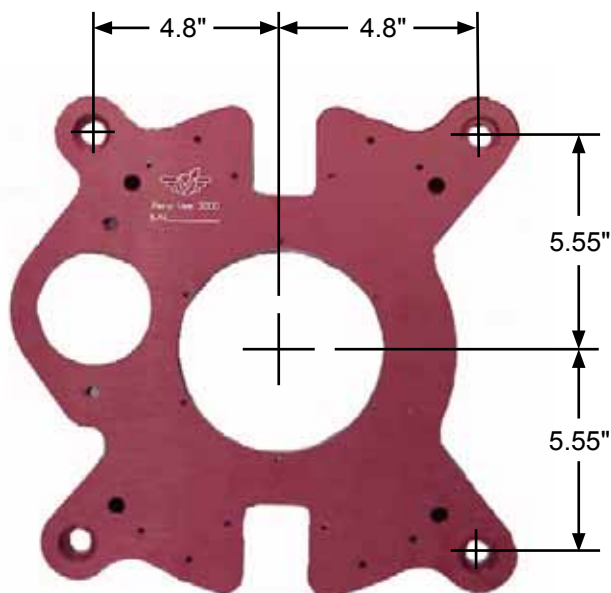


Weights and Dimensions:

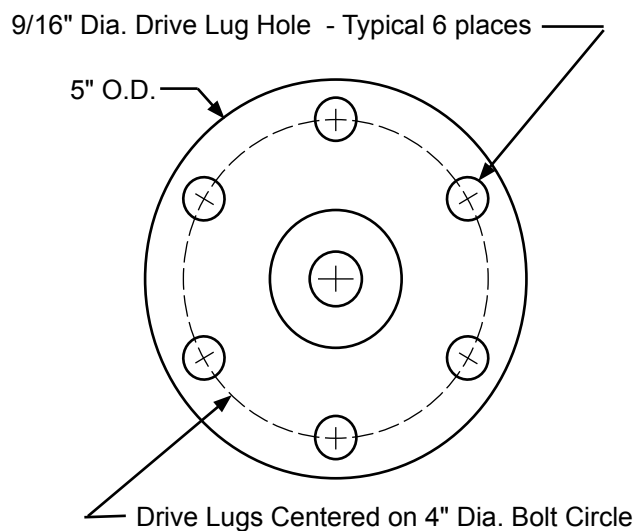
Weight (Less Oil and Exhaust):	
with Standard Pistons and Barrels.....	160 lbs.
Length.....	24.25"
Width.....	30"
Height.....	20.0625"



Mount Dimensions (Viewed from behind)
See Page 40 for Motor Mount Pin Detail



Prop Hub Bolt Pattern



General Specifications (Subject to change without notice)

Power and Displacement:

HP @ 3400 RPM	80 HP
Static RPM @ WOT (with correct propeller)	3000 RPM
Bore	92mm
Stroke	82mm
Displacement	2180cc
Compression Ratios (Builder Adjustable):	
7.0:1 For use with automotive gasoline with a posted (R+M)/2 of 90 or greater conforming with ASTM D 4814.	
8.0:1 For aviation gasoline 91/98 minimum grade conforming to ASTM D 910	

Ignition System:

Firing Order	See Photo
Spark Plugs	Autolite 4163 or equal
Spark Plug Gap:	
Top Plugs018"
Bottom Plugs032"
Timing:	
Primary Ignition (Magnatrons)	Fixed @ 28° BTDC
Secondary Ignition (Electronic)	28° BTDC
Ignition Module Gap (Primary Ignition)010-.014"

Cooling and Lubrication:

Primary Cooling	Air
Secondary Cooling	Oil
Oil Capacity	2.75 US Qts.
Oil Type	See "Engine Oil" section for approved oils.

Fuel System:

Throttle Body	AeroInjector, ACV-C07S, 32mm
Approved Fuels:	
7.0:1 Compression: Automotive gasoline with a posted (R+M)/2 of 90 or greater conforming with ASTM D 4814.	
8.0:1 Compression: Aviation gasoline 91/98 minimum grade conforming to ASTM D 910.	

Electrical System:

Battery Required (minimum)	12v @ 20 amp
Starter	Geared
Alternator	20 amp

Propeller Drive:

Propeller Drive	Direct (1:1)
Prop Bolt Pattern	6 holes, 9/16" dia., on 4" dia. center
Prop Drive Bushings	9/16" dia. x 7/16" long

Valve Setting:

Valve Setting (cold)006" to .008"
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Cylinder Identification, Engine Orientation, and Firing Order

Cylinder Identification

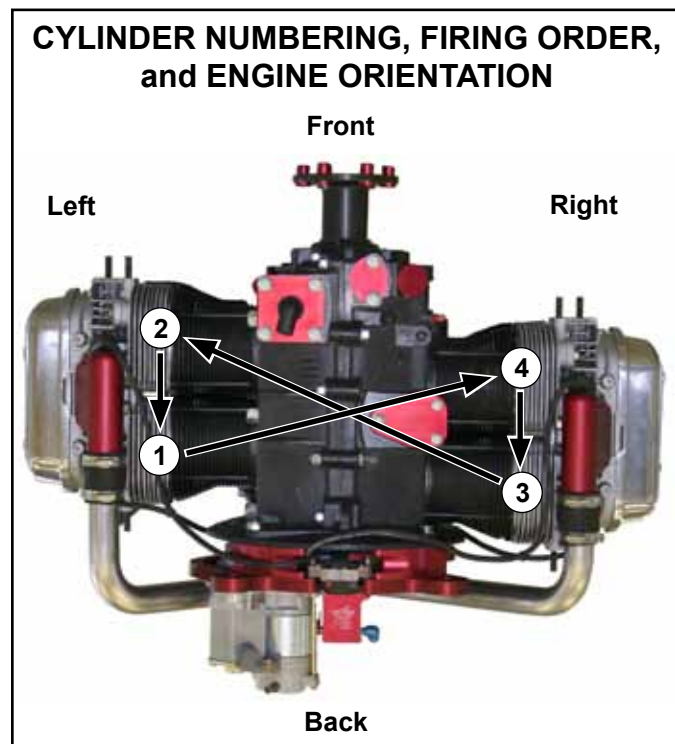
For assembly and maintenance, the AeroVee uses the cylinder identification numbers shown below.

Engine Orientation

When referencing the location / orientation of items on the engine, "Front", "Back", "Left", and "Right" are used as if the engine is installed in a tractor configuration and viewed from behind the engine, as shown below.

Firing Order

The AeroVee has a "wasted spark" ignition system which allows the spark plugs to fire on non-combustion strokes as well as combustion strokes. The arrows in this diagram illustrate the order of combustion.



Operating Limitations (Subject to change without notice)

Idle RPM	700-900 RPM
Cruise RPM	3200 +/- 200 RPM
Maximum RPM	4,000 RPM
Oil Temp. - Min.	160° F
Oil Temp. - Max.	230° F
Oil Pressure - Min.	10 PSI (hot oil, idle RPM)
Oil Pressure - Max.	100 PSI
Oil Pressure @ Cruise	40-50 PSI
CHT @ Cruise	350°-375° F
CHT @ Climb (5min.)	420° F
CHT Max	450° F
EGT Max	1400° F



A Successful, Reliable Engine Installation Begins Here.

Protect Yourself

Always wear safety glasses

When using paint and chemicals, work in a well ventilated room and wear appropriate protective gear (gloves, mask, etc.).

The use of compressed air to clean parts is not recommended. Compressed air can send debris flying at great speed and cause serious injury.

Do not use flammable liquids near open ignition sources such as water heaters, furnaces, electric motors, etc.

Read, Understand, and Follow the Instructions

Read through each procedure before performing the individual steps.

Make sure you have the appropriate tools, parts, and consumables on hand. Some procedures cannot be interrupted while you track down that forgotten tool.

Photo References in this Manual

Photos in this manual are included to illustrate specific steps and may not accurately illustrate what an engine looks like during an actual build-up. **Do not add or remove parts based on the photographs in this manual.** The step-by-step instructions are your only guide for adding or removing parts during engine assembly.

Work Cleanly

Parts must be thoroughly cleaned with Mineral Spirits and in many cases, lubricated, before assembly. Remove rust-inhibiting coatings from each part.

The engine case and cylinder heads must be carefully cleaned and inspected to remove any metal chips which may remain from the machining process.

The use of compressed air to clean parts is not recommended. Compressed air can send debris flying at great speed and cause serious injury, as well as drive the debris deeper into crevasses.

Work Smartly

Parts should never be forced into position. If excess effort seems to be needed to assemble parts, STOP and investigate the problem.

NEVER apply concentrated heat (such as with a torch) to assemble or disassemble parts. Excess heat will damage parts and result in a potentially dangerous engine installation.

Part Numbers and Packing Lists

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AeroConversions reserves the right to supply compatible, alternative replacement parts for any part of the core engine or conversion package. Such parts may appear different than the part originally provided in the kit or depicted in the manual, and may bear a different part number, but will be functionally identical or superior to the original kit-supplied component.

Note: If you have the optional pre-assembled crank shaft (part number ACV-H01-20), skip to Step 10.



Tools Required:

- ___ Oven Heated to 400 degrees F.
- ___ Heat-proof Gloves
- ___ White Lithium Grease
- ___ 1/2" Impact Wrench with 30MM Socket
- ___ Locktite #242
- ___ Block of Wood
- ___ Hammer or Mallet
- ___ Torque wrench (80 ft. lbs. capacity)

Parts Required:

- ___ Prop Hub, ACV-H01-16
 - ___ Prop Hub Bushing and Washer, ACV-H01-17
 - ___ Crankshaft, ACV-P01-98
 - ___ Oil Slinger, ACV-P01-101
 - ___ #1 and #2 Bearings from Main Bearing Set, ACV-P01-57
- Note: Bearing #1 is the small cylindrical bearing, Bearing #2 is the large cylindrical bearing without flanges.
- ___ Retaining Ring, ACV-P01-64
 - ___ Forward Woodruff Key, ACV-P01-99
 - ___ Aft Woodruff Key, ACV-P01-104
 - ___ Crank Timing Gear, ACV-P01-62
 - ___ Bolt, ACV-Z01-74

Preparation:

- ___ 1. Inspect the bore of the Crank Timing Gear for burrs. If necessary, lightly polish it with fine emery cloth.
- ___ 2. Thoroughly clean all parts with Mineral Spirits.
- ___ 3. Remove the four (4) hex plugs from the crankshaft and thoroughly clean the crankshaft with Mineral Spirits. Re-install the hex plugs with Locktite #242.
- ___ 4. Test fit the prop hub. **The prop hub should NOT slide onto the crankshaft.**
- ___ 5. Place the cleaned crankshaft in a freezer at least 12 hours prior to assembly.
- ___ 6. Heat an oven to 450° F. Place the crank timing gear and prop hub in the oven and heat for 60 minutes.
- ___ 7. Apply an even coat of white lithium grease to the inside surface of bearing #1 and bearing #2 from the Main Bearing Set.

Assembly Instructions:

- ___ 1. Install the Aft Woodruff Key into the crankshaft. Make sure it is fully seated.
- ___ 2. Slide bearing #2 (with an even coat of white lithium grease applied to the inside surface) onto the crankshaft with the machined dot (arrow in photo) toward the crankshaft's counter-weight.



IMPORTANT. Perform steps 3 through 10 near the oven. Once the parts are removed from the oven, work quickly but carefully to assemble the crankshaft. DO NOT FORCE PARTS ONTO THE CRANKSHAFT.

If a part does not go into place on the crankshaft, STOP. Do not force it on and do not try to remove it. Contact Sonex Aircraft LLC before continuing.

- ___ 3. Install the Timing Gear with the two machined dots (arrow in photo) facing away from bearing #2.



- ___ 4. Install the Retaining Ring in the groove in the crank.



- ___ 5. Enlarge the oil supply hole in bearing #1 by updrilling it with a #30 drill bit. Remove any burrs which may occur while drilling.



- ___ 6. Slide bearing #1 (with an even coat of white lithium grease applied to the inside surface) onto the crankshaft with the machined dot (arrow in photo) toward the retaining ring.



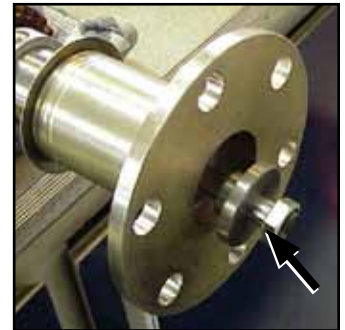
- ___ 7. Slide the Oil Slinger onto the crankshaft with the curved (concave) side of the slinger facing the end of the crankshaft.

- ___ 8. Install the Forward Woodruff Key into the crankshaft.



- ___ 9. Align the keyway of the Prop Hub with the forward woodruff key installed in the crankshaft and tap the prop hub into place using a mallet and block of wood. The prop hub must be tight against the oil slinger.

Immediately install Prop Hub Bushing and Washer and Bolt (ACV-Z01-74). Use an impact wrench to tighten the bolt and push the prop hub against the oil slinger.



- ___ 10. After the prop hub cools to room temperature, remove the bolt (ACV-Z01-74), apply Locktite 242 to its threads, and re-install. Torque the bolt to 80 ft.-lbs.

Tools Required:

- ___ Socket Wrench
- ___ 13mm Socket
- ___ Torque Wrench (20 ft.-lbs. capacity)
- ___ "Red" Locktite (High Strength Threadlocker)

Parts Required:

- ___ Cam Gear, ACV-P01-49
- ___ Cam Shaft (w/ hardware), ACV-P01-72

Assembly Instructions:

Note: The Assembly Lube provided with the cam gear will be used to lubricate the valve lifters in a later operation. Do not lubricate the cam shaft bolts as instructed on the assembly lube package included with the cam shaft.

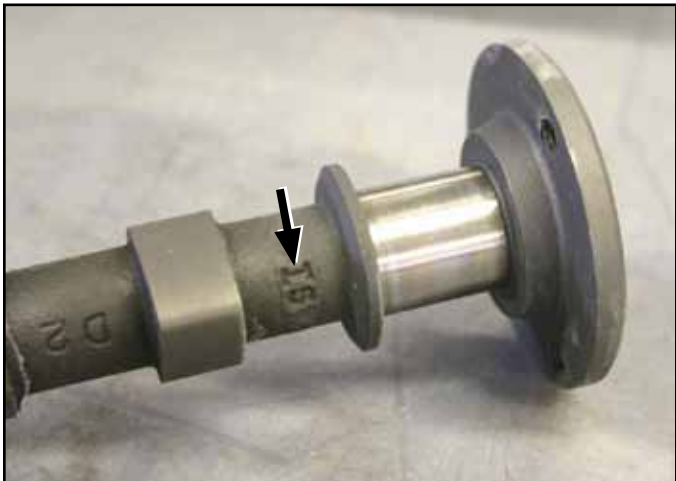
Note: Cam shafts are supplied with varying hardware, all of which is acceptable. Use the hardware supplied with the cam to attach the cam gear. This may include either:

Cam Bolts with integral lock washers.

Cam bolts and wavy spring washers.

Cam bolts and tab lock washers.

Note: While not common, slight interference between the cam and the connecting rods does occasionally occur. One cause of this interference is a raised edge around the numbers stamped in the shaft of the cam. Lightly polishing these numbers will remove the raised edge and eliminate a possible source of interference.



A raised edge around the stamped numbers on the cam can sometimes cause interference with the connecting rods.

- ___1. Align the machined dot on the face of the Cam Gear (arrow in photo) with the slot in the Cam Shaft. Apply Red Locktite to the bolts and install the bolts and washers (if provided).
- ___2. Torque the bolts to 20 ft.-lbs.



- ___3. If tabbed washers were provided with your cam shaft, bend the tabs against the bolt heads with a flat-blade screwdriver.



Tools Required:

- ___ White Lithium Grease
- ___ Socket Wrench and Socket Set
- ___ Moly Lube
- ___ "Red" Locktite (High Strength Threadlocker)
- ___ Torque Wrench (40 ft.-lbs. capacity)
- ___ Feeler Gauge

Parts Required:

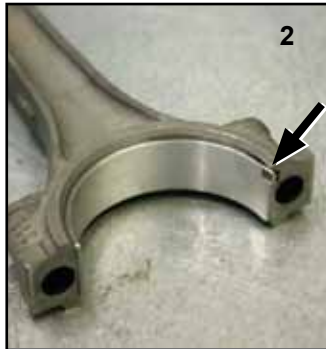
- ___ Connecting Rods, ACV-P06-33 or ACV-P01-33
- ___ Rod Bearing Set, ACV-P01-59
- ___ Crankshaft Assembly

Assembly Instructions:

Note: Both parts of each connecting rod are stamped with a unique number, identifying them as matched parts. The connecting rods *must* be re-assembled as matched parts, with the numbers together as shown in this photograph.



- ___ 1. Remove the fastener from each Connecting Rod and carefully separate the two parts. Do not scratch or score the machined surface of the connecting rods.
- ___ 2. Wipe the mating surfaces of the connecting rods and bearing halves so they are free of oil and dust. Install the bearing halves by aligning the tab on each bearing half with the notch in each connecting rod and pressing the bearing halves into place.

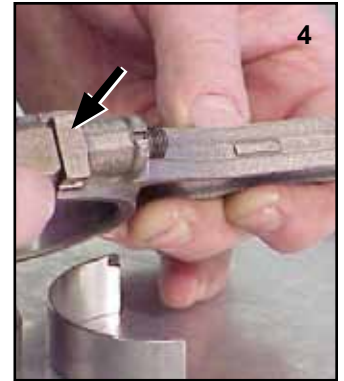


Note: The clearance between the rod bearings and rod journals must be between .002" and .0025". When assembling new parts, as provided in the AeroVee 2.1 kit, the proper clearance is often assumed. When rebuilding an engine using remanufactured parts, this clearance *must* be checked. Detailed instructions for checking this clearance are given in Tom Wilson's book "How to Rebuild Your Volkswagen Air Cooled Engine".

- ___ 3. Apply an even coat of white lithium grease to the exposed surfaces of each bearing half.

CONNECTING ROD ASSEMBLY

- ___ 4. The connecting rods are attached to the crankshaft, as shown in the photo below, with the stamped numbers facing up. **Be sure to re-assemble the connecting rods as matched parts.**



The connecting rods are installed on the crankshaft in the orientation shown above with the stamped numbers on each rod facing up.

- ___ 5. **ACV-P06-33 Rods Only (with starred bolt and nut):** Apply Moly Lube to each rod bolt and install. Torque each bolt as follows:
 - ___ first to 8 ft.-lbs.
 - ___ then to 15 ft.-lbs.
 - ___ then 24 ft.-lbs.
 - ___ Then the final torque of 38 ft.-lbs.**ACV-P01-33 Rods Only (with hex bolt):** Apply "Red" Locktite (or, if supplied with your rods, ARP Ultra-Torque) to the threads of each rod bolt and install. Torque each bolt in four steps:
 - ___ first to 8 ft.-lbs.
 - ___ then to 15 ft.-lbs.
 - ___ then 24 ft.-lbs.
 - ___ Then the final torque of 30 ft.-lbs.
- ___ 6. Check each connecting rod for freedom of movement and .005" to .020" side clearance.

Tools Required:

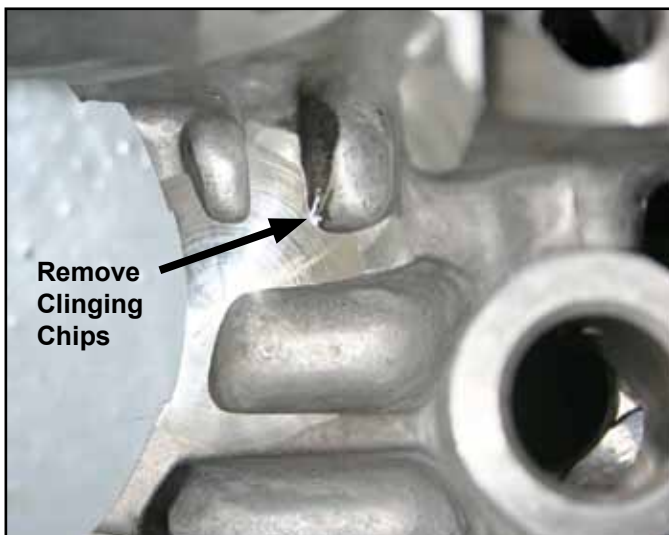
- ___ Flat Blade Screwdriver
- ___ Rubber Mallet
- ___ Fine File
- ___ White Lithium Grease

Parts Required:

- ___ Engine Case
- ___ 8mm Head Stud Kit, ACV-P01-86
- ___ Case kit, ACV-P02-12
- ___ Main Bearing Dowel Pins (Set of 5), ACV-P01-46
- ___ Valve Lifters, ACV-P01-48
- ___ Main Bearing Set (split bearings only), ACV-P01-57
- ___ Cam Bearings, ACV-P01-58
- ___ Gasket Set, ACV-P02-15

Preparation:

- ___ 1. Separate the case halves and thoroughly clean them with mineral spirits. **Remove all traces of metal chips and dust from the case.** Pay particular attention to removing metal chips which still cling to the edge of machined surfaces (see photo) and to casting slag on the inside of the case which may dislodge after the engine is in service.



Remove clinging chips and loose slag from the cases interior.

- ___ 2. If you are painting the case, now is the best time to do so. Mask off all machined surfaces, mating surfaces, and holes before painting.

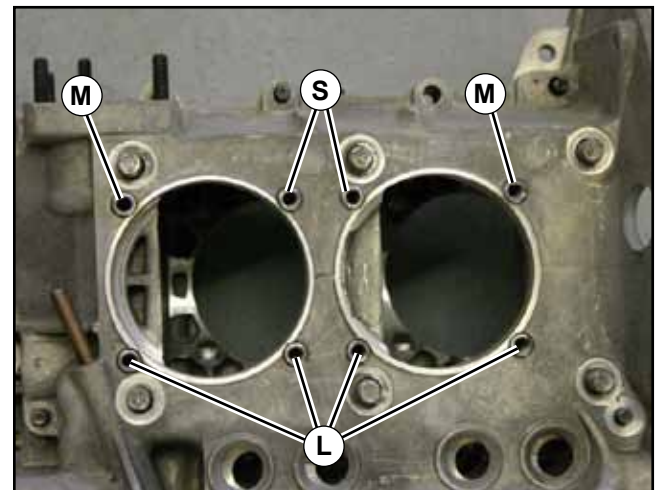
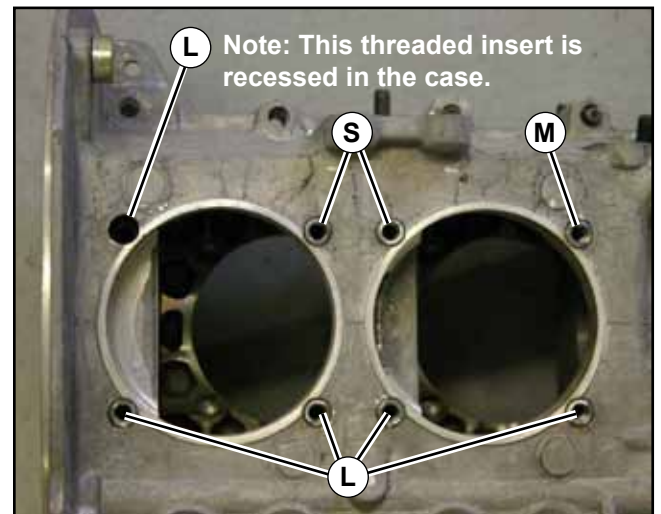
Note: We have had good luck using "Barbecue Black" spray paint on the case and piston barrels.

Assembly Instructions:

- ___ 1. Install the head studs as shown in the photos below.

Cylinder Head Stud Placement

- (S) = Short Cylinder Head Stud (7-3/8" - 7-1/2" long)
- (M) = Medium Cylinder Head Stud (8" - 8-1/4" long)
- (L) = Long Cylinder Head Stud (9-5/16" - 9-3/4" long)



- ___2. Lay the case on it's side so the oil pressure relief ports in the bottom of the case are accessible.



- ___3. Find the oil pressure relief plungers (2), springs (1 long, 1 short), metal gaskets (2) and retaining plugs (2) in the Case Kit.

Note: The remainder of the case kit may be discarded as it is not needed on the AeroVee.

- ___4. Insert the grooved plunger, lightly lubricated with motor oil, solid end first into the oil pressure relief port in the bottom of the case near the prop hub.

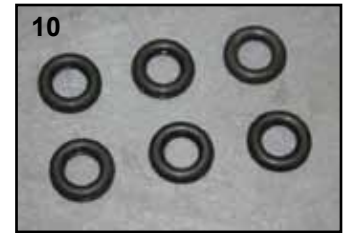
Note: The plungers must move freely in the passages. If they do not, clean the plungers with fine emery cloth until they do.

- ___5. Insert the long spring behind the grooved plunger.
- ___6. Place a metal gasket on a retaining plug and screw the plug into the relief port.
- ___7. Insert the non-grooved plunger, lightly lubricated with motor oil, solid end first into the oil pressure relief port in the bottom of the case near the flywheel.



- ___8. Insert the short spring behind the non-grooved plunger.

- ___9. Place a metal gasket on a retaining plug and screw the plug into the relief port.



- ___10. Install the Main Bearing Stud Seals (Qty. 6) from the Gasket Set (ACV-P02-15). The seals slide over the 6 large studs in the right case half.



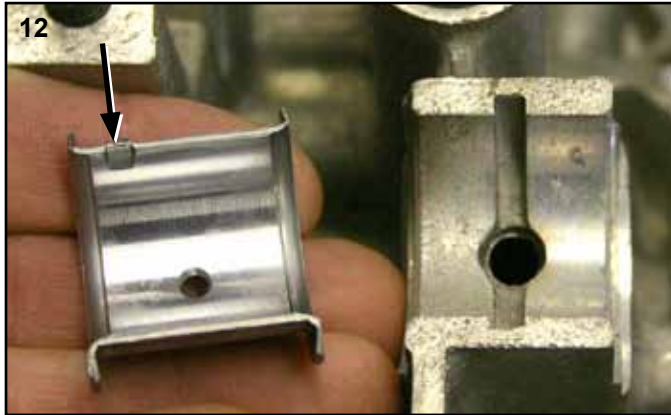
The Stud Seals slide over the 6 large studs in the right case half.

- ___11. Wipe clean the case journals and the back of each Cam Bearing and install the bearings in the left half of the case. The following photos show where each bearing is installed.



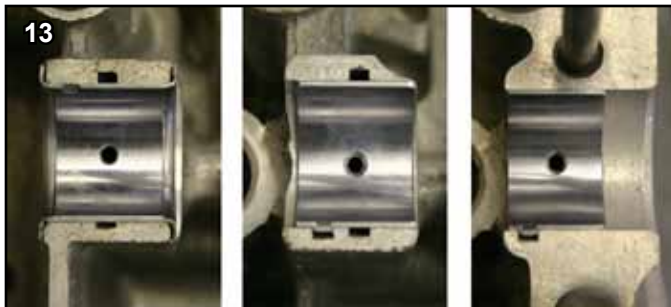
The cam bearings are installed in the left case half as shown in these photos. The left photo is the rear (flywheel end) of the case, the right photo is the front (prop hub end).

- __12. The flanged cam bearing for the right case half must have its alignment tab filed off. File the tab off with a fine file.



File the tab (arrow) off the flanged bearing with a fine file.

- __13. Wipe clean the case journals and the back of each Cam Bearing and install the bearings in the right half of the case. The following photos show where each bearing is installed.



The cam bearings are installed in the right case half as shown in these photos. The right photo is the rear (flywheel end) of the case, the left photo is the front (prop hub end).

CRANK CASE PREPARATION

- __14. Test fit each Valve Lifter in a guide. The lifters must slide freely in the guides. If a lifter sticks, clean the guide with very fine emery cloth. After test-fitting, liberally lubricate each lifter with white lithium grease and install them in their guides.



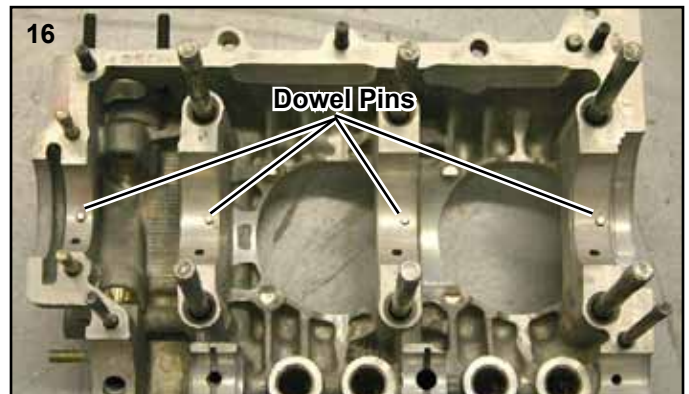
Test fit each valve lifter to assure smooth operation.

- __15. Test fit the Cam Shaft in each case half to make sure there is clearance between the lobes of the camshaft and each valve lifter. Interference between the cam shaft and a lifter must be investigated.

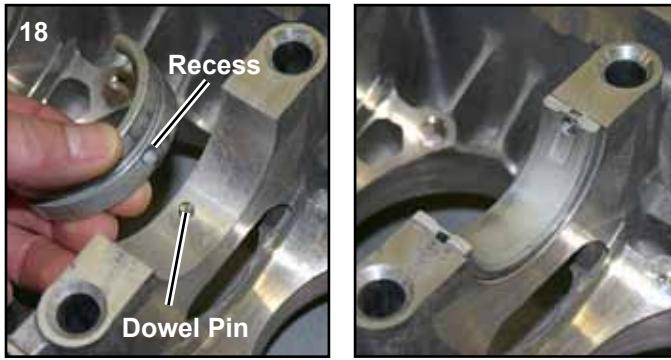


Test fit the camshaft to confirm there is clearance between the lobes of the camshaft and each lifter.

- __16. Install four (4) Dowel Pins in the right case half. Make sure they are fully inserted.



- ___ 17. Install one (1) Dowel Pin in the left case half. Make sure it is fully inserted.
- ___ 18. Install one half of the Split Main Bearing (from Main Bearing Set, ACV-P01-57) into the middle journal of each case half, carefully aligning the recess in the bearing with the dowel pin in the journal. A light tap may be required to properly seat each bearing half.



Align the recess in the bearing half with the dowel pin in the bearing journal and press the bearings in place.

- ___ 19. Apply an even coat of white lithium grease to all of the cam bearings and main bearings.

Tools Required:

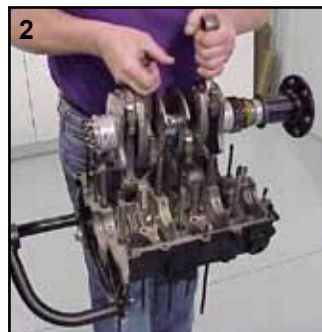
- ___ White Lithium Grease
- ___ "Red" Locktite (High Strength Threadlocker)
- ___ Torque Wrench (25 ft-lbs. capacity)
- ___ Torque Wrench (227 ft-lbs. capacity)
- ___ Rubber Mallet
- ___ Feeler Gauge Set
- ___ 13, 19 and 36mm Sockets
- ___ Permatex Aviation Form-A-Gasket #3 or Flange Sealant
- ___ Cam Assembly Lubricant

Parts Required:

- ___ Previously Completed Sub-Assemblies
- ___ Main Bearing Set, Bearing #4 (Flanged), ACV-P01-57
- ___ Flywheel Assembly, ACV-F01-02
- ___ Cam Plug, ACV-P01-35
- ___ Gland Nut, ACV-P01-42
- ___ End Shim Kit, ACV-P02-19
- ___ Gland Nut Washer, ACV-P01-44
- ___ ACV-Z01-75, Elastic Stop Nut, 12mm, Qty. 6
- ___ ACV-Z01-16 Bolts, Qty. 3
- ___ ACV-Z01-23 Elastic Stop Nuts, Qty. 15
- ___ ACV-Z01-26 Washers, Qty. 17
- ___ ACV-Z01-28 Washers, Qty. 6
- ___ Cam Screw Gaskets from Gasket Kit), Qty. 2, ACV-P02-15

Assembly Instructions:

- ___ 1. Apply a coat of white lithium grease to the inside of Main Bearing #4 and slide it onto the end of the crank shaft assembly. Make sure the dowel pin hole is toward the end of the crankshaft.
- ___ 2. Carefully set the crank shaft assembly into right case half. Make sure dowel pin hole in each bearing is aligned with the dowel pins in the case half, and the crankshaft assembly is fully seated in the case half.

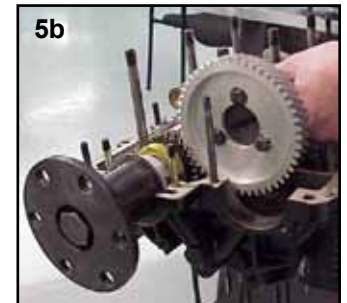


- ___ 3. **IMPORTANT!** Temporarily mate the case halves and rotate the crankshaft. Listen and "feel" for a knock which may indicate the case is interfering with the connecting rods. If interference is detected:
 - a. Disassemble the case halves and identify the location of the interference.
 - b. Remove crank assembly.
 - c. Taking care not to get grinding dust on other parts, use a remove case material to provide at least .045" clearance. Dremel-style motor tools work well for this operation.
 - d. Reinstall the crankshaft assembly and repeat step 3 until all interference is eliminated.

- ___ 4. Apply a small amount of cam assembly lubricant to each valve lifter.



- ___ 5. Align the single dot on the gear of the cam shaft assembly with the two dots on the gear of the crankshaft assembly and rotate the cam down into the cam bearings in the right case half. After seating the camshaft in the bearing, make sure the dots still align as shown in photo 5a.



- ___ 6. **IMPORTANT!** Make sure the main bearings of the crankshaft are still fully seated on the dowel pins in the case half.

___7. Align the 8 holes in the center of the flywheel with the dowel pins on the end of the crankshaft. The hole pattern permits the flywheel to be installed in only one position.

___8. The flywheel is a tight fit onto the crankshaft. It must go on squarely. If it binds, remove it and lightly polish the dowel pins with fine emery cloth. Once the flywheel has been started by hand, complete the installation by tightening the gland with an impact wrench.



___9. Push the crankshaft towards the back (flywheel end) of the engine and, with a feeler gauge, measure the gap between the flywheel and the rear main bearing. Record this measurement in the "Shim Chart".



___10. Complete the shim chart by subtracting .006" from gap recorded in step 9. This is the total thickness of shims you will use to set the proper end play.

___11. Clean the end shims with a mild solvent to remove the preservative.

___12. Select any combination of three to five shims which most closely equals the "Shim Thickness" determined in step 10.

Shim Chart:

Complete this chart to determine the total thickness of shims required. See steps 9 through 10.

Gap (see Step 9) = 0._____"
 Subtract .006" - .006"
 Shim Thickness = 0._____"
 Continue with step 11.



___13. Check your shim selection by sliding the shims, together with a feeler gauge, between the flywheel and the main bearing. You should have between .003" and .006" of end play.

If necessary, adjust your shim selection to achieve the required end play of .003" to .006"

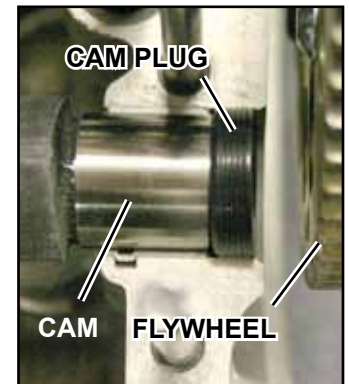
Set the shims aside for later installation.

___14. Remove the gland nut and flywheel from the crankshaft. It may be necessary to use a flywheel puller.



___15. Carefully align the Cam Plug, with its closed (flat) end out, and install it in the cam plug bore at the flywheel end of the case.

Note: Most cases have a smooth cam bore for a "ribbed" plug. Some cases have a groove in the cam bore for a cam plug with a raised bead.



ACV-P01-35

Metal plug with a single ridge. Used in cases with a "grooved" cam bore.

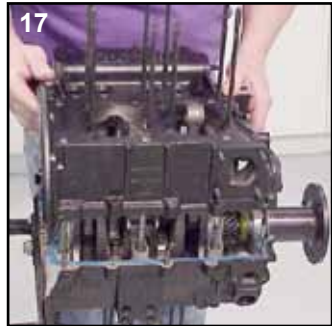
ACV-P01-34

Plastic plug with a ribbed diameter. Used with a "smooth" cam bore.

- ___16. Apply Permatex Aviation Form-A-Gasket #3 or Flange Sealant to the mating surfaces of the case halves. Apply according to the product manufacturer's instructions. Apply sparingly.

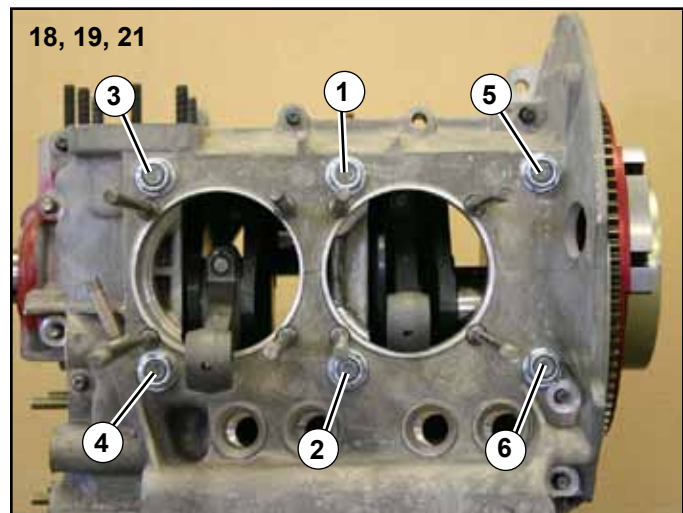


- ___17. Note: While assembling the case halves, the lifters in the left half will want to slide out. This can be minimized by giving them each a heavy coat of white lithium grease.



Assemble the two case halves by placing the left half over the right half. Gently tap the left half with a rubber mallet to seat it against the right half of the case.

- ___18. Place one ACV-Z01-28 washer and one ACV-Z01-75 12mm elastic stop nut on each of the six large studs. **Do not tighten the nuts at this time.**



Torquing order for the six 12mm nuts. See steps 19 and 21.

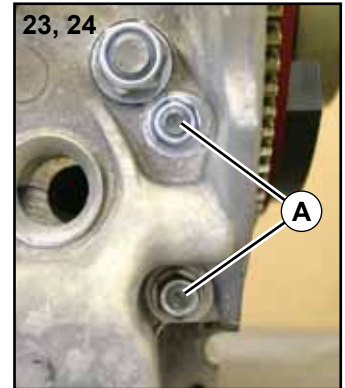
- ___19. In the order shown in the photo above, torque the 6 large nuts to 15 foot-pounds.
- ___20. Check for free movement of the crankshaft. If interference is detected, identify the source of the interference (most likely poorly seated main or cam bearings).

Note: If the connecting rods are not held near their normal operating position while checking for interference, you may experience interference which does not exist on an assembled engine.

- ___21. In the order shown in the photo, re-torque the 6 large nuts to 25 foot-pounds. **Do not exceed 25 foot-pounds.**
- ___22. Check for free movement of the crankshaft, as described in step 20.

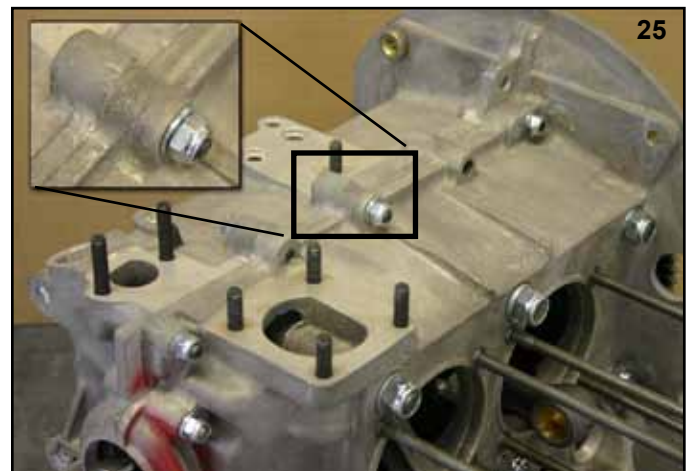
- ___23. Apply Permatex Aviation Form-A-Gasket #3 to two (2) ACV-Z01-26 washers and place them over the cam shaft studs the lower left side of the engine.

- ___24. Install an ACV-Z01-23 stop nut on each cam shaft stud and lightly tighten.



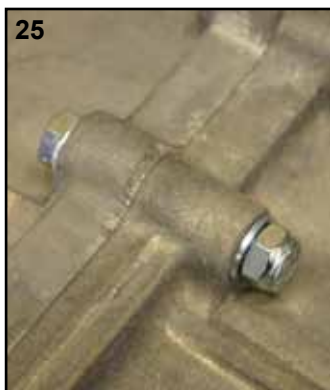
The cam shaft studs (A).

- ___25. Install an ACV-Z01-26 washer and ACV-Z01-23 stop nut on the remaining (10) studs on the perimeter of the case. Lightly tighten each nut.



There are 10 studs protruding through the case which serve to join to two case halves. Each must have a washer and nut installed (inset photo).

- ___26. Install and lightly tighten an ACV-Z01-16 hex head cap screw, two (2) ACV-Z01-26 washers, and an ACV-Z01-23 stop nut in each of the three through-holes which serve to join to two case halves. Minimal thread engagement is normal. Nuts will be flush with ends of screws.



- ___27. Torque the two cam nuts (from step 24) to 10 ft.-lbs.
- ___28. Torque the remaining case-assembly nuts (from steps 25 and 26) to 13 ft.-lbs. There is no defined order for torquing these nuts.
- ___29. Check for free movement of the crankshaft, as described in step 20.

Tools Required:

- ___ Needle-Nose Pliers
- ___ SAE 30 Motor Oil
- ___ 1" Utility Brush
- ___ Permatex Aviation Form-A-Gasket No. 3 Sealant
- ___ Rubber Mallet
- ___ Ring Compressor
- ___ Vise-Grips
- ___ Micrometer Caliper

Parts Required:

- ___ Crank Case Sub-Assembly
- ___ Big Bore Piston and Cylinder Kit, ACV-P02-14
- ___ Barrel Shims, .090, ACV-P01-39
- ___ Barrel Shims, .040, ACV-P01-40
- ___ Barrel Shims, .060 (2 sets), ACV-P01-41
- ___ Super Tin, ACV-P06-71

Assembly Instructions:

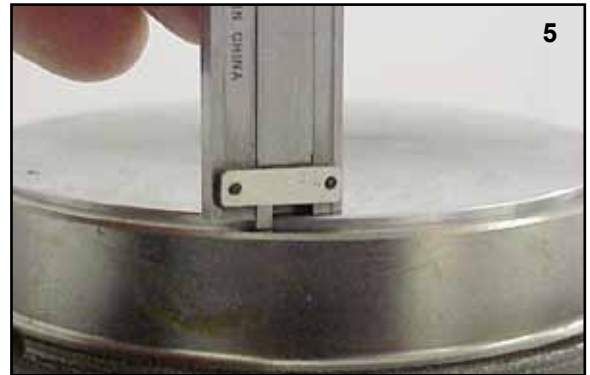
IMPORTANT: Pistons and pins have been matched to within 5 grams. Keep each piston and pin together as a set.

- ___ 1. Remove a piston ring from each piston and slide it squarely inside it's matched cylinder. Measure the gap between the ends of the ring - it should be between 0.012"-0.022". Re-install the ring on the piston.
- ___ 2. Re-install the piston into the cylinder using a ring compressor.
- ___ 3. Slide one piston and cylinder assembly into place on the crank case. Install the piston pin and make sure the cylinder is well seated.
- ___ 4. Bring the piston to Top Dead Center.
- ___ 5. Measure the deck height (distance be-

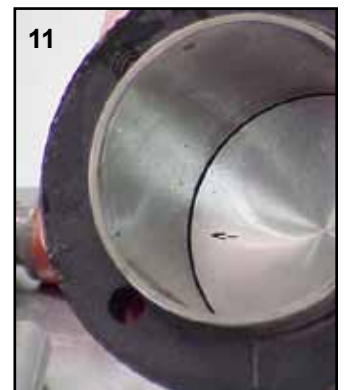


PISTON & CYLINDER ASSEMBLY

tween the top of the piston and the top of the cylinder). If the piston is below the top of the cylinder you have a positive (+) deck height. If the piston is higher than the top of the cylinder, you have a negative (-) deck height. Use your measured deck height to determine which cylinder shims are required from the chart on page 21.



- ___ 6. Remove the cylinder and piston assembly from the case.
- ___ 7. Apply a light coat of motor oil to the outside of each piston and the inner wall of each cylinder.
- ___ 8. Install the cylinder shims (as required, see chart on next page) onto each cylinder. Align the shims so they match the reliefs in the cylinder for the case studs.
- ___ 9. Apply Permatex Aviation Form-A-Gasket No. 3 Sealant to the shims and base of cylinder.
- ___ 10. Rotate the crank to bring a connecting rod to top dead center - this eases installation of the piston and cylinder.
- ___ 11. Note: The arrow on each piston face points to the flywheel end of the engine.



Partially slide the cylinder over the head studs. Push the piston out the bottom of the cylinder just far enough to attach the piston to the connecting rod with a piston pin, and secure the pin in place with a snap ring on each side of the piston pin.

Note: The snap rings were included in the piston/cylinder box.



- ___12. Remove excessive sealant and tap the cylinder with a rubber mallet to seat it in position.
- ___13. Repeat steps 10 through 12 for the other cylinders.
- ___14. Install the super tin (below) under the cylinders and cylinder head. It "snaps" in place with the dividing rib between the cylinders and the cylinder head. See photo at right.



CYLINDER SHIM CHARTS

These charts identify the shims needed to achieve the desired compression ratio based on your engine's measured deck height (See step 5). Compression ratios are based on the 55cc cylinder heads provided with the kit. **Choose the correct compression ratio for the type of fuel you will be using.**

For future reference, record your measured deck height here: _____

7.0:1 Compression*

For use with automotive gasoline with a posted (R+M)/2 of 90 or greater conforming with ASTM D 4814. Also compatible with aviation gasoline 91/98 minimum grade conforming to ASTM D 910. Slightly less power output than 8.0:1 compression ratio.

Measured Deck Height (+/- .005")**	Head Gasket	+	Cylinder Shims Needed:	=	Total Shims
-0.08 to -0.10	.06		.09 + .09 + .06 + .04		.34
-0.05 to -0.07	.06		.09 + .06 + .06 + .04		.31
-0.01 to -0.04	.06		.09 + .06 + .04		.25
0.00 to +0.01	.06		.09 + .04 + .04		.23
+0.02 to +0.03	.06		.09 + .04 + .04		.23
+0.04 to +0.05	.06		.06 + .06		.18
+0.06 to +0.07	.06		.09 + .04		.19
+0.08 to +0.10	.06		.06 + .04		.16

* Actual compression ratio will be between 6.9 and 7.1 to 1, based on 55cc heads (as supplied).

**"+" means piston is below top of cylinder, "-" means it is above the top of the cylinder. See step 4.

PISTON & CYLINDER ASSEMBLY



The super tin is installed under the cylinders and cylinder heads. Friction keeps it in place.

8.0:1 Compression*

For use with aviation gasoline 91/98 minimum grade conforming to ASTM D 910. Not compatible with auto fuel. **Use of a lower grade fuel will result in high temperatures, detonation, and damage to the engine.**

Measured Deck Height (+/- .005")**	Head Gasket	+	Cylinder Shims Needed:	=	Total Shims
-0.10	.06		.09 + .09		.24
-0.09	.06		.09 + .06		.21
-0.08	.06		.09 + .06		.21
-0.07	.06		.09 + .04		.19
-0.06	.06		.09 + .04		.19
-0.05	.06		.06 + .06		.18
-0.04	.06		.06 + .04		.16
-0.03	.06		.06 + .04		.16
-0.02	.06		.09		.15
-0.01	.06		.09		.15
0.00	.06		.06		.13
+0.01	.06		.06		.12
+0.02	.06		.04		.10
+0.03	.06		.04		.10
+0.04	.06		.04		.10
+0.05	.06		---		.06
+0.06	.06		---		.06
+0.07	.06		---		.06
+0.08	---		.04		.04
+0.09	---		.04		.04
+0.10	---		.04		.04

Parts Required:

- ___ Cylinder Head Nuts and Washers, from ACV-P01-86
- ___ Copper Cylinder Head Gaskets, 0.060 Thick, ACV-P01-92
- ___ Cylinder Head Assemblies, (See packing list for part number)
- ___ Push Rod Tubes, ACV-P06-50
- ___ Rocker Arm Nuts, (from Valve Cover package)
- ___ Gasket Set (partial), ACV-P02-15

Assembly Instructions:

Important: The cylinder heads will contain debris from machining. You must clean and inspect the cylinder heads for debris before installing them.

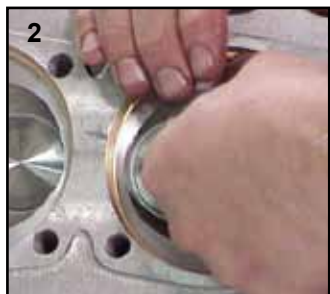
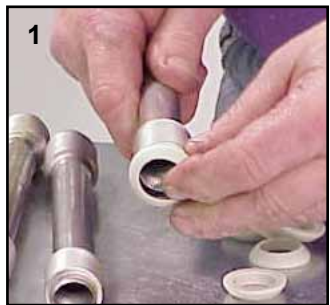
Note: The process of machining the spark lug holes for the secondary ignition often damages neighboring cooling fins. Missing fins is normal. You may wish to sand/file the rough edges to make them smooth.



Note: "Grooves" in the seat of the secondary ignition spark plug hole are normal and do not impact the seal of the spark plug washer



- ___ 1. Install Push Rods Seals (from Gasket Set) on each end of the Push Rod Tubes. Expand the bellows end of each push rod tube slightly. This will improve the seal between the push rod tubes, engine case, and cylinder heads.
- ___ 2. Insert Cylinder Head Gaskets into Head Assemblies.

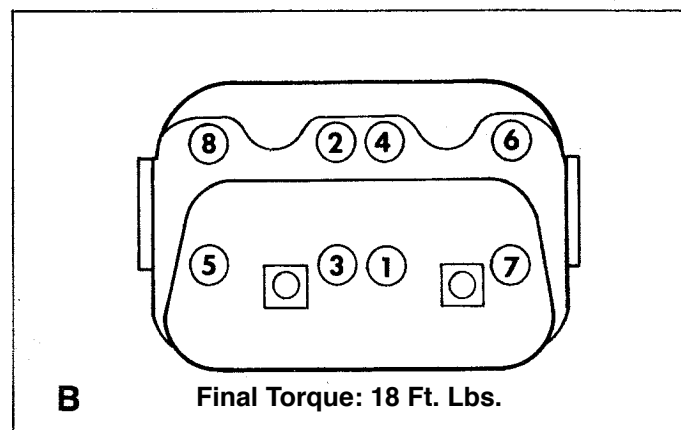
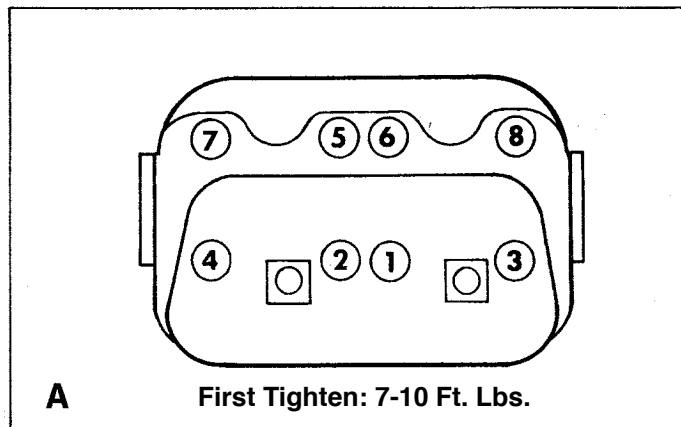


CYLINDER HEAD INSTALLATION

- ___ 3. Align the cylinder head with the engine studs and cylinders and then install the push rod tubes. Check alignment of Push Rod Tubes and barrels as you push the cylinder head into place.



- ___ 4. Place washers and retaining nuts (from the head stud kit) onto the head studs. Tighten in sequence shown in drawings A and B, below. Torque sequence must be used to prevent the head from warping.



- ___ 5. Perform this step only if the cylinder head has an O-ring recess at the base of the stud.

Install O-ring (from Gasket Set) onto the two head studs that hold the rocker assembly in place.



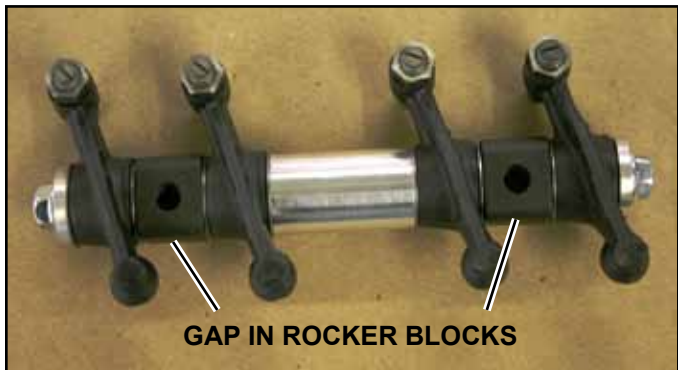
Parts Required:

- ___ Push Rods, ACV-P06-51
- ___ Pushrod Measuring Tool
- ___ Cylinder Head Nuts and Washers, from ACV-P01-86
- ___ Rocker Arm Nuts, from Valve Cover package
- ___ Rocker Shaft Assembly, ACV-P02-10

Assembly Instructions:

Note: Pre-assembled rocker assemblies often need to be disassembled for proper installation.

- ___ 1. Assemble the rocker shafts with the gap in the rocker blocks facing the cupped end of the rocker arms and the thin shims evenly distributed.



The rocker blocks are installed so their gaps are toward the cupped end of the rocker arms.

- ___ 2. Turn each adjuster fully counter-clockwise until the pad lightly contacts the rocker arm, and then turn it back clockwise 1.5 turns.

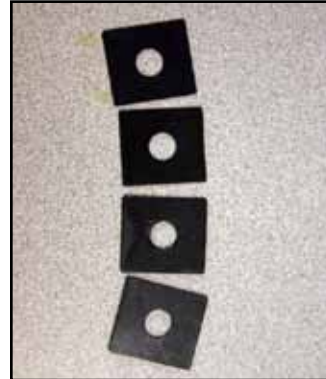


Two different swivel pads exist. The one on the left is a large, swiveling pad, the one on the right is a ball with a flat spot. The flat spot on the ball must contact the valve's stem.

ROCKER SHAFT INSTALLATION

Note: Steps 3 through 19 apply to one side of the engine at a time and will be repeated for each side.

- ___ 3. Place a square spacer from the rocker arm package over each of the rocker shaft mounting studs on a cylinder head.



- ___ 4. Place a rocker assembly over the mounting studs and inspect for interference between the rocker arm assembly and the head studs. If the rocker arm assembly contacts the head studs, trim the ends of the head studs to remove the interference.

The spacers placed under the rocker blocks influence the alignment of the rocker arm swivel pads to the valve tip. Proper alignment is achieved when the flat of the swivel pad is partially off-center from the valve stem. This is typically achieved with 1 or 2 shims under each rocker block.



Incorrect - Too few spacers. The swivel pad is centered on the valve stem.



Incorrect - Too many spacers. The flat of the swivel pad is off the edge of the valve stem.



Correct - The flat of the swivel pad is off center from the valve stem but sits fully on the valve stem. Typically 1 or 2 shims.

- ___ 5. Observe the lateral alignment of each swivel pad to its corresponding valve stem. Arrange the spacers on the rocker shaft, between each rocker arm and mounting block, as needed to get each swivel pad properly aligned. It is acceptable to have no spacer between components if that will achieve the proper alignment between the valve stem and the swivel pad.

This slight offset rotates the valve a small amount each time it opens, improving the life of the valve train.



Correct - The flat of the swivel pad is off center from the valve stem but sits fully on the valve stem.



Incorrect - The flat of the swivel pad is centered on the valve stem.



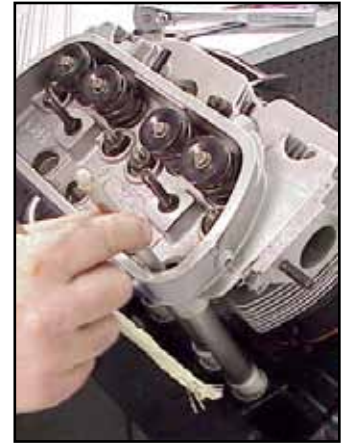
Incorrect - The flat of the swivel pad is off the edge of the valve stem.



The spacers between the rocker arms and mounting blocks must be distributed as needed to get each swivel pad correctly aligned with each valve stem. It is acceptable to have no spacer between components if that will achieve the proper alignment between the valve stem and the swivel pad.

ROCKER SHAFT INSTALLATION

- ___ 6. Torque the hex head cap screws on the end of the rocker shaft assembly to 25 foot-pounds.
- ___ 7. Remove the rocker assembly from the cylinder head.
- ___ 8. Slide the pushrod length tool into a pushrod tube until it engages the lifter in the case.
- ___ 9. Rotate the crank until the pushrod reaches the bottom of its travel.
- ___ 10. Re-install the rocker shaft assembly and secure it with the retaining nuts included with the valve covers. Torque the nuts to 14 foot-pounds.



The pushrod length tool is inserted in a pushrod tube after removing the rocker shaft.

- ___ 11. Adjust the length of the pushrod tool until it is engaging the lifter, is seated in the cup of the rocker arm, and is holding the rocker arm swivel pad against the tip of valve stem.
- ___ 12. Remove the rocker arm assembly.
- ___ 13. Remove the pushrod length tool without disturbing its setting. The pushrod length tool is set for the over-all length of the four (4) pushrods for that side of the engine.

Note: It is not necessary to measure and trim each pushrod individually, however, it may be beneficial to determine the pushrod lengths for each side of the engine individually.

- ___ 14. Allow for the length of the pushrod tip and trim the pushrod bodies as needed.
- ___ 15. Make sure the inside of each pushrod is clean.
- ___ 16. Press a tip onto each of the trimmed pushrods. The end of the pushrod body may be heated if necessary, but do not apply excessive localized heat.
- ___ 17. Apply white lithium grease to the end of each pushrod and slide them into the pushrod tubes.
- ___ 18. Re-install the rocker assembly, carefully aligning the pushrods with the cups of the rocker arms.
- ___ 19. Install the rocker assembly retaining nuts and torque them to 14 ft-lbs.
- ___ 20. Repeat steps 3 through 19.

Tools Required:

- ___ Socket Wrench
- ___ 10 mm Socket

Parts Required:

- ___ Oil Change Kit, ACV-P01-53
- ___ ACV-Z01-22, 6mm Elastic Stop Nut (Qty 6)
- ___ Oil Temp Sender (Optional), ACV-P01-77
- ___ Machined Oil Sump Plate (Optional), ACV-P02-20

Assembly Instructions:

- ___ 1. Install a gasket from the oil change kit over the studs in the oil sump.



- ___ 2. Install the oil screen.
- ___ 3. Install the second gasket from the oil change kit over the oil screen.
- ___ 4. Install the steel bottom plate, or optional ACV-P02-20 Oil Sump Plate, with the 6mm copper washers from the oil change kit and the 6mm nuts from the shakeproof nut kit. Do not over-tighten these nuts.

Or

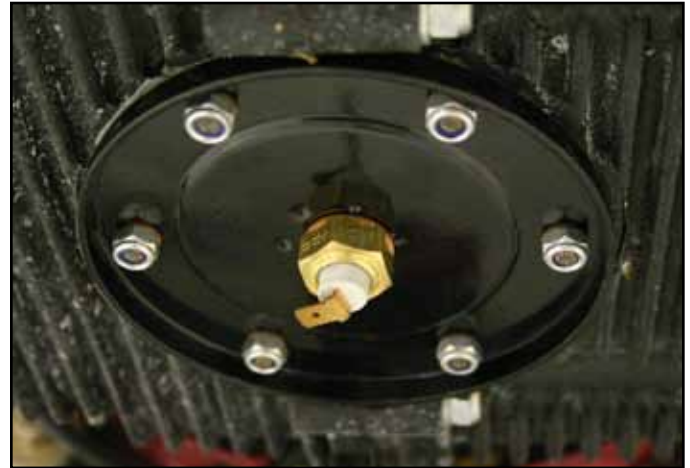
- ___ Install the optional ACV-P02-20 Oil Sump Plate with the provided 6mm copper washers and acorn nuts. You may also use the elastic stop nuts from the Shakeproof nut kit instead of the acorn nuts.

OIL SCREEN INSTALLATION

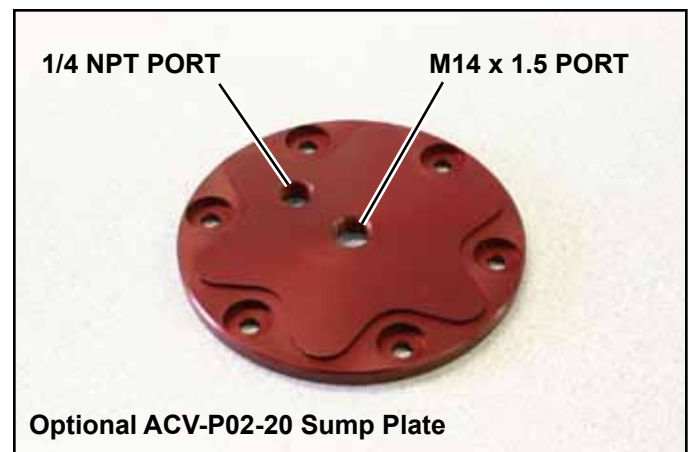
- ___ 5. Install the oil drain plug and included metal/copper gaskets, or the optional oil temp sender w/gasket.

Note: On engine cases requiring an ACV-P01-12 Oil Temperature Plate it is recommended that an oil temperature sender be installed in that plate rather than the oil screen. See "Block-Off Plates and Plugs", page 30.

Note: It is not uncommon to have to deform the oil screen when installing the optional oil temp sender.



The optional oil temperature sender can be installed in the oil drain hole of either standard sump plate (shown) or the optional sump plate (below).



The optional Oil Sump Plate's dual ports provide flexibility for installing combinations of an oil temperature sender, drain plug, quick drain, or oil return line from an oil separator. Any unused port can be plugged with a pipe plug.

Tools Required:

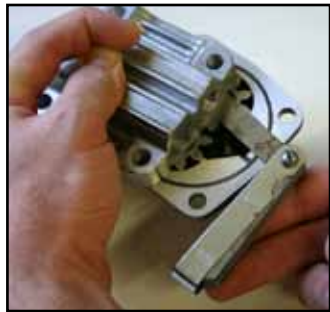
- ___ Socket Wrench
- ___ 13 mm Socket
- ___ Plastic Mallet
- ___ White Lithium Grease
- ___ Aviation Form-A-Gasket #3 or Flange Sealant

Parts Required:

- ___ Maxi Oil Pump (with Oil Cooler Ports), ACV-P01-55
- ___ Straight Pump (without Oil Cooler Ports), ACV-P01-56

Assembly Instructions

- ___ 1. Measure the clearance between the pump gears and the pump cover. Proper clearance is .000" to .004". Tighter is better. Clearances greater than .004" will result in reduced oil pressure.



- ___ 2. Install oil pump gasket under the oil pump housing and align pump housing with oil galley ports.
- ___ 3. Tap oil pump housing into place with a plastic mallet.

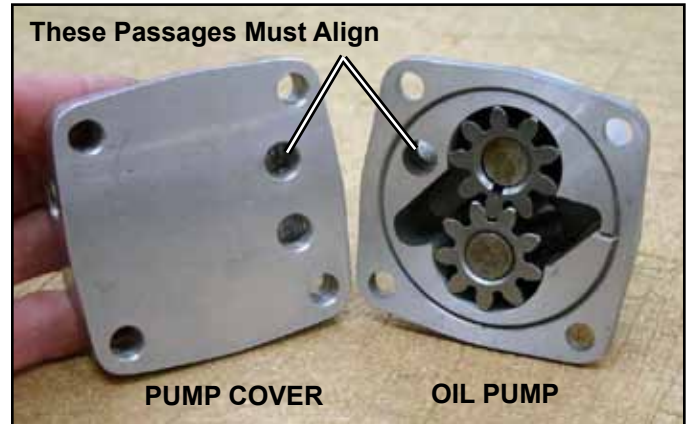


- ___ 4. Liberally grease the top gear and install it, making sure it engages the cam.
- ___ 5. Liberally grease and install the free running bottom gear.



- ___ 6. Apply a very thin coat of Aviation Form-A-Gasket or Flange Sealant to the oil pump cover. If installing the ported oil pump, make sure the oil passages are aligned properly (see photo, next column).

Important! Failure to properly align the passages in the ported cover plate will result in low oil pressure and engine damage.



The ported oil pump cover plate must be installed so the upper oil passage in the back of the cover is directly over the oil passage in the pump body. Though it appears there should be an o-ring, the pump does not have an o-ring in its outer groove.

- ___ 7. Install the 4 mount bolts and torque them to 14 ft-lbs.

Oil Cooler Installation

Installation of an oil cooler is described in the Appendix of this manual. All oil cooler installations must use threaded AN fittings and high quality -06 hose.

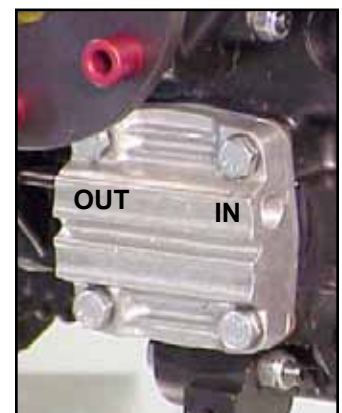
Operation Without an Oil Cooler

To operate your AeroVee without an oil cooler you must either run a loop of -06 hose from the output side of the ported pump to the input side of the ported pump, or replace the entire pump with the ACV-P01-56 Straight (unported) Pump.

Important: Do not plug the output and input ports of a ported pump with plugs. This will prevent oil flow and cause significant engine damage.

Important: Do not replace a ported pump cover with a non-porting cover. This will prevent oil flow and cause significant engine damage.

Additional information on installing oil coolers can be found in Appendix A of this manual.



Tools Required:

- ___ High Temperature RTV Silicone Gasket Maker
- ___ VW Oil Seal Installation Tool (optional, recommended)
- ___ Rubber Mallet

Parts Required:

- ___ End Shims, ACV-P02-19
- ___ Oil Seal, ACV-P01-68

Assembly Instructions

Note: The correct number and thickness of end shims was determined in Crank Case Assembly, page 17.

- ___ 1. Clean the oil seal bore of excessive sealant, particularly around near the case parting lines.
- ___ 2. Install the end shims over the flywheel end of the crank.
- ___ 3. Apply a light coat of High Temperature RTV Silicone Gasket Maker to the outside diameter of the oil seal and install the seal. A VW seal installation tool may be used for best results, however the seal can also be lightly tapped in place if care is used.
- ___ 4. Wipe off any excess sealant.



Tools Required:

- ___ 5/16-18" x 2" Hex Head Cap Screw (not supplied in kit)
- ___ 5/16-18 Nut (not supplied in kit)
- ___ 5/16 Washer (not supplied in kit)
- ___ 5/8" Socket

Parts Required:

- ___ Prop Drive Bushings, ACV-H01-11

Assembly Instructions

- ___1. Insert a prop drive bushing into the prop hub.
- ___2. Insert the bolt through a drive bushing using a socket as a spacer.
- ___3. Use the bolt, washer, nut and socket to pull the drive bushing into the hub.
- ___4. Repeat for other 5 drive Bushings.



Tools Required:

- ___ 0.006" Feeler Gauge
- ___ Flat blade screw driver
- ___ Socket Wrench
- ___ 13 mm Socket

Parts Required:

- ___ Valve Covers, ACV-P01-15

Assembly Instructions:

- ___ 1. Rotate the prop hub until the # 1 cylinder is at top dead center and both the intake and the exhaust valves are closed (valve springs fully extended). The TDC mark on the prop hub should also be lined up with the split-line of the engine case.
- ___ 2. Insert a .006" feeler gauge between the adjusting screw and the valve.
- ___ 3. Adjust the screw until the 0.006" feeler gauge moves smoothly between the valve and the swivel foot.
- ___ 4. Lock the adjustment screw in place by torquing the locking nut to 14 foot pounds.
- ___ 5. Recheck the valve setting with the .006 feeler gauge.
- ___ 6. Repeat steps 2 through 5 for the other valve of cylinder #1.
- ___ 7. Rotate the crankshaft 180 degrees and adjust the valves of cylinder #4, following steps 2 through 6.
- ___ 8. Rotate the crankshaft 180 degrees and adjust the valves of cylinder #3, following steps 2 through 6.
- ___ 9. Rotate the crankshaft 180 degrees and adjust the valves of cylinder #2, following steps 2 through 6.
- ___ 10. Install the valve covers using the cork gaskets, hex head cap screws, O-rings, and washers included with the valve covers. The cap screws are tightened by feel to secure the covers and prevent leaks.



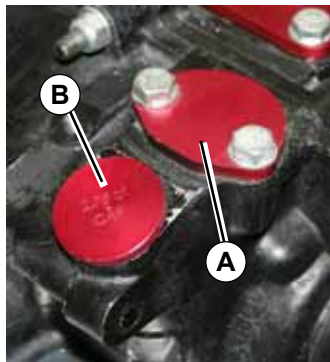
Parts Required

- ___ Gasket Set (partial), ACV-P02-15
- ___ ACV-Z01-18 Bolts, Qty 6
- ___ Machined Breather Plate, ACV-P01-85
- ___ Oil Temperature Plate, ACV-P01-12
- ___ Fuel Pump Block-Off Plate, ACV-P01-14
- ___ Oil Fill Plug, ACV-P01-17
- ___ Dip Stick, ACV-P01-24
- ___ Oil Pressure Sender (Optional), ACV-P01-76



Assembly Instructions

- ___ 1. Install fuel pump block-off plate using ACV-Z01-18 Bolts (Qty 2) and the corresponding gasket (from Gasket Set).
- ___ 2. Spread a light coat of clean engine oil on the O-rings of the oil fill plug and insert it in the case.
- ___ 3. Remove the pre-installed studs from the engine case and install Oil Breather Plate using ACV-Z01-18 Bolts (Qty 4) and the corresponding paper gasket from Gasket Set. **Do not install the metal louvered gasket as it will restrict the breather.**



Fuel pump block-off plate (A) and oil fill plug (B).



BLOCK-OFF PLATES and PLUGS

- ___ 4. Some engines require the installation of an oil temperature plate below cylinder #2. It is installed with two (2) ACV-Z01-23 nuts and the corresponding gasket (from Gasket Set).

Note: If your engine requires the use of this plate, it can be drilled and tapped for an optional M14 x 1.5 oil temperature probe.



The oil temperature plate is not needed on all engine blocks. It is located on the front of the engine, below cylinder #2.

- ___ 5. Slide the dipstick into the dipstick tube in front of cylinder #2.

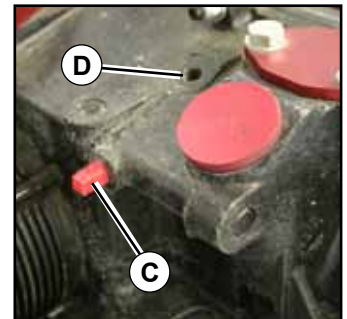
Note: The dipstick will be calibrated and marked in a later procedure.



- ___ 6. If you will not be installing an oil pressure sender in the port in the side of the case (C), install a 1/8 NPT pipe plug.

Important: Do not overtighten the oil pressure sender or the pipe plug as this can result in a cracked case.

Note: A small tapped hole (D) near the oil fill plug does not need to be plugged.



Tools Required:

- ___ Socket Wrench
- ___ 36mm Socket
- ___ Torque Wrench
- ___ Permatex High Temp Red RTV Silicone Gasket

Parts Required:

- ___ Flywheel Assembly, ACV-F01-02

Hardware Required

- ___ ACV-Z01-13 Cap Screws
- ___ ACV-Z01-20 Bolts
- ___ ACV-Z01-21 Bolt
- ___ ACV-Z01-24 Nut
- ___ ACV-Z01-27 Washers

Assembly Instructions:

- ___ 1. Using a high-temperature silicone sealant, lightly coat the dowel pin area of the flywheel and place a small bead (1/8" diameter) in the groove near the dowel pin area of the flywheel.

Note: The engine assembly DVD may show an O-ring being used instead. The O-ring has been discontinued.



- ___ 2. Install the flywheel on the back of the engine.

Important: The 8 dowel pins will only align one way.

Note: The flywheel may require some effort to get it started and seated on the drive pins. This is normal.

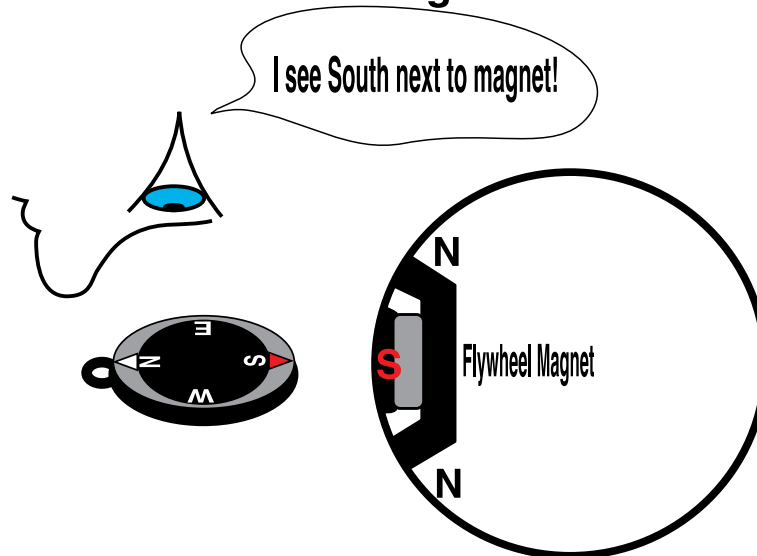


- ___ 3. Install wavy washer and gland nut with Locktite 272. Torque to 227 ft-lbs.

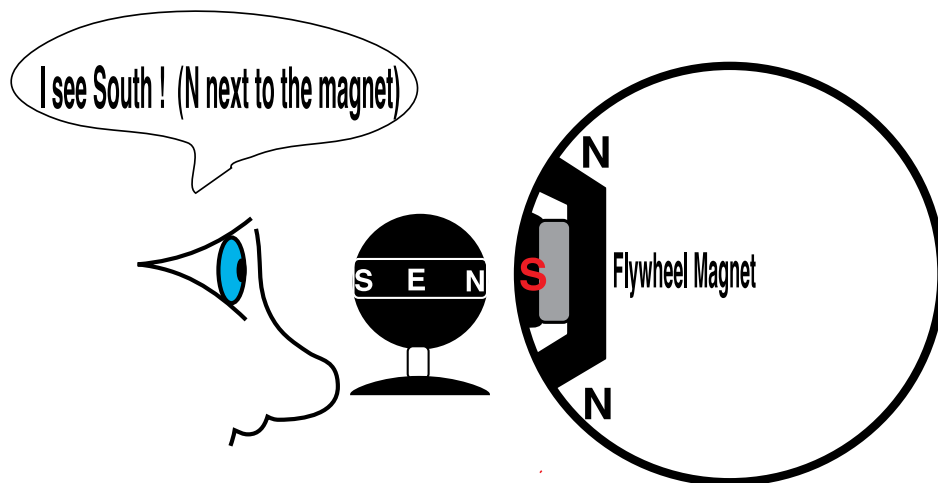
Note: A piece of wood temporarily bolted to the prop hub provides good leverage to keep the crank from turning while the gland nut is being torqued.



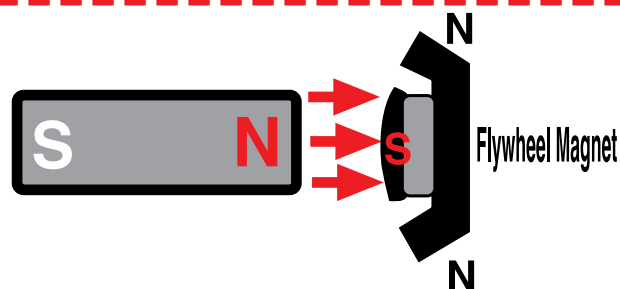
Confirming **AeroVee** Ignition Magnet Orientation. The **Center Pole** of the Magnet must be **South**!



1) Checking Magnet using a "Hiking" or "Boy Scout" Compass



2) Checking Magnet using an Auto or Aircraft Compass



3) Checking Magnet using a "BAR" Magnet N will attract...**S will repel**!

AeroConversions, Inc 10/02

Tools Required:

- ___ Socket Wrench
- ___ 13mm Socket
- ___ 13mm Ignition Wrench
- ___ 9/64" Allen Wrench
- ___ 7/32" Ignition Wrench

Parts Required:

- ___ Accessory Plate, ACV-A01-10
- ___ Ignition Modules (Magnatron), ACV-A01-19
- ___ ACV-Z01-13 Cap Screws
- ___ ACV-Z01-20 Bolts
- ___ ACV-Z01-21 Bolt
- ___ ACV-Z01-24 Nut
- ___ ACV-Z01-27 Washers
- ___ MS21042-08 Hex Nuts
- ___ Shim Stock .010", ACV-P01-75

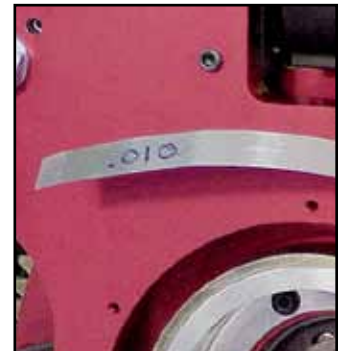
- ___ 1. Bend P-Lead tabs on ignition modules 90° to clear the accessory plate.



- ___ 2. Attach ignition modules to the accessory plate using ACV-Z01-13 Cap Screws and ACV-Z01-30 hex nuts. Install bolt at the bottom of the slot. **The note 'THIS SIDE OUT' stamped in each Magnatron must face towards the front of the engine.**



- ___ 3. Match the accessory plate to the raised groove on the back of the engine case.
- ___ 4. Attach accessory plate using the ACV-Z01-20 Bolts (Qty 3), ACV-Z01-21 Bolt (Qty. 1), ACV-Z01-24 Nut, ACV-Z01-27 Washers (Qty 4). Torque to 25 ft-lbs.
- ___ 5. Rotate the flywheel until the magnet shoe on the flywheel is under the Magnatron.

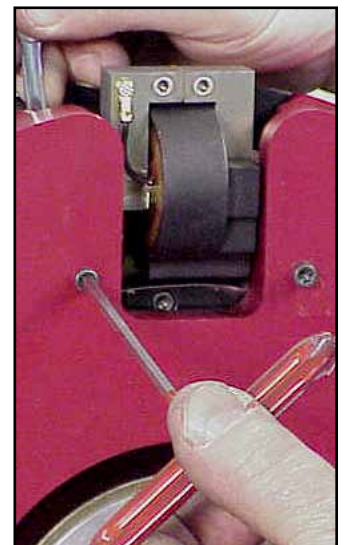


- ___ 6. Slide the 0.010 shim between the ignition module and magnet shoe.



- ___ 7. Push module down against the shim and tighten the module mount bolts.
- ___ 8. Remove 0.010 Shim.
- ___ 9. Repeat steps 5 through 9 for the remaining ignition module.

Note: The Ignition Timing is fixed. There is no need to time the primary ignition system.



Tools Required

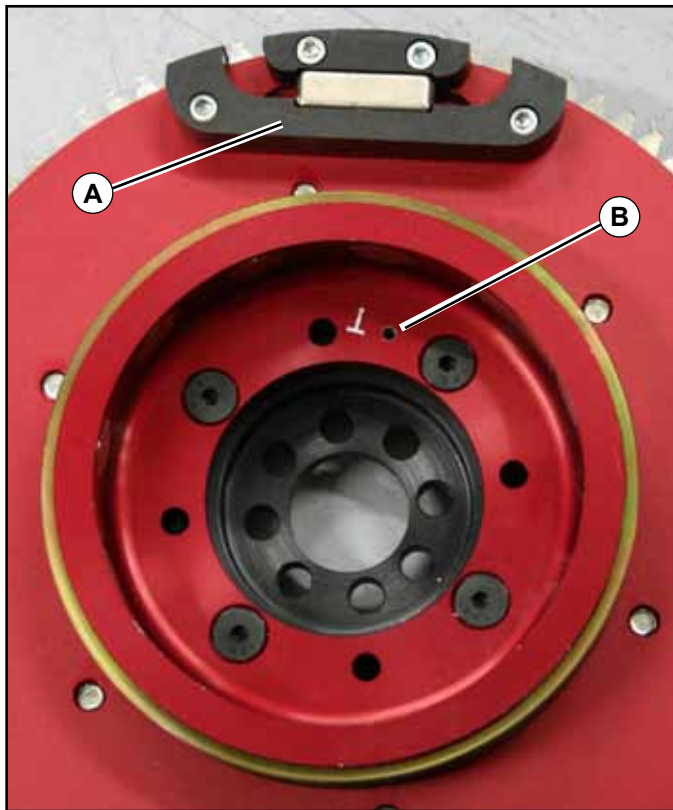
- ___ 9/64" Hex Drive
- ___ Locktite 242

Parts Required

- ___ Trigger Shaft Assembly, ACV-F01-24
- ___ ACV-Z01-81 Flat Head Socket Cap Screw, Special, Qty. 4

Trigger Shaft Installation

- ___ 1. Rotate the crank until the magnet shoe (A) on the flywheel is at the top of the engine. This will also put the witness hole in the flywheel assembly (B) near the 12 o'clock position, as shown in the photo below.

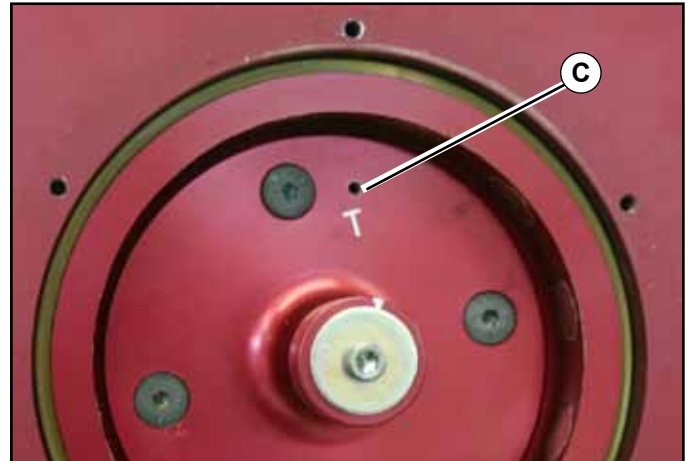


Rotate the engine until the magnet shoe (A) is in the 12 o'clock position. This will also put the flywheel's witness hole (B) near the 12 o'clock position. For clarity the flywheel is shown removed from the engine.

TRIGGER SHAFT INSTALLATION

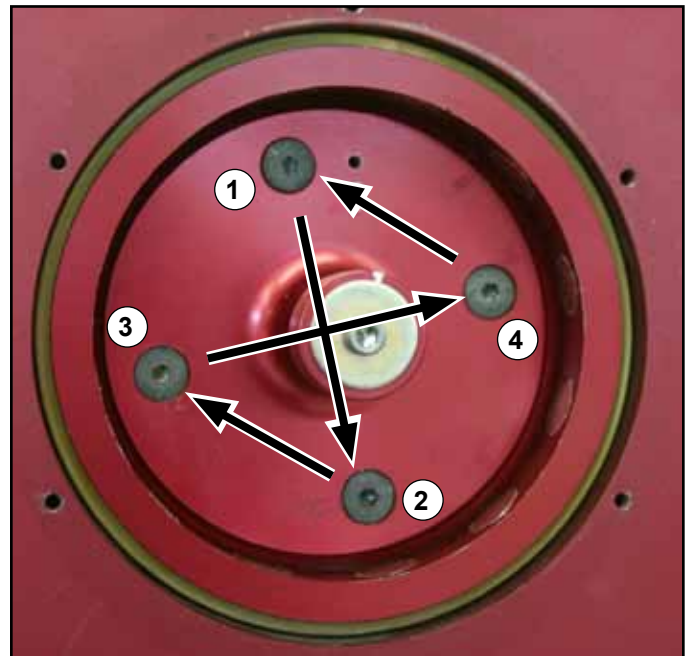
- ___ 2. Line up the witness hole in the trigger shaft (C) with the witness hole in the flywheel. Apply Locktite 242 to each of the four (4) ACV-Z01-81 flat head cap screws and install them loosely. They will be tightened in step 3.

Note: If your trigger shaft does not have a witness hole, the trigger shaft may be attached in any orientation.



The "C" identifies the witness hole on the trigger shaft. Align this hole with the witness hole in the flywheel.

- ___ 3. Sequentially tighten the screws in the crossing pattern shown below. This will center the shaft on the flywheel.



The screws are sequentially tightened in the crossing pattern shown here. This helps center the trigger shaft on the flywheel.

Tools Required:

- ___ 11/16" Spark Plug Socket Wrench
- ___ 0.018" & 0.032 Feeler Gauges
- ___ Anti-Seize Compound

Parts Required:

- ___ Autolite 4163 Spark Plugs (Qty 8), ACV-P01-21

Plug Installation:

- ___ 1. Gap four (4) TOP spark plugs to 0.018".
- ___ 2. Gap four (4) BOTTOM spark plugs to 0.032".



- ___ 3. Apply an anti-seize compound to the threads of each spark plug and install them in the cylinders.
- ___ 4. Torque each spark plug to 12 foot-pounds.

Supplies Required:

___ Permatex Aviation Form-A-Gasket #3 or Flange Sealant

Parts Required:

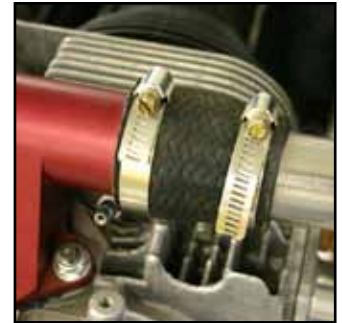
- ___ AeroInjector, ACV-C07S
- ___ Intake Manifold, as supplied
- ___ Intake Elbow Spacers (Qty 2) ACV-M01-17
- ___ Intake Elbow-Right Hand, ACV-M01-11
- ___ Intake Elbow-Left Hand, ACV-M01-12
- ___ Intake Hose (Qty 3), ACV-M01-20 (was ACV-M01-13)
- ___ Hose Clamp (Qty. 6), ACV-Z01-10
- ___ ACV-Z01-49, Socket Head Cap Screw (Qty. 4)
- ___ ACV-Z01-26, Washer (Qty. 4)

Assembly Instructions

- ___ 1. Temporarily place each of the intake elbow spacers and intake elbows on the cylinder heads and inspect for interference between the elbows and the two upper, center head studs. If necessary, trim the ends of the studs to eliminate interference.
- ___ 2. Apply Permatex Aviation Form-A-Gasket #3 to one side of each intake elbow spacer and position each spacer on each cylinder head, Permatex side against the cylinder head.
- ___ 3. Apply Permatex Aviation Form-A-Gasket #3 to each intake elbow and secure the elbows to the cylinder heads with ACV-Z01-26 Washers (Qty 4), and ACV-Z01-49 Cap Screws (Qty. 4) torqued to 10 foot pounds.



- ___ 4. Thoroughly clean the inside of the manifold before installing it.
- ___ 5. Secure an intake hose to each intake elbow with a hose clamp from the intake boot kit.
- ___ 6. Push the intake manifold securely inside the hose and secure it with hose clamps from the intake boot kit.
- ___ 7. Secure the intake manifold to the engine with the lower, aft engine case bolt. Bend the mounting tab on the intake manifold as needed to clear the lower Magnatron.
- ___ 8. Attach the AeroInjector to the bottom of the manifold using the remaining hose and hose clamps from the intake boot kit.
Note: For uniform delivery of the fuel mixture, the AeroInjector must be installed parallel to the airframe.
Note: Fuel inlet goes to the back of the engine.
- ___ 9. Safety wire the AeroInjector to the intake manifold.
- ___ 10. Throttle, mixture, fuel line and air filter connections are described in the AeroInjector manual.



Tools Required

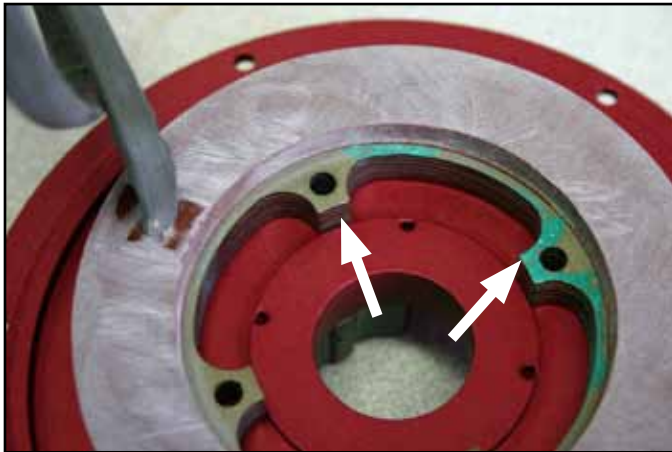
- ___ 9/64" Hex Drive
- ___ Locktite 242
- ___ Locktite 7088 Primer

Parts Required

- ___ Alternator Mount Plate w/ Ignition Modules, ACV-A01-03
- ___ Alternator Stator, 20 Amp, ACV-A01-15
- ___ ACV-Z01-12 Cap Screw, Qty. 6
- ___ ACV-Z01-76 Cap Screw, Patched, Qty. 4

Stator Assembly

- ___ 1. Test fit the stator to the stator plate. If interference is noted between the mounting lugs of the stator and the boss on the plate, sand or file the lugs to remove the interference.



Make sure the lugs of the stator do not interfere with the raised boss of the stator plate.

- ___ 2. Pass the wires of the stator through the hole in the stator plate.
- ___ 3. Prime four ACV-Z01-76 screws with Locktite 7088 Primer.



- ___ 4. Attach the stator to the alternator mount plate using the four (4) primed ACV-Z01-76 screws and Locktite 242 on each screw prior.



ALTERNATOR INSTALLATION

Installing the Stator Assembly

- ___ 1. "Paint" the surface of each magnet in the magnet ring and the outside of the stator with a permanent marker.

Important: The magnets of the magnet ring are very strong and will try to pull the stator assembly out of your hands as you install it. Maintain a firm grip to avoid pinched fingers.



- ___ 2. Carefully place the stator assembly over the magnet ring with the "top" pick-up near the 1 O'clock position and the "bottom" pick-up near the 7 O'clock position. The magnet ring may force the stator assembly into an unwanted position. Rotate the flywheel until the stator plate can be properly positioned.

- ___ 3. Temporarily install 6 (six) ACV-Z01-12 cap screws to secure the stator assembly in place.

- ___ 4. Rotate the crank shaft 3 or 4 full revolutions. This is easily done by removing a spark plug and turning the crank with a socket wrench on the prop hub bolt.



- ___ 5. Remove the stator plate and inspect the magnet ring and stator for signs that the two are in contact with each other. If the marker is intact on both parts, your clearance is acceptable. Continue with Step 6.

If there is evidence of contact between the parts, use a belt sander or equivalent to remove some material from the stator where the marker has been rubbed away and then repeat steps 1 through 5.

- ___ 6. Re-install the stator assembly as described in Step 2.
- ___ 7. Prime six ACV-Z01-12 screws with Locktite 7088 Primer.
- ___ 8. Secure the stator assembly to the accessory plate using six primed ACV-Z01-12 screws and Locktite 242.

Parts Required

- ___ Voltage Regulator, ACV-A01-20
- ___ Ignition Coils (Red), Qty. 2, ACV-A01-25
- ___ AN-grade hardware as required (not supplied)

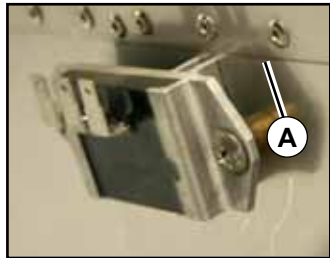
Before the engine is installed on the engine mount, the firewall should be prepared. This includes mounting the AeroVee's secondary ignition coils and voltage regulator.

Though not part of the AeroVee kit, careful consideration must be given to the placement of the gascolator, battery box, master solenoid, and other firewall-mounted components to avoid interference with the engine installation and assure ease of maintenance.

Voltage Regulator Installation

Note: The voltage regulator must be grounded. In a typical installation the regulator will be grounded through the hardware which secures it to the firewall. If your installation uses non-conductive materials for the firewall, or for the mounting of the regulator, dedicated ground wires will be necessary between the regulator and a suitable ground point.

- ___ 1. Mount the voltage regulator to the firewall in a location which allows easy connection of the wires from the alternator. The use of 3/8" long stand-offs (aluminum or bronze tubing) is recommended to space the regulator away from the firewall.



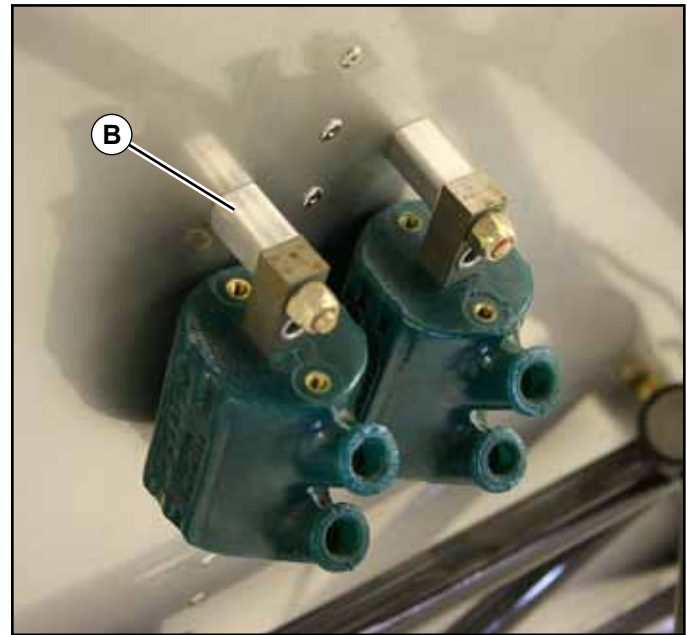
Stand-offs (A) are used to space the regulator off the firewall.

Wiring the alternator to the voltage regulator is described later in this manual.

Secondary Ignition Coil Installation

Note: The ignition coils must be grounded. In a typical installation the coils will be grounded through the hardware which secures them to the firewall. If your installation uses non-conductive materials for the firewall, or for mounting the coils, dedicated ground wires will be necessary between the coils and a suitable ground point.

- ___ 1. Mount the ignition coils (ACV-A01-25) to the firewall in a location which allows easy connection of the lower spark plug wires. The use of 3/4" long stand-offs (aluminum or bronze tubing) is recommended to space the coils away from the firewall.



Stand-offs (B) are used to space the coils off the firewall.

Parts Required

- ___ Motor Mount Shock Bushings (Qty. 8), ACV-P01-19
- ___ 3/8" ID x 1.25" OD Fender Washer (Qty. 16), ACV-Z01-40
- ___ AN4-36A Bolt (Qty. 4, not supplied)
- ___ AN363-428 Nut (Qty. 4, not supplied)
- ___ AN960-416 Washer (as needed, not supplied)

Sonex Aircraft Airframes

Bolting the engine to the engine mount is shown in detail in the "Engine Installation, AeroVee" drawing of your airframe plans and on the next page of this manual, however, these few notes may save you some time.

All Airframes

Mount Bushings

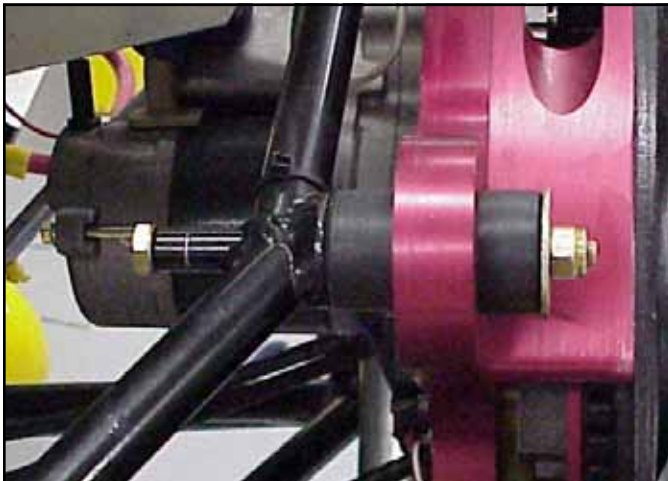
The engine mount bushings will go on the engine mount much easier if they lightly lubricated with soapy water.

Lifting the Engine

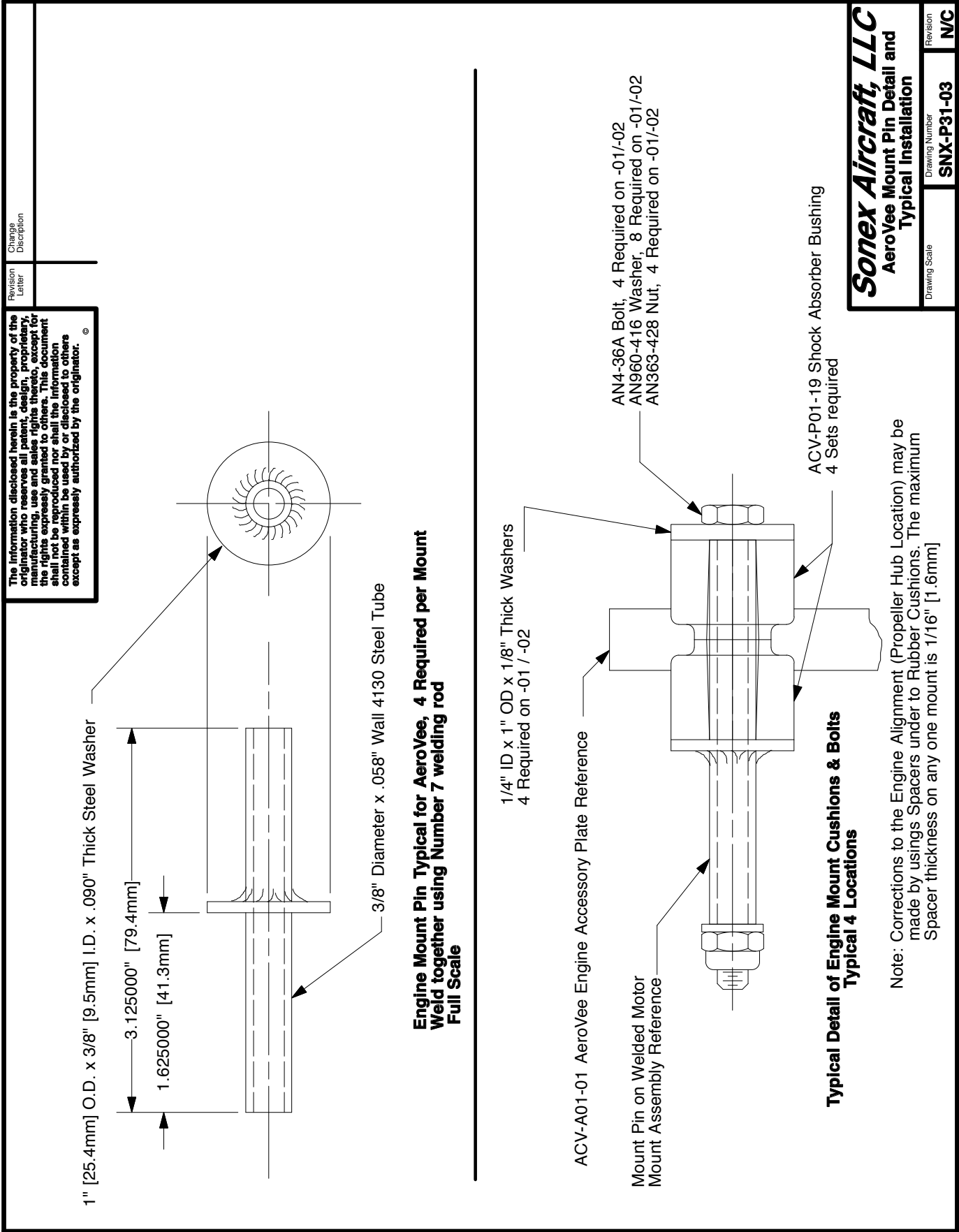
When lifting the engine into place care must be taken to make sure the pushrod tubes are not damaged.

Installing the Mount Bolts

The head of the mounting bolts may be inserted in either direction.



A typical engine mount and shock-rubber installation. A minimum of two ACV-Z01-40 washers (1/8" thick total, minimum) must be placed against the front bushing. Additional washers may be used as needed, and washers may be used behind the rear bushings as spacers to shim the thrust line as needed.

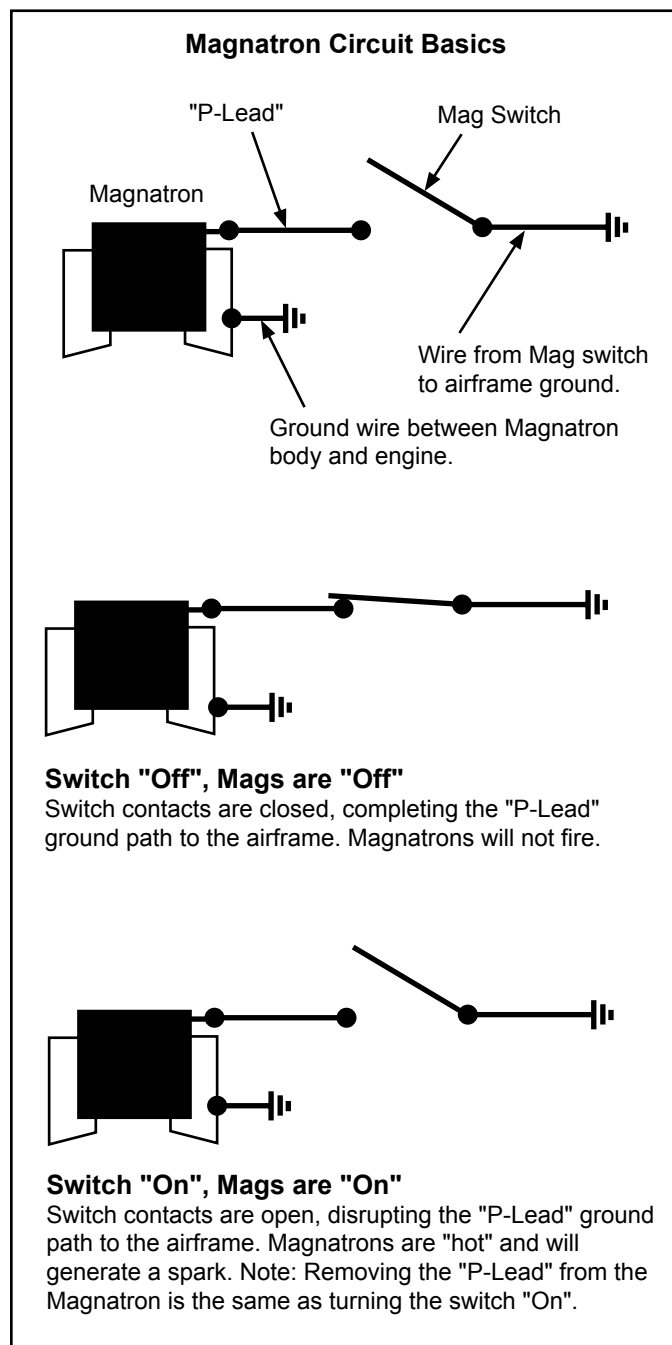


Parts Required

- ___ Spark Plug Boots, Qty. 4, ACV-P01-23
- ___ Dual Pole, Single Throw Switch (not supplied)

Magnatron Circuit Basics

The magnatron is a very simple ignition system, however, understanding the circuit wiring is often confusing. Unlike most other electrical devices, when the switch is "Off" the Magnatron circuit is *closed* and the Magnatrons are *disabled*. When the switch is "On" the ground path is *open* and the Magnatrons become *operational*.



MAGNATRON IGNITION WIRING

Magnatron Wiring

The Magnatron ignition should be controlled by a single Dual Pole, Single Throw (DPST) toggle switch.

Important: Aircraft-style key switches (Off-Left-Right-Both-Start) may not work, depending on how they are internally wired. Sonex Aircraft LLC is unable to assist on any installation with this type of switch.

Important: The DPST switch must be installed in the panel in a manner that assures that when the switch is in the down ("Off") position, its contacts are closed, grounding the P-Leads to the air-frame and disabling the Magnatron ignition.

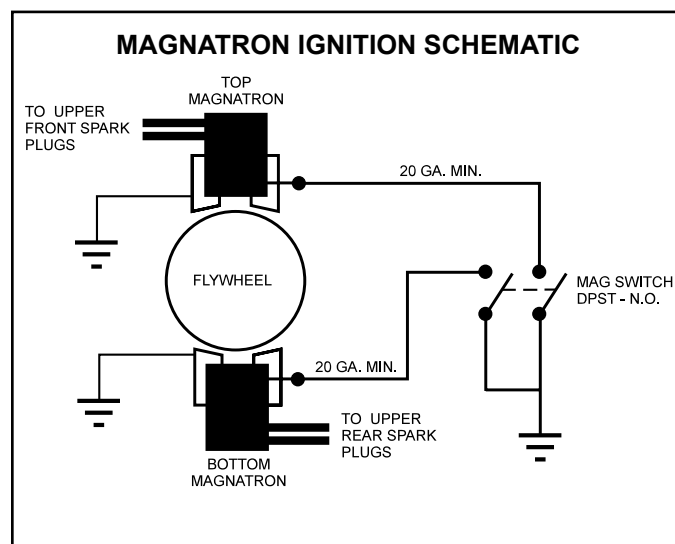


This DPST switch would have a P-lead from each Magnatron attached to the top terminals, and wires to ground attached to the lower terminals. Your switch may vary.

To check for proper switch installation:

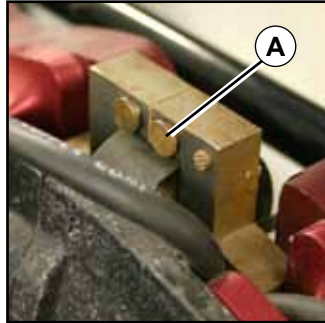
- ___ A. Place the switch in the down ("Off") position.
- ___ B. Place an ohmmeter across a pair of the switches' terminals. If there is no resistance (0 ohms) between the terminals, the switch is properly oriented in the panel.

If the resistance is infinite, the switch is "On" and needs to be rotated 180-degrees in the panel for proper installation.



- ___ 1. Attach a 20 gauge (minimum) ground wire to the body of each magnatron. The ground wire may be attached to a magnatron mounting bolt, or to one of the "studs" (A) on the metal frame.

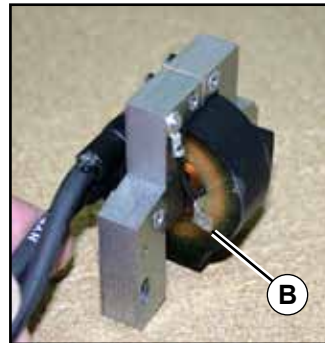
Attach the other end of the ground wire to a suitable ground on the engine block.



A large spade terminal will slip over a stud (A), providing a ground point for each Magnatron.

Do not attach the ground wire to the "P-Lead" terminal ("B", photo below). This terminal must only be used for the ignition switch wiring.

- ___ 2. Attach a 20 gauge (minimum) wire between a DPST ignition switch and the P-Lead terminal (B) of each magnatron.



Magnatron P-Lead terminal.

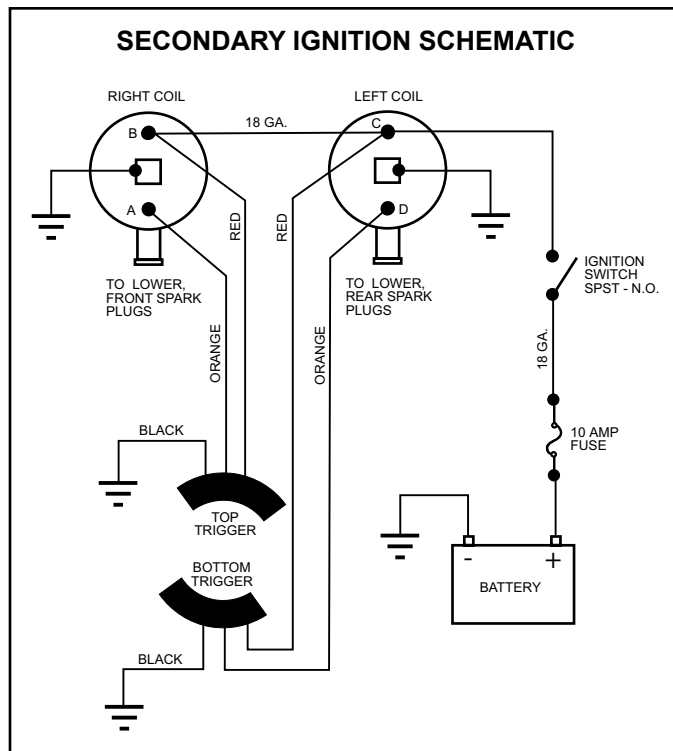
- ___ 3. Attach a 20-gauge (minimum) wire between the remaining terminals of the DPST switch and an appropriate airframe ground.
- ___ 4. Slide a spark plug boot over the end of each spark plug wire.



- ___ 5. Attach the top Magnatron's spark plug wires to the upper front spark plugs.
- ___ 6. Attach the bottom Magnatron's spark plug wires to the upper rear spark plugs.

Parts Required

- ___ Electrical Terminals (not supplied)
- ___ Electrical Wire (not supplied)



Top Trigger Wiring

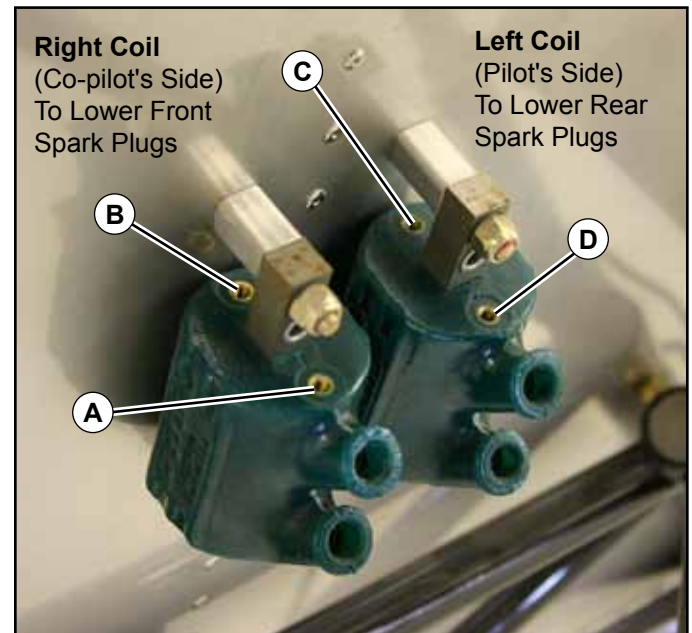
- ___ 1. Black wire (ground). Attach to any ground point. The ground wires from both the top trigger and bottom trigger can share the same ground point.



The secondary ignition triggers.

ELECTRONIC IGNITION WIRING

- ___ 2. Red wire (+12V). Attach to rear terminal screw of right hand coil (terminal "B" in photo).
- ___ 3. Orange wire (Trigger). Attach to the front terminal (terminal "A" in photo) of right hand coil.



The coils are mounted on the firewall as near the fuselage centerline as possible. Note that "Left" and "Right" are as viewed from the pilot's seat.

Bottom Trigger Wiring

- ___ 1. Black wire (ground). Attach to any ground point. The ground wires from both the top trigger and bottom trigger can share the same ground point.
- ___ 2. Red wire (+12V). Attach to the rear terminal screw of left coil (terminal "C" in photo).
- ___ 3. Orange wire (Trigger). Attach to the front terminal (terminal "D" in photo) of left coil.

Coil Wiring

- ___ 1. Connect an 18 ga. wire between terminals "B" and "C". This is a jumper for the +12V power supply wire.
- ___ 2. From the ignition switch, run an 18 ga. wire through a 10 amp fuse and connect the wire to terminal "B" of the right coil.
- ___ 3. The coils must be grounded. In a typical installation the coils will be grounded through the hardware which secures them to the firewall. If your installation uses non-conductive materials for the firewall, or for the mounting of the coils, dedicated ground wires will be necessary between the coils and a suitable ground point.

Parts Required:

___ Spark Plug Wires, ACV-A01-24

Assembly Instructions:

Important: The factory crimped ends of each wire will be re-used. When cutting the wires to the correct length, do not cut the crimped ends off.

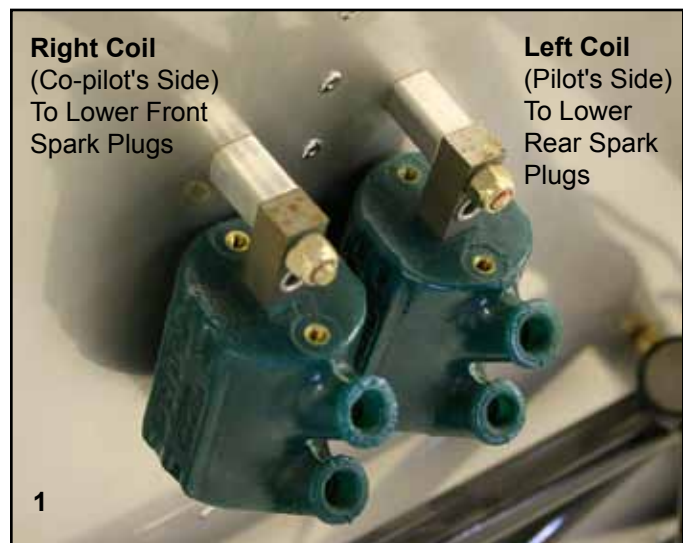
Note: Extra wires have been included with your kit. It is possible to wire your secondary ignition with a single package of spark plug wires, leaving the second set for spares.

___1. Determine the length for each spark plug wire.

The front, lower plug wires attach to the right coil.

The rear, lower plug wires attach to the left coil.

The pre-crimped ends are kept in place for the spark plugs. Cut the wires to the correct length.



Attach the spark plug wires to the proper coils. Note that "Left" and "Right" are as viewed from the pilot's seat.



The crimped end of each plug wire is re-used - do not cut them off.

___2. Slide a boot (included with ACV-A01-24) over the cut end of each spark plug wire.



The boot included with the spark plug wires is slipped over the cut end of each wire.

___3. Remove the black outer jacket and the white insulation core to expose a 3/8" length of the inner conductor.



___4. Fold the conductor over the jacket and crimp a metal connector in place. The end of the cable must come to the hole in the connector.



___5. Slide the boot over the connector. This is the end of the cable which attaches to the coil.



___6. Attach the spark plug wires to the coils and spark plugs.

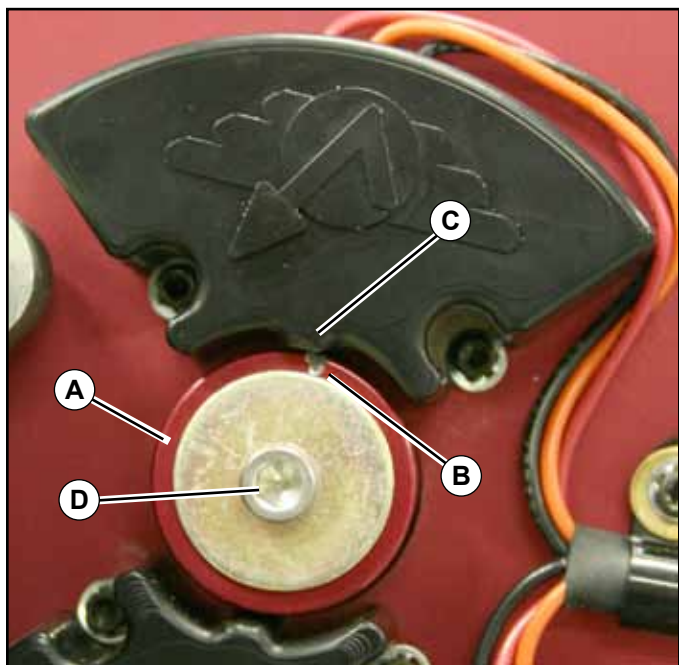
Tools Required

— 5/32" hex wrench

Timing Basics

The electronic (secondary) ignition is timed to match the Magnatron (primary) ignition, which is fixed at 28 degrees BTDC. Accurate timing is accomplished when the two ignition systems are firing as one, which is indicated by little or no difference in engine RPM when switching between ignition systems.

The trigger cap (A) of the secondary ignition system rotates to make timing adjustments. It is locked in position by a socket head cap screw (D). When the magnet in the trigger cap passes by the sensor in the triggers (C), it fires the spark plugs. The location of the magnet in the trigger cap is marked with a line (B).



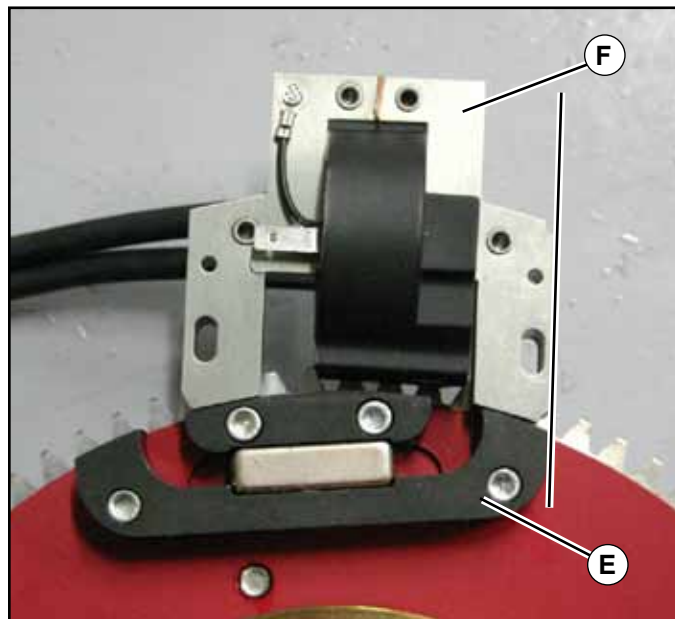
The trigger cap (A) is locked in position by a socket head cap screw (D). A mark (B) on the trigger cap corresponds with the location of the trigger magnet. When this magnet passes by a sensor (C) in the upper and lower triggers, the spark plugs fire.

ELECTRONIC IGNITION TIMING

Timing the Secondary Ignition

Important: The secondary ignition will spark when the ignition is on and the trigger magnet passes by the sensor. This can cause ignition. Avoid serious injury or death by turning off the fuel, ignition switch, and master switch and remaining clear of the propeller while timing the ignition.

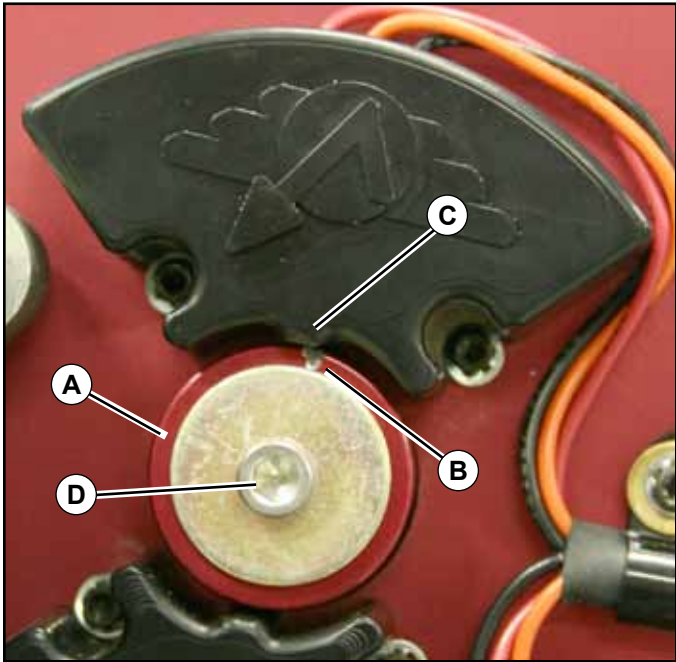
Initial timing is achieved by aligning the right edge of the magnet shoe on the flywheel (E, photo below) with the right edge of the top Magnatron (F) and then rotating the trigger cap (A) until the mark on the cap (B, previous column) is centered under the sensor (C) of the upper trigger. The following steps detail this process.



The black / white line on the right shows how the top Magnatron and magnet shoe on the flywheel align prior to setting the secondary ignition timing. For clarity these parts are shown removed from the engine.

- 1. Turn off the aircraft's Master switch, secondary ignition switch and fuel valve.
- 2. Pull the cockpit mixture control to "Idle Cut-off".
- 3. Rotate the crank until the right edge of the magnet shoe on the flywheel (E, above) is aligned with the right edge of the top Magnatron (F, above). Look down between the accessory plate and the rear flange of the engine case to check the alignment of the top Magnatron to magnet shoe on the flywheel.

- ___ 4. Loosen the socket head cap screw (D) and rotate the magnet cap (A) until the mark on the magnet cap (B) is centered under the sensor (C) of the upper trigger.



When the crankshaft is in the proper position (see steps 1 thru 4), static timing is achieved by loosening the cap screw (D) and rotating the trigger cap (A) until the mark on the cap (B) is centered under the sensor of the upper trigger (C).

- ___ 5. Tighten the socket head cap screw.

ELECTRONIC IGNITION TIMING

Timing Check

Ground Check. Running the engine and performing a mag check will indicate the accuracy of the timing of the secondary ignition. A mag check at 1600 - 2000 RPM should reveal little or no change in RPM. If a change of 50 RPM or greater is noted, the magnet cap should be rotated slightly one way or the other.

In Flight Check. Under normal cruise power (2900 to 3400 rpm):

- ___ 1. Turn off the secondary ignition and observe the cylinder head temperature.
- ___ 2. Turn on the secondary ignition and turn off the Primary ignition. Observe the cylinder head temperature.

If the cylinder head temperature rises when operating with only the secondary ignition, the secondary ignition is advanced. Retard the secondary ignition by turning the magnet cap slightly clockwise, as viewed from the flywheel end of the engine.

Parts Required

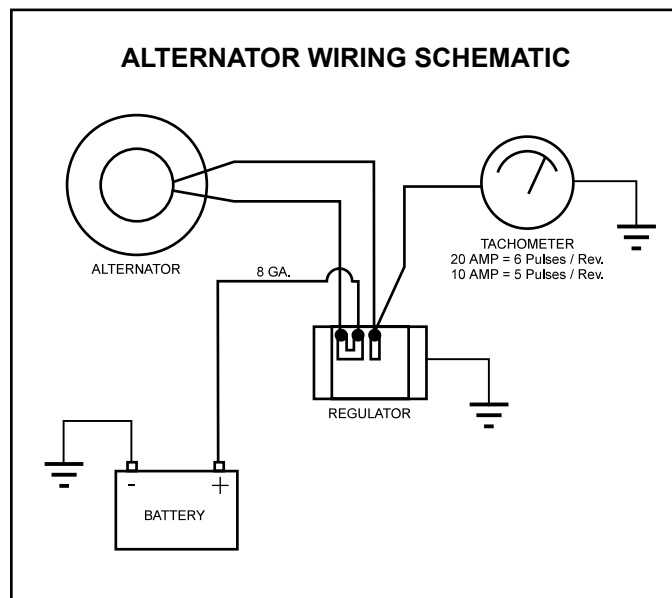
- ___ Electrical Terminals (not supplied)
- ___ Electrical Wire (not supplied)

Alternator - Regulator Wiring

- ___ 1. Attach the two wires from the alternator to the two outer terminals of the voltage regulator. It does not matter which wire attaches to which terminal.
- ___ 2. Attach an 8 or 10 gauge wire from the center terminal of the voltage regulator to the positive battery terminal.
- ___ 3. If you will be using a tachometer which senses pulses from the alternator, it must be spliced in to one of the wires from the alternator. Consult the instrument manufacturer's instructions for proper installation and set-up.

Note: The 20 amp alternator delivers 6 pulses per revolution.

- ___ 4. If the voltage regulator is attached to a non-conductive surface a ground wire needs to be attached between the body of the regulator and an appropriate airframe ground.



Tools Required:

- ___ 3/8" Hex Wrench
- ___ Locktite 262

Parts Required

- ___ Starter, ACV-A01-16
- ___ ACV-Z01-14 Cap Screws
- ___ Electrical Terminals (not supplied)
- ___ Electrical Wire (not supplied)

Starter Installation

Note: Though the starter is grounded through the bolts which secure it to the accessory plate, anodizing in the threads of the accessory plate and the recommended use of Locktite can degrade this ground path. You may wish to install an 8 to 10 gauge supplemental ground wire under one of the starter attachment bolts and attach the other end to an appropriate ground on the airframe or battery.

Do not use an engine mount bolt for a grounding point as they are insulated from the engine by the rubber engine mounts and do not provide a good ground path.

- ___ 1. Attach the starter to the accessory plate using two (2) ACV-Z01-14 cap screws and Locktite 262.

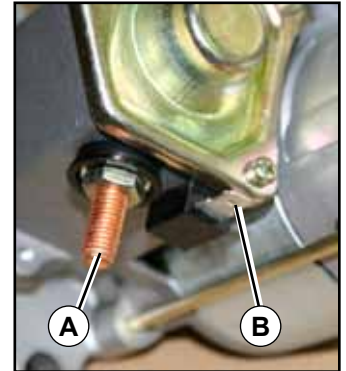


When installing the starter, consider attaching an 8 gauge ground wire under one of the starter mounting bolts and connecting the other end to the negative terminal of the battery.

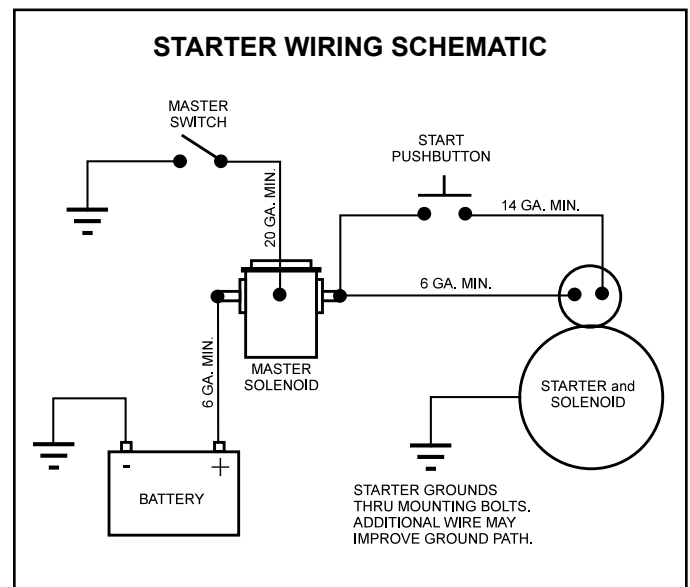
Starter Wiring

The drawing below illustrates a typical starter wiring schematic. This can be modified to suit your needs. Note that a separate starter solenoid is not needed as the AeroVee starter has a built-in solenoid.

The starter has two points for electrical connections: A large threaded lug (A) for the 6 gauge starter wire, and a small male spade terminal (B) for the 14 gauge solenoid wire.



Electrical connectors on the starter solenoid.



Materials Required

- ___ 5/8" O.D. x .035" Aluminum Tube (6061-T6 or 5052-0)
- ___ Permatex High Temp Red RTV Silicone Gasket

Breather Installation

- ___ 1. Form an engine breather tube from 5/8 diameter x .035" wall 6061-T6 or 5052-0 aluminum tube. The tube should curve up slightly after exiting the breather plate. This encourages oil to flow back into the case rather than get discharged.



Additionally, a 1/16" diameter hole drilled at the top of the curve permits crankcase breathing in the event the exit tube freezes shut.

Route the tube so it discharges out the bottom of the cowlings, or into the top of the optional AeroConversions Oil Separator.

- ___ 2. Secure the tube in the breather plate with high temperature silicone gasket.
- ___ 3. Secure the tube as needed to prevent vibration.

The AeroVee can be fitted with two different factory-developed oil cooler installations or, in rare circumstances, no oil cooler at all.

Your engine kit was shipped with the AeroConversion-specific parts needed for one of the two oil cooler installations detailed on the following pages. The oil cooler and some additional items such as hardware and fittings must be sourced by each builder. Each section begins with a list of items that will be needed to complete the installation. In many cases these are common parts which may be sourced locally from automotive-supply stores or hardware stores.

Additionally, both Wicks and Aircraft Spruce offer AeroVee Firewall Forward Kits which may contain the parts you need for the oil cooler installation as well as the fuel system.

IMPORTANT: Because of the wide range of possible installation variations, the hardware and fittings mentioned in this manual and included in the 3rd-party hardware kits may or may not match your specific needs or desires. Each builder must make their own determination of which parts are appropriate for their particular installation.

Parts Required

___ Optional Sonex/AeroVee Baffle Kit (p/n SNX-P30-10)

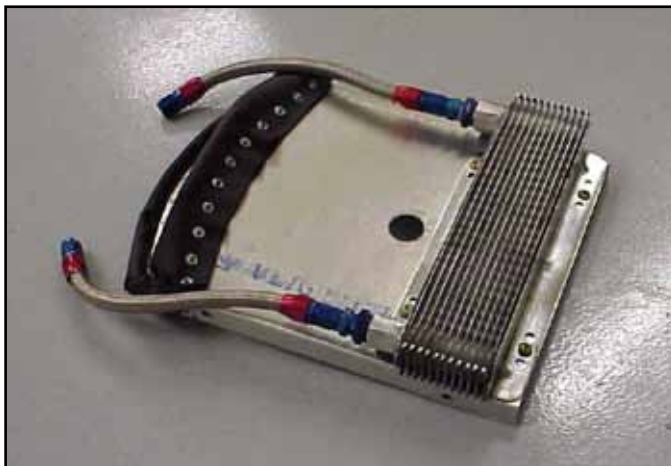
The following parts are not supplied by Sonex Aircraft.

- ___ Oil Cooler (Jeg's P/N 130-70265)
- ___ AN912-4D Reducer Bushing, Qty. 2
- ___ AN816-6-6D Straight Flare Fitting, Qty. 2
- ___ AN816-6D Straight Flare Fitting, Qty. 2
- ___ -06 Straight Hose Fitting, Qty. 4 (Jeg's P/N 799-610020)
- ___ -06 Pro Flex Hose, 2 ft. (Jeg's P/N 799-632060)
- ___ AN3-3 bolts, Qty. 4
- ___ AN960-1032 Washers, Qty. 4
- ___ MS20365-1032 Lock Nuts, Qty. 4

Installing the Oil Cooler

The optional Sonex / AeroVee Fence Baffle kit includes laser-cut parts for the oil cooler installation.

1. Position the oil cooler near the back of the lower shroud with the inlet ports facing forward. Make sure the cooler does not interfere with the exhaust and mark the location of the mounting holes.

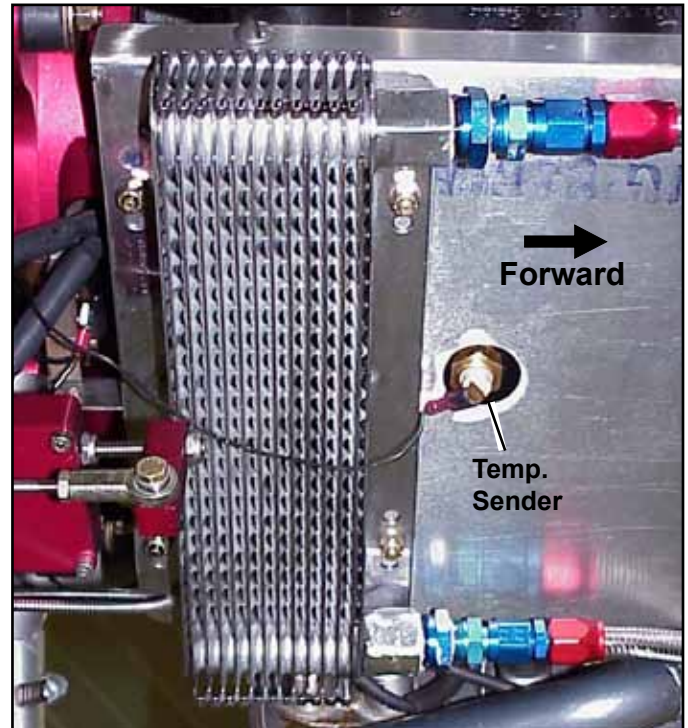


The oil cooler is mounted to the shroud. This photo shows the oil cooler hoses and baffle seal already installed on the cooler; however these steps come later.

2. Drill four 3/16" diameter mounting holes in the shroud to match those in the oil cooler and attach the cooler with four AN3-3A bolts, MS20365-1032 nuts, and AN960-10 washers.

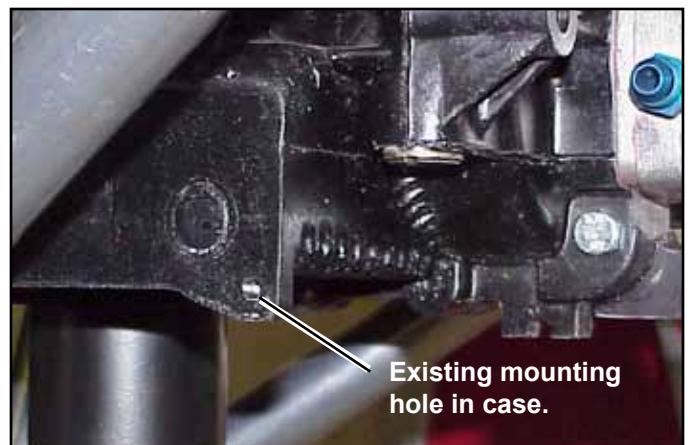
OIL COOLER, BOTTOM MOUNT

3. Cut an air passage in the bottom of the shroud and install an air deflector to force the air traveling under the oil sump to exit through the oil cooler.



This view, looking up at the bottom of the engine, shows the clearance hole for the oil temperature sender (see step 3).

4. Attach the oil cooler shroud to the engine case with four M6x1 screws, or re-tap the holes and use 1/4-20 screws. See photo below.



The oil cooler shroud is attached to the engine case at each corner of the case's oil sump.

5. Apply teflon paste (do not use teflon tape) to the threads of each AN912-4D bushing and install one in each port of the oil cooler.
6. Apply teflon paste (do not use teflon tape) to the threads of two AN816-6-6D nipples and install one in each of the bushings installed in step 5.

7. Install a straight hose fitting (Jeg's p/n 799-610020) on each end of a 12" length of Pro-Flex hose. Do this twice to make two hose assemblies.
8. Install the hose assemblies on the oil cooler. Do not use sealing compounds or teflon tape on these fittings.
9. Apply teflon paste (do not use teflon tape) to the threads of each AN816-6D nipple and install one in each port of the oil pump.



This photo shows the oil cooler lines attached to the oil pump.

10. Install the free end of each hose assembly on the oil pump. Do not use sealing compounds or teflon tape on these fittings.

Note: The cooling air inlets of the cowl must be cut open before you install the baffle seal. Refer to the "Cowl Openings" section of this manual.

11. Fit one half of the cowl at a time and note any interference with the oil cooler shroud. Remove the cowl and trim the shroud as needed to achieve a gap of 1/4" to 3/8" between the cowling and the shroud.

Note: Bend the front lips of the cooling shroud as needed so they seal above and below the cowl's oil cooler inlet.

12. Install baffle seal to seal the gap between the metal shroud and cowling.
13. Install the Oil Pressure Bypass Plate. See next column.

OIL COOLER, BOTTOM MOUNT

Oil Cooler Bypass Plate

The oil cooler bypass plate is required on all bottom-mounted oil cooler installations.

Parts Required (Supplied by Sonex Aircraft)

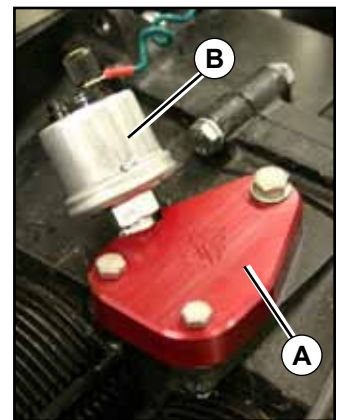
- ___ Oil Cooler Bypass Plate, ACV-P01-11
- ___ Viton O-Ring, ACV-Z01-73
- ___ ACV-Z01-17 Bolts Qty 2
- ___ ACV-Z01-19 Bolts Qty 1
- ___ ACV-Z01-22 Nut-Elastic Stop Qty 2
- ___ ACV-Z01-25 Washer, 6mm- Qty 2
- ___ Oil Pressure Sender (optional), ACV-P01-76
- ___ 1/8 NPT Pipe Plug (optional, not supplied)

- ___ 1. Insert Viton O-ring into the oil cooler bypass plate.
- ___ 2. Install the oil cooler bypass plate using the ACV-Z01-19 bolt (Qty. 1), ACV-Z01-17 bolts (Qty. 2), ACV-Z01-22 elastic stop nut (Qty 2), and ACV-Z01-25 washer (Qty 2).
- ___ 3. Install a 1/8 NPT pipe plug or an optional oil pressure sender (B) (1/8 NPT) in the tapped hole of the oil bypass plate.

The pipe plug can be installed with teflon paste.

When installing the optional oil pressure

sender do not use teflon paste or teflon tape on the threads as this will inhibit the grounding of the sender; good grounding is required for an accurate signal. You may even consider adding a dedicated ground wire to the body of the sender.



Oil cooler bypass plate (A), with optional oil pressure sender installed (B). If no oil pressure sender is installed in that port then it must be plugged with a 1/8 NPT pipe plug.

Parts Required

Supplied by/available from Sonex Aircraft:

- ___ Oil Cooler Mount Plate, ACV-P01-106
- ___ Rubber gaskets from ACV-P02-15 Gasket Kit
- ___ AN4-14A bolt, Qty. 2
- ___ MS20365-428 Stop Nut, Qty. 3
- ___ ACV-Z01-80, M8-1.25 x 20mm Button Head Screw, Qty. 1
- ___ AN4-24A bolt, Qty. 1
- ___ AN4-27A bolt, Qty. 2
- ___ AN960-416 Washers, Qty. 6

Not supplied by Sonex Aircraft:

- ___ Oil Cooler for 1971 or later T1 or T2 VW engine
(such as CB Performance part number 1727)



The top-mounted oil cooler positions the oil cooler on top of the case, near the accessory plate.

Installing the Oil Cooler

1. Insert the two orange-colored cylindrical seals from the gasket kit (provided with your AeroVee engine) in the oil cooler ports on the top, right-hand side of the engine.

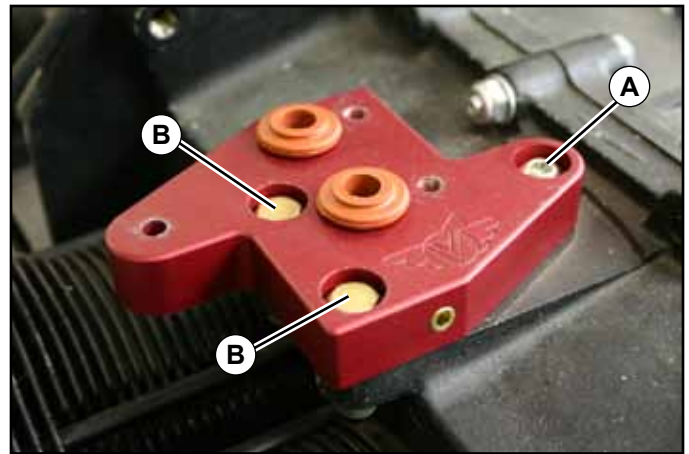


The arrow in this photo shows one of the seals before it is installed in its port.



This photo shows both seals installed in the ports.

2. Carefully position the Oil Cooler Mount Plate over the seals and bolt the plate to the engine case using the hardware identified in the photo below.

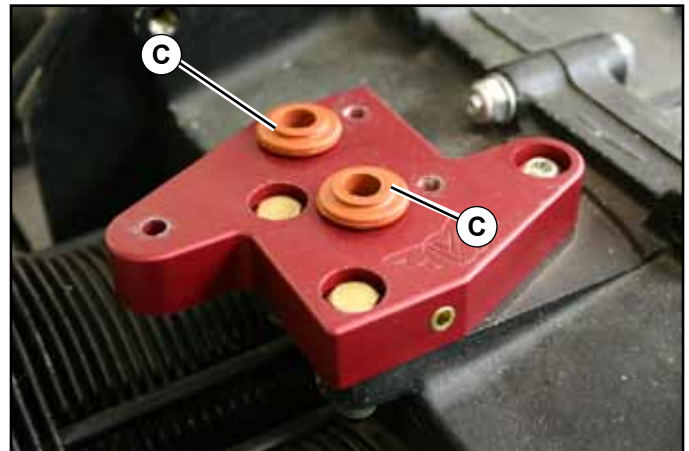


The Oil Cooler Mount Plate is attached with the following hardware:

*A = ACV-Z01-80, M8-1.25 x 20mm button head screw
B = AN4-14A bolt, AN960-416 washer (under nut) and MS20365-428 stop nut.*

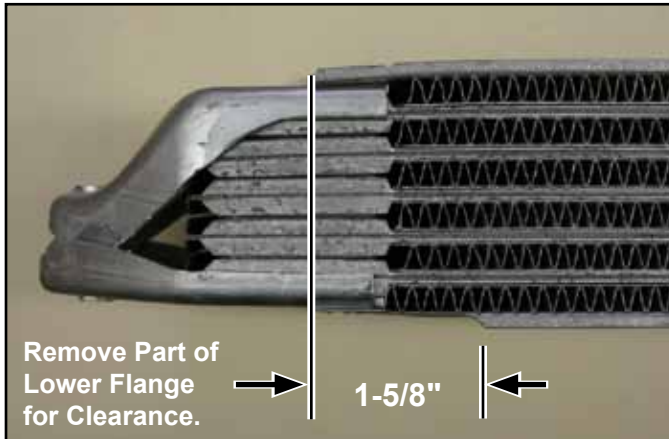
3. Insert the two short, orange-colored flanged seals from the gasket kit (provided with your AeroVee engine) in the oil ports of the Top Plate. See photo below.

Important: The gasket kit contains both tall (thick) and short (thin) flanged oil seals. Be sure to use the short (thin) seals for this installation.



The short (thin) flanged oil seals installed in the Top Plate's oil ports (C).

4. Remove a 1-5/8" long portion of the front, lower flange of the oil cooler. This is necessary to eliminate interference between the oil cooler's flange and the adapter plate. See photo below for details.



5. Carefully position the oil cooler over the seals in the mount plate and bolt the oil cooler to the plate using the hardware identified in the photo below.

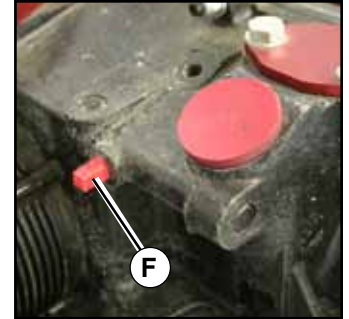


The Oil Cooler is attached with the following hardware:

D = AN4-27A Bolt with AN960-416 washer.

E = AN4-24A Bolt with two AN960-416 washers (one top, one bottom) and MS20365-428 stop nut.

6. Install the optional oil pressure sender or a 1/8 NPT pipe plug in the port in the side of the case (F).



Important: Do not overtighten the oil pressure sender or the pipe plug as this can result in a cracked case.

When installing the optional oil pressure sender do not use teflon paste or teflon tape on the threads as this will inhibit the grounding of the sender; good grounding is required for an accurate signal. You may even consider adding a dedicated ground wire to the body of the sender.

Bypassing / Removing a Bottom-Mounted Oil Cooler

Parts Required

- ___ 6061-T6 Sheet (approx 12" x 12")
- ___ Oil Pump, AeroConversions p/n ACV-P01-56

The AeroVee has flown successfully in the Sonex airframes without an oil cooler. Depending on your flight conditions and climate, you may not need the oil cooler. You must, however, retain the cooling shroud to direct cooling air across the bottom of the engine case.

To operate the AeroVee without the bottom-mounted oil cooler:

1. Disconnect the oil cooler lines from the oil pump.
2. Remove the oil cooler and hoses from the cooling shroud.
3. Seal the opening in the bottom of the cooler shroud with a piece of aluminum.

Important: Do not plug the inlet and outlet ports of the oil pump after removing the hoses. This will result in oil starvation and engine damage. To properly eliminate the oil cooler from the system you must complete one of the options in step 4, below.

4. Run a loop of -06 braided hose from the inlet port of the existing oil pump to the outlet port.

or:

Remove the oil pump and replace it with a Standard Oil Pump, AeroConversion part number ACV-P01-56.



This airplane has had the oil cooler removed. Note the aluminum panel which closes off the oil cooler opening in the bottom of the shroud.

Bypassing / Removing a Top-Mounted Oil Cooler

Parts Required

- ___ Oil Cooler Bypass Plate, AeroConversions p/n ACV-P01-56
- ___ Viton O-Ring, ACV-Z01-73

The AeroVee has flown successfully in the Sonex airframes without an oil cooler. Depending on your flight conditions and climate, you may not need the oil cooler.

To operate the AeroVee without the top-mounted oil cooler:

1. Remove the oil cooler from the adapter plate.
2. Remove the adapter plate.
3. Install the Oil Cooler Bypass Plate as shown on page 52.

Parts Required

- ___ Optional Sonex Aircraft Exhaust Kit
- ___ Exhaust Gaskets (included in ACV-P02-15 Gasket Kit). Available separately as p/n ACV-P01-73.

- ___ 1. Using the supplied Exhaust Attach Bolts (ACV-Z01-39), temporarily attach the exhaust manifolds to the cylinder heads without exhaust gaskets.

Note: If your cylinder heads have exhaust studs installed they will need to be removed to fit the 2-into-1 exhaust.

Note: The left side exhaust pipe (pilot's side) may contact the super tin and/or cylinder head baffle. The super tin and/or baffle can be reformed as needed to minimize the contact, though some contact is not a concern.

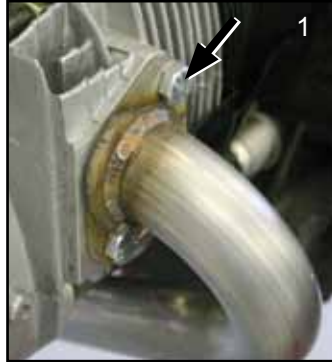
Note: The space between the exhaust flanges can be increased or decreased by hand if it is too tight or too loose on the cylinder head. Tightening the exhaust attach bolts during final installation will pull the header together for a proper fit on the cylinder head.

- ___ 2. Slide an extension pipe onto each manifold. It may be necessary to shorten the length of the exhaust manifold if the extensions interfere with the firewall. Do not shorten the expanded portion of the extension pipes.



Trim the end of each exhaust manifold (arrow) as needed to get the exhaust extensions to exit the cowl in the desired location.

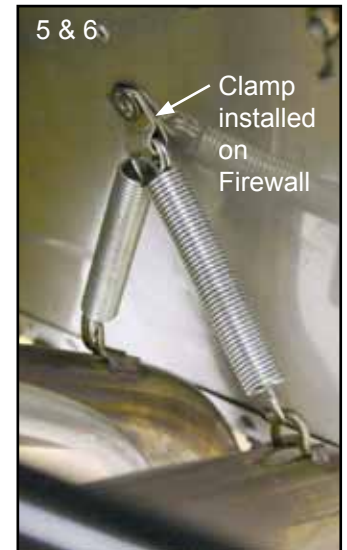
- ___ 3. After each exhaust manifold has been trimmed to the proper length, remove the manifolds from the cylinder heads and re-install them with new exhaust gaskets (included in the gasket kit).



- ___ 4. Attach a spring between each pair of spring clips. It may be necessary to shorten the springs for your particular installation.



- ___ 5. Attach a loop-type line support clamp (AN742 or equivalent) to the firewall approximately 3" above the spring clips on the exhaust extensions.
- ___ 6. Attach a spring between the support clamp and each exhaust extension. It may be necessary to shorten the springs for your particular installation.



- ___ 7. Trim the ends of the exhaust pipes to final length. The pipes must be long enough to ensure the exhaust gases exit the cowl, yet pipes which extend too far below the cowl will add drag and reduce your airspeed.

Installing EGT Probes

EGT probe(s) must be installed 4" from the exhaust flange of each cylinder that is being monitored. This distance is based on a path down the center of the exhaust pipe. It is also important to consider the orientation of each probe to avoid interference between the probe and cowlings.

Important: Do not trim the EGT probe wires.

There are a variety of EGT probe styles with different mounting methods. Follow the instructions provided with your probes for the proper mounting method.

This section supplements the fuel system installation page(s) of the Sonex Aircraft airframe blueprints. Additionally, the AeroCarb/AeroInjector manual provided with your AeroCarb/AeroInjector should be referenced.

Other than the fuel tank (included with your Sonex Aircraft airframe kit) and the AeroInjector (AeroCarb) included with your AeroVee engine kit, all other fuel system components must be sourced by each builder. Many of the pipe and tube fittings can often be sourced from automotive-supply stores or hardware stores.

Additionally, both Wicks and Aircraft Spruce offer AeroVee Firewall Forward Kits which may contain the parts you need for the fuel system.

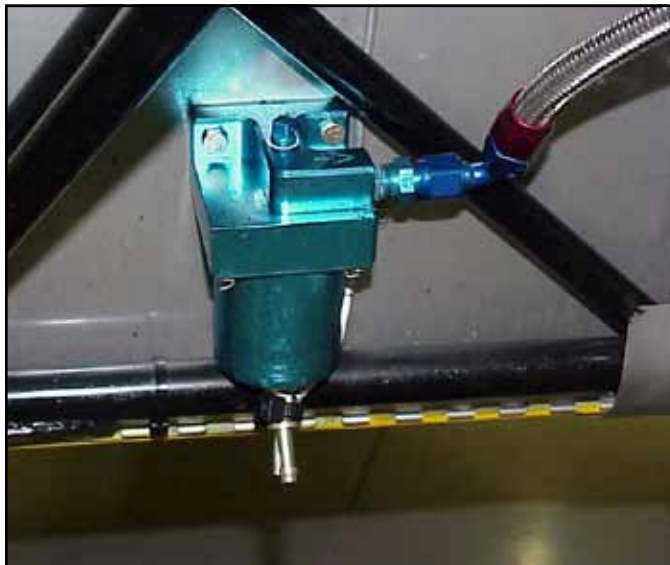
IMPORTANT: Because of the wide range of possible installation variations, the hardware and fittings mentioned in this manual and included in the 3rd-party hardware kits may or may not match your specific needs or desires. Each builder must make their own determination of which parts are appropriate for their particular installation.

Gascolator Installation

The gascolator must be the lowest point in your fuel system so it will collect water from your fuel system for easy draining.

Never use teflon tape on any fuel system connections as it may block fuel flow.

Position the gascolator on the firewall after the motormount has been installed so there is no interference between the gascolator, drain fitting, and motormount.



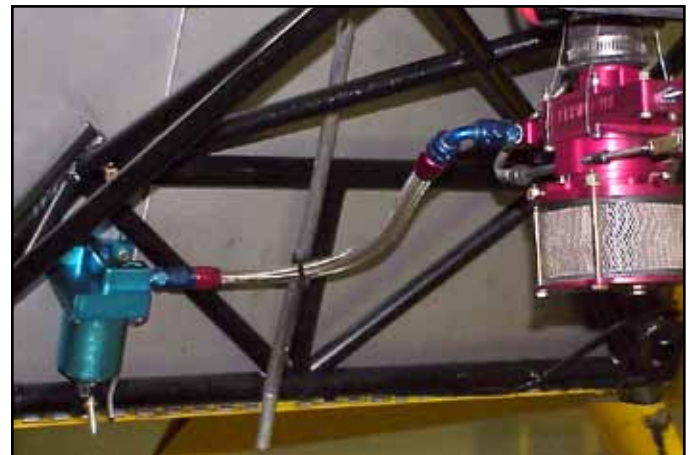
A street elbow and fuel drain are installed in the gascolator before the gascolator is positioned on the firewall.

Fuel Line Installation

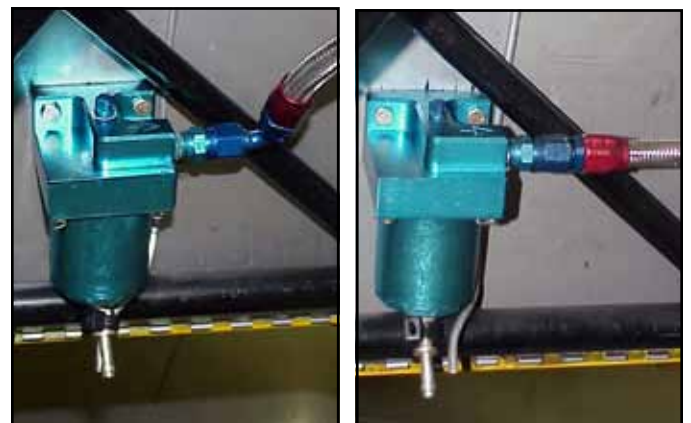
The fuel line must flow smoothly from the gascolator to the AeroInjector, with no part of the fuel hose rising higher than the carburetor fuel inlet. If the hose is higher than the fuel inlet at any point between the gascolator and the AeroInjector, an air pocket can form and hinder fuel flow.

The use of 3/8" I.D. (-06 hose) stainless steel reinforced fuel line, such as Pro-Flex brand hose from Jegs, with AN hose fittings is recommended. **Do not use barbed hose fittings and hose clamps in the fuel system.**

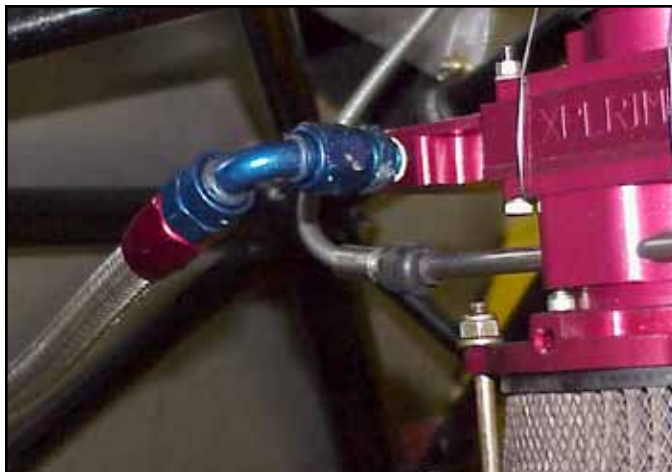
Important. Never use teflon tape on any fuel system connections as it may block fuel flow.



This view shows very clearly the fuel line routing on a Sonex, Waix, or Xenos. While the fuel connection at the AeroInjector should be installed exactly as shown, the use of a different gascolator may require slightly different fittings at the gascolator outlet.



The fuel line at the gascolator can be fitted with either a 90° swivel fitting (left), or a straight fitting (right). The choice of which to use should be based on the best routing for the fuel line to avoid the exhaust pipes.



A typical fuel line connection at the AeroInjector

The AeroVee requires the use of baffles to direct air over and through the piston barrels and cylinder heads. The system must be designed and installed to keep the cylinder head within their operating limits during normal operation.

Sonex Aircraft LLC has developed a fence baffle system specifically for use on Sonex Airframes /AeroVee installations. These systems may also be adapted to other airframe installations.

Each fence baffle comes with its own instructions for fitting.

Available Fence Baffle Systems

- SNX-P30-10, For a Sonex, Waix, or Xenos airframe.
- ONX-P01-10, For a Onex airframe.



An AeroConversions' fence baffle fitted to a Sonex airframe. The installation shown here has a bottom-mounted oil cooler.

Parts Required

___ 3 quarts approved SAE engine oil. Approved oils are listed below.

Approved Oils**Break-in Period (First 25 hours)**

The flat-tappet (non-roller rocker) design of the AeroVee requires an oil with zinc and phosphate levels of approximately .12% to .14% (1200 - 1400 ppm)

Additionally, break-in oil must be non-detergent, non-synthetic, and contain no friction modifiers.

Do not use diesel engine oils (Rotella) and do not use oil additives.

Approved break-in oils are:

Valvoline VR-1, 20w50, non-synthetic
Brad Penn Penn-Grade 1 Racing 20w50

Post Break-in

The flat-tappet (non-roller rocker) design of the AeroVee requires an oil with zinc and phosphate levels of approximately .12% to .14% (1200 - 1400 ppm)

Do not use diesel engine oils (Rotella) and do not use oil additives.

Synthetic oils may be used but do not extend the recommended oil change interval. The primary benefit to using a synthetic oil is improved heat transfer.

Approved post break-in oils are:

Valvoline VR-1, 20w50, non-synthetic
Valvoline VR-1, 20w50, synthetic
Brad Penn Penn-Grade 1 Racing 20w50
Mobil 1, 15W-50

Priming the Engine and Setting Oil Level

The AeroVee has a 2.75 quart capacity without oil cooler and lines. The following method may be used to achieve the proper oil level for your engine whether fitted with oil cooler or not:

- ___ 1. Add 2 quarts of oil to the crankcase and allow it to settle into the sump.
- ___ 2. With the aircraft in its normal ground attitude (on its tailwheel for tailwheel aircraft), remove the dipstick and file a mark on the dipstick at the oil line. This is the "Low" mark for the oil level.
- ___ 3. Add an additional .75 quart of oil to the crankcase and allow it to settle into the sump.
- ___ 4. With the aircraft in its normal ground attitude (on its tailwheel for tailwheel aircraft), remove the dipstick and file a mark on the dipstick at the oil line. This is the "Full" mark for the oil level.
- ___ 5. Remove one spark plug from each cylinder.
- ___ 6. With the fuel off and ignition switches off, operate the starter until oil pressure registers on the oil pressure gauge.

Note: If no oil pressure registers, the oil pump may need to be re-primed with white lithium grease. Also, check the electrical connection of the oil pressure sender.
- ___ 7. Re-install the spark plugs.
- ___ 8. Add oil as needed to bring the oil level back to "Full".

In operation you may find that your engine prefers a slightly lower oil level. This will be evidenced by excessive oil draining from the breather tube and, in some cases, the front seal. It is acceptable to operate your engine with less than 2.75 quarts, 2.5 quarts being fairly common.

If your oil level is allowed to drop too low you will experience increased oil temperatures and fluctuating and/or decreased oil pressure. **Do not operate your engine in this condition.**

Oil Changes During Break-in Period

During the first 25 hours of operation the oil level should be monitored closely and oil changes performed at 1 hour, 5 hours, 15 hours, and 25 hours. Thereafter, oil should be changed every 25 hours or 3 months.

Note: Engines which are not operated frequently collect damaging moisture. This moisture can only be removed by operating the engine until oil temperatures are above 190-degrees for an extended period of time, or by changing the oil. Short runs of the engine, which do not allow the engine to come to full operating temperature, are more damaging than not running the engine at all.

Bringing your engine to life is exciting and rewarding. These points and procedures will assure the greatest success.

SAFETY FIRST!

- ___ 1. Have the correct propeller installed, torqued and tracked. **DO NOT OPERATE THE ENGINE WITHOUT A PROPELLER.**
- ___ 2. Remove loose tools, rags, and debris from the engine and immediate area.
- ___ 3. One person **MUST** remain in the cockpit while the engine is running, and an observer **MUST** be on hand to keep an eye on the engine in case of oil leak, fire, and to observe and keep bystanders safely away.
- ___ 4. Have an approved fire extinguisher available.
- ___ 5. Know your aircraft's cockpit controls.
- ___ 6. Tie the aircraft down securely, set the brakes, and chock the wheels.
- ___ 7. Start the engine using a checklist. The AeroCarb manual includes some sample start-up and shut-down checklists which may be used or adapted to your aircraft.

Engine Checks

- ___ 1. Cowl removed.
- ___ 2. Oil in crankcase.
- ___ 3. All parts installed and secured.
- ___ 4. Propeller installed, torqued, and tracked.
- ___ 5. Heads torqued and valves properly adjusted.
- ___ 6. Electronic ignition system static-timed.

Starting the Engine

- ___ 1. Install the correct oil and prime the engine as described in "Engine Oil", previous page.
- ___ 2. Use your start-up checklist to start the engine.
- ___ 3. Immediately upon engine start look for oil pressure. If no oil pressure registers in 5 seconds, turn off the engine and investigate.
- ___ 4. If the engine does not start, investigate the cause (see Troubleshooting section).
- ___ 5. Adjust the timing of the electronic ignition as required. There should be little or no change in RPM when performing a mag check between 1600 and 2000 RPM. A change of more than 50 RPM indicates a timing correction is needed.
- ___ 6. Tune the AeroCarb for optimum engine performance. Tuning is detailed in the AeroCarb manual.
- ___ 7. Limit ground running to the minimum necessary to correct the timing, tune the AeroCarb, assure smooth throttle response, confirm proper oil pressure, and assure no oil leaks.

Important: Extended ground running will overheat the engine and cause serious damage.

Break-in, the First 25 Hours

Proper break-in will help you get the best performance and longest life from your AeroVee engine.

- ___ 1. Limit ground running to what is needed to properly tune the engine and assure no oil leaks.
- ___ 2. Do not "baby" the engine during the first few flights. As soon as possible, climb to a safe altitude over your airfield and operate the engine at 3000 rpm and above for at least an hour. This will seat the rings. Monitor the engine's temperatures and reduce throttle as needed to keep the engine temperatures "in the green". Step climb if needed. Higher than normal temperatures during the break-in period are to be expected, however, temperatures which exceed the redline or continue to climb must be investigated.
- ___ 3. Change the oil at 1 hour, 5 hours, 10 hours, and 25 hours.
- ___ 4. Adjust the valves at 5 hours, 10 hours, and 25 hours.
- ___ 5. Torque the heads and adjust the valves at 10 hours and 25 hours. Always torque the heads before adjusting the valves.

After 25 hours you should see the engine's temperatures decrease and stabilize and there should be little change in the head torque.

Minimum Maintenance Interval

1 Hour Accumulated

- ___ Change the oil and wash the oil screen.

5 Hours Accumulated

- ___ Change the oil.
- ___ Adjust the valves (cold engine). See page 29.

10 Hours Accumulated

- ___ Change the oil.
- ___ Torque the heads to 18 foot pounds. Do NOT loosen the nuts prior to torquing them. See page 22 for proper torque sequence. The rocker shaft assemblies must be removed to torque the heads.
- ___ Adjust the valves (cold engine). See page 29. Valves must be adjusted after torquing the heads.
- ___ Check all fasteners for tightness and security.

25 Hours Accumulated

- ___ Change the oil and wash the oil screen.
- ___ Torque the heads to 18 foot pounds. Do NOT loosen the nuts prior to torquing them. See page 22 for proper torque sequence. The rocker shaft assemblies must be removed to torque the heads.
- ___ Adjust the valves (cold engine). See page 29. Valves must be adjusted after torquing the heads.

Every 25 Hours

- ___ Change the oil.

Every 50 Hours

- ___ Change the oil and wash the oil screen.
- ___ Adjust the valves (cold engine). See page 29.
- ___ Inspect and/or replace air filter.

On Annual Inspection

- ___ Change the oil and wash the oil screen.
- ___ Torque the heads to 18 foot pounds. Do NOT loosen the nuts prior to torquing them. See page 22 for proper torque sequence. The rocker shaft assemblies must be removed to torque the heads.
- ___ Adjust the valves (cold engine). See page 29. Valves must be adjusted after torquing the heads.
- ___ Inspect and/or replace air filter.
- ___ Inspect and/or replace spark plugs.
- ___ Check all fasteners for tightness and security.
- ___ Check all hoses for condition, tightness and security.
- ___ Check all wiring for condition and security.
- ___ Perform a leak-down test of each cylinder. 80 psi is normal, anything below 60, or a large deviation between individual cylinders, requires additional investigation.

When to Rebuild Your AeroVee

Experimental engines, such as the AeroVee, have no TBO. As the owner/operator of an AeroVee engine you decide when it will be rebuilt and to what extent.

Signs an engine needs some degree of rebuilding include low compression, loss of power, increased oil usage, and low oil pressure.

Torque Values

Item	Socket	Ft. lbs.	In. lbs.
Large Case Nuts	19mm	25	300
Cam Case Nuts	10	120	
Small Case Nuts	13mm	14	168
Cylinder Head Nuts	15mm	18	216
Rocker Arm Nuts	13mm	14	168
Prop Hub Nuts	30mm	70-80	840-960
Flywheel Gland Nut	36mm	227	2724
Connecting Rod Nuts	14mm	30	360
Oil Pump Cover	13mm	14	168
Valve Cover Bolts	13mm	10	120
Oil Pump Cover	13mm	14	168
Oil Pan Cover Nuts	10mm	5	60
Rear Unit Mount Bolts	17mm	25	300
Prop Bolts/Nuts*	1/2"	11	132
Spark Plugs	11/16"	12	144

*Refer to the propeller manufacturer's torque specification. In the absence of a manufacturer specification, use these values.

Engine does not start

Possible Cause

- 1) Ignition OFF
- 2) Spark plug gaps too large
- 3) Closed fuel valve or clogged filter
- 4) No fuel in tank
- 5) Wrongly connected spark plug leads
- 6) Starting speed too low, faulty or discharged battery
- 7) Coil to magnet gap too wide
- 8) High tension leads loose or damaged
- 9) Spark plugs damp due to condensation
- 10) Spark plugs wet by fuel due to flooding
- 11) Water in fuel system
- 12) Insufficient compression
- 13) Engine damage
- 14) No Spark from Secondary Ignition module

Remedy

Switch ON
Adjust gaps or replace plugs
Open valve, replace or clean filter, check for fuel system leaks
Refuel
Connect as shown in manual
Recharge or replace battery

Adjust to .010"
Check or renew connections
Thoroughly dry both inside and outside of plugs
Remove, dry and reinstall spark plugs
Drain water from sump and tank
Trace pressure loss & repair if necessary
Inspect oil screen for metallic particles
If present, an engine overhaul may be necessary.
Check for/add ground wires from ignition cap screws to engine case.

Engine idles unsteadily after warm-up period and/ or smokey exhaust emission

Possible Cause

- 1) Rich idle setting
- 2) Intake manifold leak

Remedy

Adjust **AeroCarb** (See AeroCarb manual)
Tighten all connections, replace hose

Engine runs erratically or misfires occasionally

Possible Cause

- 1) Spark plug failure
- 2) Faulty ignition leads or caps
- 3) Faulty ignition unit
- 4) Clogged fuel filter

Remedy

Check plugs, clean inside & outside, adjust electrode gap. If necessary, replace plugs
Dry damp leads, replace damaged leads
Replace ignition unit
Clean or replace fuel filter

Engine runs too hot - Oil temperature above 230°F (110° C) or high CHT (400°+)

Possible Cause

- 1) Too much oil in crankcase
- 2) Low oil level
- 3) Poor quality oil
- 4) Clogged oil screen
- 5) Excessive piston blow by
- 6) Faulty bearings
- 7) Faulty oil or CHT temperature gauge/ probes
- 8) Faulty cooling baffles
- 9) Oil cooler not installed
- 10) Secondary Ignition Advanced

Remedy

Check oil level & adjust if necessary
Check oil level & add oil if necessary
Change oil, use specified oil
Clean screen
Common reason: worn or sticking piston rings, "top" engine overhaul necessary
If metallic particles are present in oil, a complete engine overhaul is necessary
Replace the gauge or probes
Check for leaks, cowl inlets and exits and baffles are built to plans
Install recommended oil cooler and baffles
Retard Secondary Ignition Timing

Unsatisfactory power output

Possible Cause

- 1) Ignition failure
- 2) Too much oil in crankcase
- 3) Insufficient fuel supply
- 4) Fuel not according to specifications
- 5) Incorrect throttle adjustment
- 6) Leak in air intake

Remedy

Check ignition circuits; Check wiring and /or replace ignition units
Check oil level & adjust if necessary
Check fuel supply system
Refuel with specified fuel
Readjust throttle setting
Check and tighten all manifold and Carb connections

Low oil pressure

Possible Cause

- 1) Insufficient oil in sump
- 2) High oil temperature
- 3) Faulty pressure gauge, sender or wiring
- 4) Faulty crankshaft bearings
- 5) Oil Pump plate on Incorrectly

Remedy

Check oil level and top as necessary
Improve engine cooling
Check gauge, sender & wiring. Replace if necessary
Engine overhaul
Properly install oil pump cover

Engine Keeps Running with Ignition Off

Possible Cause

- 1) Faulty ignition switch
- 2) Overheated engine
- 3) Bad fuel or octane rating too low

Remedy

Check switch & cables.
Conduct cooling run at 900 RPM
Refuel with recommended fuel

Excessive oil consumption

Possible Cause

- 1) Worn, broken or poorly fitted piston rings
- 2) Poor oil quality
- 3) Worn valve guides
- 4) Oil leaks

Remedy

Repair or engine overhaul necessary
Oil change, use specified oil
Repair of cylinder head necessary
Seal leaks

Knocking under load

Possible Cause

- 1) Octane rating of fuel too low
- 2) Spark plug fitted without sealing washer
- 3) Heavy carbon deposits
tion chamber

Remedy

Use fuel with higher octane rating
Ensure one sealing washer on each plug
Remove cylinder heads & remove deposits in combustion chamber

Engine Hard to Start at Low Temperature

Possible Cause

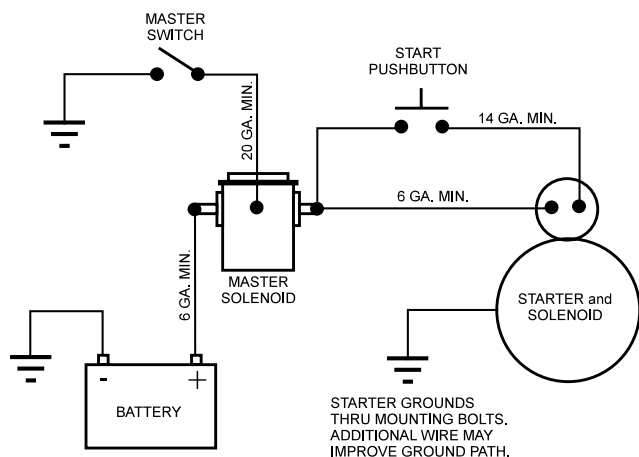
- 1) Starting speed too low
- 2) Low battery charge
- 3) No spark
- 4) Lean or rich mixture

Remedy

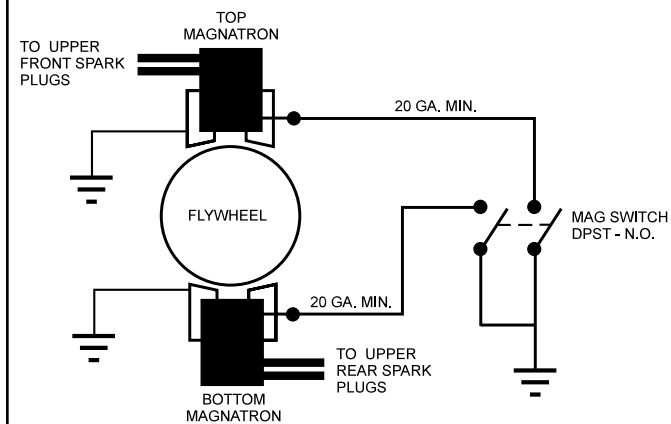
Preheat engine
Charge or replace battery
Check ignition gaps and adjust
Adjust AeroCarb. See AeroCarb manual.

This page is a quick reference of electrical schematics associated with the AeroVee installation. Detailed instructions for each sub-system are provided elsewhere in this manual.

STARTER WIRING SCHEMATIC

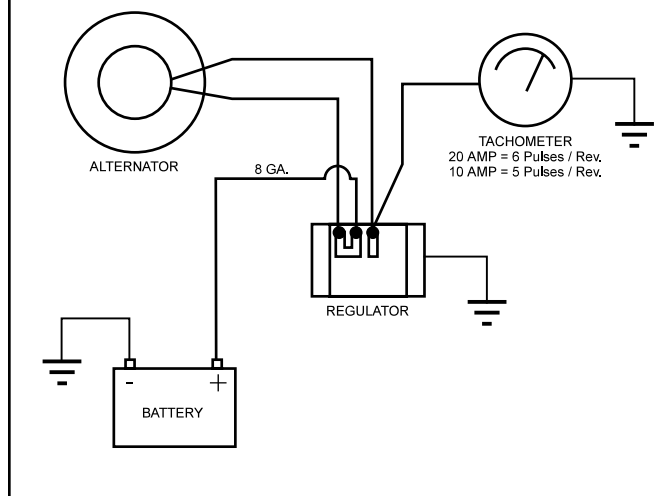


MAGNATRON IGNITION SCHEMATIC

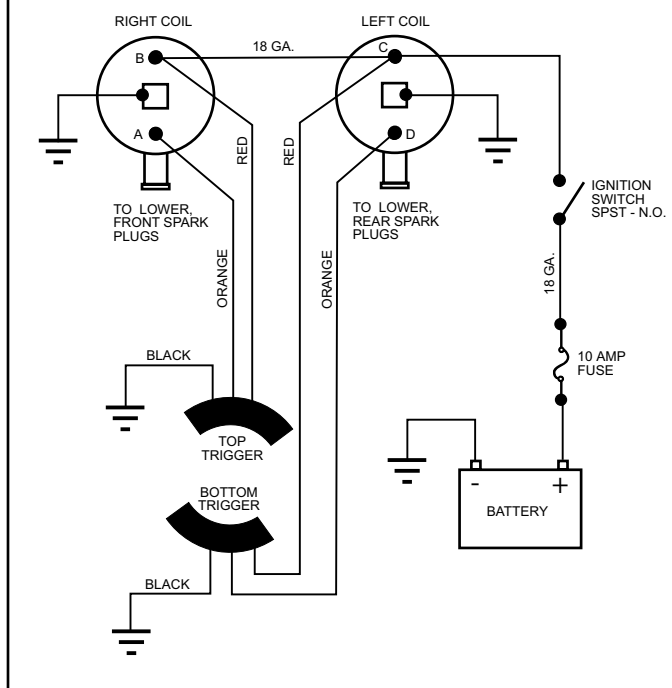


ELECTRICAL SCHEMATICS

ALTERNATOR WIRING SCHEMATIC



SECONDARY IGNITION SCHEMATIC



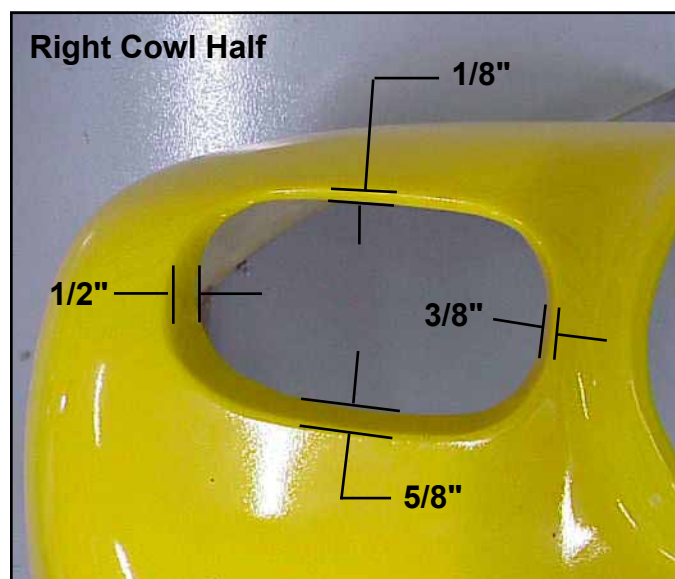
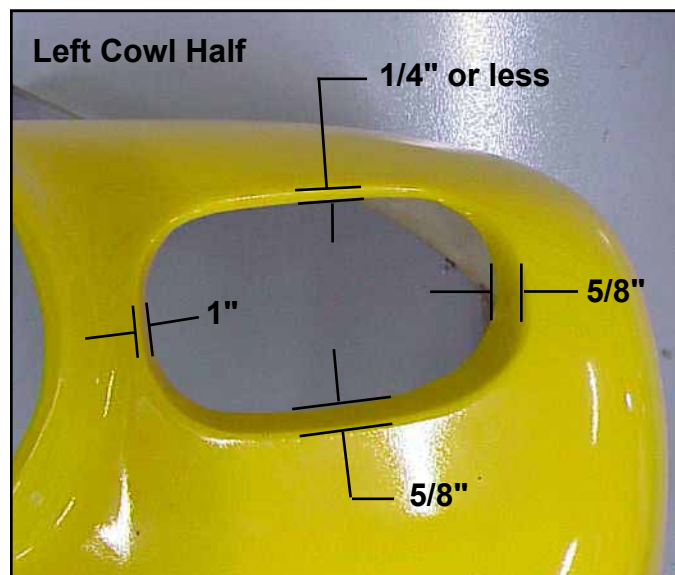
Proper cooling inlets and exhaust outlets are critical to proper engine cooling. Arbitrarily changing any of the defined openings can have a negative affect on cooling.

This Appendix details the cowling inlets and outlets of a Sonex Aircraft cowling fitted to a Sonex, Waix, or Xenos.

The cowling of a Onex airframe is supplied with all cut-outs pre-finished so no additional details are provided in this manual.

Cylinder Head Cooling Air Cut-outs

These photos identify the depth of the cowl lips for the cylinder head cooling air.

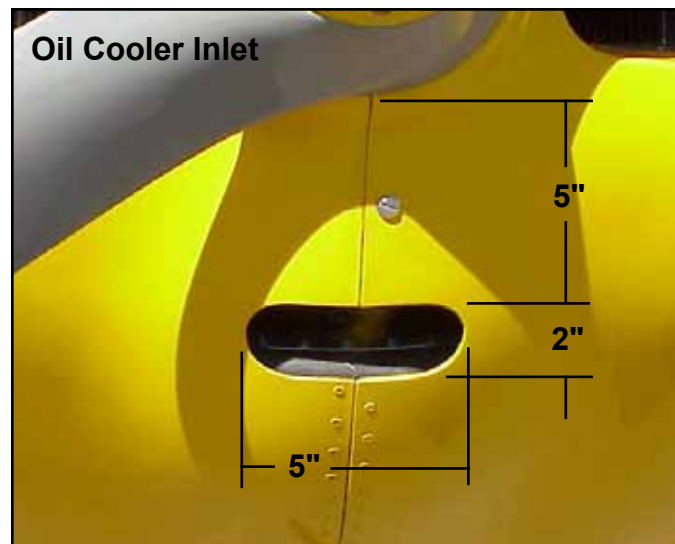


Oil Cooler Inlet Cut-outs

Important: Due to slight variations in each installation, the location of the oil cooler inlet may vary slightly.

Important: Even if you do not fit an oil cooler you must provide this cut-out so cooling air will flow over the bottom of the oil sump.

The approximate location of the oil cooler inlet is shown in the photo below. The exact location can be determined by fitting one cowl half and centering the cut-out on the oil cooler baffle fitted to your engine (see bottom photo).



This photo identifies the size and approximate location of the oil cooler inlet.



While the top photo gives approximate dimension for the location of the oil cooler inlet, fitting one cowl half and marking the exact location will ensure the correct fit for your airplane. Note that the oil cooler inlet is required even if no cooler is installed, as on this airplane.

Exhaust Cut-outs

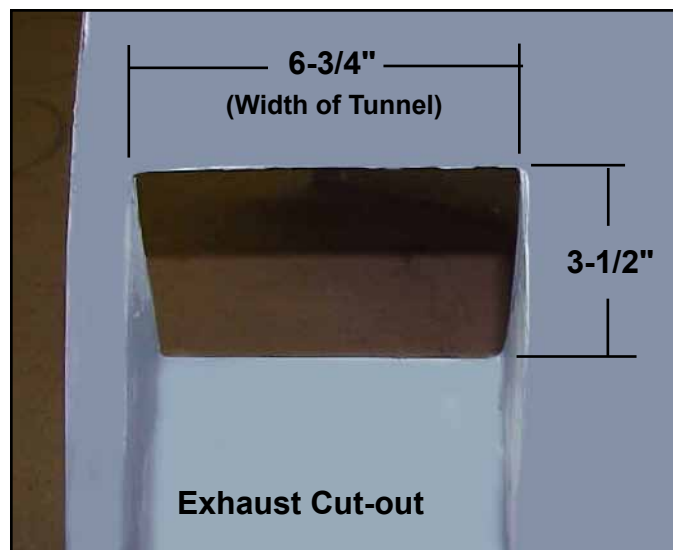
The size of the exhaust outlet(s) is a critical for proper cooling. The Sonex requires 47 to 50 square inches of outlet area for the cooling air.

The cowling provided with your kit is one of two types: a VW cowl with premolded exhaust tunnels (detailed below), or a Universal cowl, detailed on the next page.

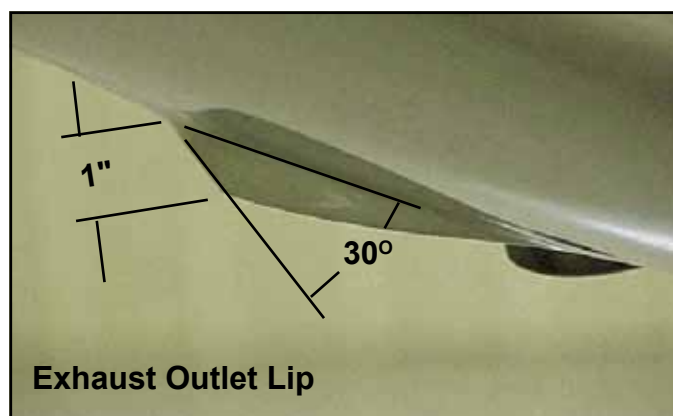
VW Cowl with Pre-molded Exhaust Tunnel

The VW cowl with pre-molded exhaust tunnels was phased out in favor of the Universal cowl in 2004. The change was made to eliminate the cheeks on the side of the cowl.

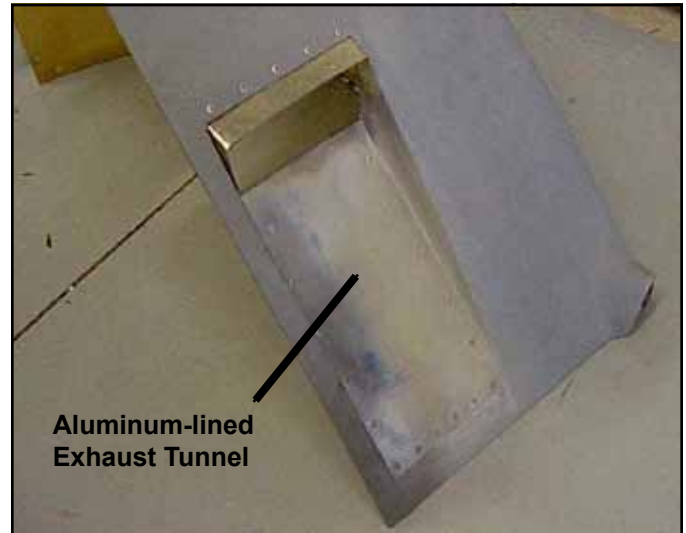
The VW cowl must have the exhaust outlets cut open to the proper size and have air deflector lips added, as shown in the accompanying photos. In addition, .025" aluminum sheet is riveted to the exhaust tunnel to protect the fiberglass from the hot exhaust gasses.



This is a view of the exhaust cut-out before the lips are added.



The exhaust lips can be molded from fiberglass, as shown here, or made from .025" aluminum and riveted in place.



This tunnel has been lined with .025" 6061-T6 aluminum to protect the fiberglass from the heat of the exhaust. The aluminum wraps around the inside as well, but only extends a few inches back. The aluminum lining is needed only for aircraft fitted with the 4-piece Sonex exhaust, which was phased-out in 2005.



This view of a completed cowl clearly shows the air deflector lips which are added to the front of the exhaust cut-out. These lips create a low pressure area which draws the cooling air through the cowl. These lips are particularly important when the airplane is in a climb attitude. This aircraft is fitted with the old-style 4-piece exhaust.

Cowl with Pre-molded (Fiberglass) Exhaust Tunnels.

If your cowl has the premolded exhaust tunnels, the tunnels must be opened as described on page 67. These openings provide the necessary outlet for the engine's cooling air.

If you are fitting the 2-into-1 exhaust you will also need to make a cowl cut-out at the firewall large enough for the exhaust pipes to exit. The cutout should be large enough to clear the exhaust, but not over-sized. If the cut-out for the exhaust is too large it can degrade engine cooling.

A small deflector lip must also be fitted in front of the exhaust pipe outlet, and a curved stainless steel deflector may be added to the bottom of the fuselage skin for the exhaust to spill against.



*This photo shows the standard outlet for a 2-into-1 exhaust fitted to a cowl **without** pre-molded tunnels. If you are fitting a cowl **with** premolded exhaust tunnels, this opening must only be large enough to allow the exhaust pipes to exit. The small tube in this photo is the oil breather.*

Universal Cowl with Aluminum Exhaust Tunnels.

If your universal cowl has aluminum exhaust tunnels installed, you will need to follow the installation outlined above for "Cowl with Pre-molded (Fiberglass) Exhaust Tunnels".

Universal Cowl with No Existing Exhaust Tunnel

Fitting the 2-into-1 exhaust to a cowl with no existing outlets is very simple.

A 4" x 12.5" cut-out is made on the lower aft edge of the cowl, where it attaches to the bottom of the firewall. This opening provides both an outlet for the exhaust pipes as well as an outlet for the engine's cooling air. No other cooling air outlets should be added to the cowl.

Note: The loss of piano hinge in this area has no impact on the strength and security of the cowl installation.

An aluminum exhaust lip must be added to the front of the opening. The lip should be 1" high and rake back 60 degrees from front to back.

A stainless steel deflector may be added to the bottom of the fuselage floor to guide and deflect the exhaust gases.



*This photo shows the standard outlet for a 2-into-1 exhaust fitted to a cowl **without** pre-molded tunnels. The cut-out measures 4" x 12.5". No additional cowl outlets are needed for cooling air. The small tube in this photo is the oil breather.*

Custom Exhaust Installations

Custom exhaust installations can set your airplane apart, but may also require extensive testing and modification to perfect.

If you do pursue a custom installation you will need to provide 47 to 50 square inches of outlet area for the cooling air. This must be placed in a low-pressure area of the cowl to function properly.

Rev. AA 08/05/15

Page 33, Part number was ACV-Z01-30, changed to MS21042-08
Pages 53 and 54, Bolts used to attach oil cooler top plate and oil cooler lengthened +1. Shorter bolts previously used are still acceptable.

Rev. Z 01/14/15

Updated some part numbers to match packing list.

Rev. Y 09/11/14

Added Intake Elbow Spacer to Intake Manifold Installation procedure.
Changed hardware requirements for installation. Spacers needed only on engines equipped with ACV-P07-47 Cylinder Heads.

Rev. X 08/15/14

Cylinder Head Installation, Step 5. Added note to not install O-ring if the supplied cylinder head does not have an O-ring recess.
Valve cover bolt torque specification reduced - tighten by feel, snug enough to secure and prevent leaks.

Rev. W 06/18/14

Added part number ACV-M01-20 Intake Hose

Rev. V 04/29/14

Added reference photos of cylinder head characteristics.
Added option to attach intake elbows with ACV-Z01-39 cap screws.

Rev. U 12/12/13

Added part number and packing list statement to the "Before You Begin" section of the manual.
Reformatted manual, de-emphasizing part numbers.
Removed non-current part number cross-references.
Added Part Number and Packing List Addendum to back of manual.

Rev. T 12/04/13

Corrected shim call-out for 8:1 compression ratio with -.07 measured deck height.

Rev. S 09/26/13

Deleted ACV-P02-21 Connecting Rods, added ACV-P06-33 Connecting Rods.

Rev. R 12/04/12

Added place to record engine's serial number.
Added ACV-P02-22 as interchangeable Super Case number.
Added note to remove clinging chips from machined surfaces of case.
Added photo of super tin installed.
Revised installation of trigger shaft to include longer screws (ACV-Z01-81 and specific tightening pattern.
Revised installation of stator mount plate to include priming screws (ACV-Z01-81) with Locktite primer.

Rev. Q 03/28/12

Changed recommended Top Mounted Oil Cooler. Was CB Performance p/n 1722, should be part number 1727.

Rev. P 02/28/12

Added top-mounted oil cooler installation details.
Revised Revision Log format.
Removed specific fuel system installation details and referenced the airframe plans for this detail.
Removed fuel and oil system specific shopping lists.
Reduced Spark Plug torque value from 22 ft. lbs. to 12 ft. lbs.

Rev. O 10/21/11

Expanded information on installing ACV-P01-56, non-ported oil pump.

Rev. N 09/11/11

Screws to attach stator is ACV-Z01-76, was ACV-Z01-12.
Added note to use ARP Ultra-Torque if provided. Increased torque of rod bolts to 30.

Rev. M 04/14/11

Added ACV-P02-21 as alternate part number for connecting rods.

Rev. L 02/08/11

Integrated Firewall Forward Manual in to Assembly manual.

Rev. K 01/14/11

Dipstick was ACV-P01-18, should be ACV-P01-24.
Added grounding wire to starter motor.
Added note to Accessory Plate photo referencing Mounting Pin Drawing.
Added Motor Mount Pin drawing.
Added ACV-P02-20 Oil Sump Plate.
Added Exhaust Gasket part number.
Added note to adjust exhaust manifold width.
Added torque specification for valve covers.
Added reference to dual pole Oil Pressure Sender, Part no. ACV-P01-135.
Added ACV-P01-104 as interchangeable number for Aft Woodruff Key.

Rev. J 10/14/10

Added step to check oil pump cover clearance.
Added note about not using the louvered metal gasket under the breather plate.
Added note to ground the oil pressure sender.

Rev. I 04/13/10

Elaborated on rocker shaft assembly and installation

Rev. H 12/18/09

Added torque value (14 ft. pounds) for rocker adjuster locking nut.
Added note to keep piston and pins together as a set.

Rev. G 09/25/09

Added specific oil recommendations and "Engine Priming" detail.

Rev. F 05/19/09

Removed Locktite application to Cylinder Head Studs.
Added ACV-P01-86 head studs.
7:1 Shim chart for -0.01 to -0.04 was .09+.06+.06 shims.
Added weight for Nikasil-equipped engines.
Corrected photo to show proper (flanged) bearing.
Added Shim Kit p/n ACV-P02-19.
Added optional ACV-P03-10 Nikasil Cylinder Kit.
Added additional package of ACV-P01-41 .060 barrel shims.
Added note for builders with pre-assembled crank to proceed to Cam Assembly page.

Rev. E 03/18/09

Changed minimum end play from .004" to .003".
Deleted cam stud gaskets.
Added Permatex coating to cam stud washers.
Added note to adjust spacers as needed on rocker assemblies.
Added flywheel installation and removal detail.

Rev. D 04/22/08

Removed incorrect mention of copper head gaskets.
Added interchangeable part numbers.

Rev. C 04/22/08

Replaced ACV-P01-65 Oil Slinger with ACV-P01-101.

Rev. B 04/07/08

Deleted ACV-P01-61 Shakeproof Nut Kit. Replaced with individual hardware part numbers.

Rev. A 03/08/08

General clean up from Rev N/C. No significant changes.

Rev. N/C 03/05/08

Original Publication of 2.1 engine Assembly Manual.

Keep Your Packing Lists

The packing list provided with each AeroVee kit lists the specific parts provided for that specific engine. Please reference your engine's packing list for correct part numbers when ordering maintenance and repair parts for your particular engine.

In addition to the packing list secured to the outside of the engine kit boxes, a duplicate packing list has been attached to the back of each physical manual supplied with that engine.

If you are holding a manual provided with an engine that was shipped after January 1st, 2014, there should be a copy of the original packing list attached after third page. If there is no packing list attached the manual you have may have printed from the website, provided as a replacement, or the packing list may have been removed.

Copies of (most) packing lists are archived by Sonex Aircraft and you may request an electronic (PDF) copy. To get a copy, provide evidence you own the engine for which you are requesting the original packing list as well as the engine's serial number.

Part Number Changes - Interchangeable Parts

AeroConversions reserves the right to supply compatible, alternative replacement parts for any part of the core engine or conversion package. Such parts may appear different than the part originally provided in the kit or depicted in the manual, and may bear a different part number, but will be functionally identical or superior to the original kit-supplied component.